Science

Class VII

Department of School Education
Ministry of Education and Skills Development
Thimphu

Published by
Department of School Education (DSE)
Ministry of Education and Skills Development (MoESD)

Provisional edition 2013
First edition 2017
Second edition 2020

Reprint 2024

Acknowledgment

The Royal Education Council would like to thank all the science faculty members of the Colleges of Education, Paro and Samtse and teachers from different schools for their valuable contributions towards the development of this book. Our sincere gratitude goes to Ministry of Education, Royal Society for Protection of Nature, Ministry of Agriculture, Ministry of Health, Ministry of Economic Affairs, and other relevant agencies for their unfailing support, starting from the development of the Science Curriculum Framework to the production of science textbooks and manuals.

The curriculum revision was possible with the generous financial and technical support rendered by relevant stake holders. The National Environment Commission in integration of Sustainable Waste Management from 'Ecology Note: Towards a Clean, Green, and Beautiful Bhutan'. The United Nations Population Fund (UNFPA) through Ministry of Education in inclusion of components of Comprehensive Sexuality Education in strengthening life skill education for children.

Our sincere courtesy to all the source of pictures that are used in this book

Advisors

Sangay Zam, Secretary, Ministry of Education, Thimphu
Tshewang Tandin, Director General, Department of Adult and Higher Education, Ministry of Education, Thimphu
Kesang C Dorji, Director, Department of Curriculum and Research Division, Ministry of Education, Paro
Kinga Dakpa, Director General, Royal Education Council, Paro
Wangpo Tenzin, Dean, Royal Education Council, Paro

Coordination

Wangchuk, Royal Education Council, Paro

Proof Reading
Gopilal Acharya, Free Lance Editor, Thimphu
Amber Kumar Rai, Curriculum Officer, Royal Education Council, Paro
Sharda Rai, Subject Specialist, Bhutan Council for School Examination and Assessment, Thimphu

Art Work and Layout
Surjay Lepcha, Curriculum Officer, Royal Education Council, Paro
Sangay Tshering, Teacher, Drugyel HSS, Paro.

ISBN 978-99936-0-416-7

Foreword

Today, science is an indispensable discipline of learning that shapes the lives of humankind and their wellbeing. The enduring engagement of people in the scientific world of exploration, inquiry and investigation has culminated in the addition of an ever-growing repository of scientific knowledge and milestones. Through the time, how science works and affects the world has been influencing the way we view and deal with the subject.

Unfortunately, many a times, the subject is seen as very complex and difficult, hard to comprehend and demanding to learn, thereby posing challenges in our effort in instilling scientific beliefs and attitudes in young learners. Such generalisation has influenced the learners to shy away from the experiential learning and the scientific endeavour in favour of a discipline that is perceived to be easier. Therefore, it is time that concerted efforts are pursued in making learning of science a way of igniting the fire of curiosity and investigation in the minds of learners.

Towards making education meaningful and relevant for students, it is imperative to link the scientific concepts to the real world through rigorous engagement of learners in the scientific processes of observation, inquiry, investigation, experimentation and generalisation. The timely revision of science textbooks is an attempt to align learning outcomes with the emerging global view of science and educational philosophies, accentuate the development of scientific skills of doing science, and foster the scientific temper and literacy in young minds. However, the endeavour in science education in our context emanates from the national, social, cultural and religious belief system imperative to nurturing nationally rooted and globally competent citizens who can productively contribute to the nation building initiatives and development of a dynamic global society.

Therefore, it is our sincere hope that the science curriculum provides a limitless avenue for every learner as a young scientist to explore continuously and engage in doing science. The meaningful participation is crucial in the development of transversal competencies of critical thinking, creativity, communication and collaboration along with other essential life skills fundamental to succeed and excel in the 21st century world as productive and socially responsible individuals.

I would like to wish all our teachers and students, a fulfilling social and academic engagement and experiential experiences through enduring and enterprising learning and doing science as part of every learner's life.

Tashi Delek

Kinga Dakpa
Director General

Contents

Introduction

Science as a body of knowledge allows an individual to explore, create, and organize ideas in the form of testable explanations and predictions that ultimately enable the discovery of new knowledge. Science has thus far played an important role in helping humankind to best understand the universe, make the best use of natural resources, and advances accordingly.

The importance of Science has been revealed through the way science and scientific knowledge has shaped the lives of human since the time immemorial. The advancement of a human world was possible due to the influence of science as almost all the activities, from sowing a seed to building a rocket involves scientific knowledge. Thus, science has become an indispensable discipline for the survival and advancement of humankind. Being conscious of the role science has played in shaping the lives of humankind and the power it holds for further advancement, catching up with the new and possible discoveries in the field of science are very important and urgent to progress along with the world around us.

Nonetheless, the unfounded belief of viewing science as a subject for the elite learner has affected the way we view and deal with the subject. Many times, the subject is seen as very complex and difficult, tough to comprehend, and demanding to make sense out of associated concepts. Such generalization has influenced the learners to shy away from it in favour of a discipline that is perceived to be easier. This trend has challenged the effort of instilling scientific beliefs and attitudes in young learners.

It has, therefore, called for a concerted effort to make learning of science a way of igniting the fire of curiosity in the minds of learners. Such a move is possible only when all the players collaborate to provide and use the right tools, forum, opportunities and instructions supported by consistent follow-up and monitoring while teaching and learning science. In essence, dealing with science should foster seeing, using and doing the real things so as to give 'the feel of real science' to the learners. It is imperative to link the concept to the real world, for science encompasses the understanding of structure and behaviour of the physical and natural world that can be better understood only through the use of the scientific inquiry process.

Scientific Process

A scientific process is an inquiry approach that involves a systematic understanding of the natural and physical world. It forms the basis of experimentation for scientific knowledge. It is imperative to know the basic scientific process to derive predictions and confirmations from the ideas and information gathered through observation of different phenomena. Thus, it entails asking relevant questions related to observation, testing ideas, and communicating the findings. The scientific process includes:

1. **Observation**

   IIt is the fundamental skill that enables learners to view the world objectively and systematically by using all the senses. It consists of gathering information, evidences, and ideas about different phenomena. This facilitates learners to compare, contrast, and generalise ideas about the world around them. These experiences foster inquisitiveness in them.

2. **Questioning**

   The competency that involves creative and critical thinking which attempts to link the known with the unknown ideas. It enhances the ability of the learners to put their observations in the form of a question that is clear, concise, and testable.

3. **Hypothesis**

   It is an educated guess and possible explanation about the observation and question. Based on the limited evidence as a starting point, learners carry out further investigation. Therefore, the hypothesis is a specific and testable prediction about what may happen in a study.

4. **Background information**

   It is the collection of relevant and significant information regarding the topic in order to provide a comprehensive understanding of what has been said on the topic and by whom. Through this step, the learner build-up a story related to the question and hypothesis.

5. **Design**

   It is an experimental set-up that allows investigation of the relationship between variables. This allows learners to manipulate the variables and test whether their prediction is accurate.

6. **Data collection**

   It is the systematic observation, measurement, and recording of information about various phenomena happening in the experimental set-up. It allows learners to gather evidence to answer stated research questions, test hypotheses, and evaluate outcomes.

7. **Analysis**

   It is an interpretation of data through the use of analytical and logical reasoning to determine the patterns, relationships, and trends. The learner makes sense out of the information recorded to establish a relationship between variables, based on which results and conclusions are drawn.

8. **Conclusion**

   It is the step where the learner makes generalisation of the information based on the data analysis and interpretation. The generalisation may or may not support the hypothesis. This facilitates learners to develop the skills of articulating diverse information to draw a comprehensive conclusion about the phenomena.

9. **Sharing**

   This is the final step wherein the learner presents their findings in the form of a final report, display or presentation as asked by the subject teacher. The learners explore and learn to use different forms of communication such as graphic, audio-visual, etc. to share their ideas or findings.

Textbook Content

The content in this textbook covers topics on Biology, Chemistry, and Physics in equal proportion to promote the learning of concepts in all the three disciplines. The concepts under each topic are made learner-friendly by incorporating various kinds of activities that meaningfully engages both teacher and learners. Essentially, this textbook contains the following learning experience plan.

Learning objectives: The list of statements that define what learners are expected to know at the end of each topic or chapter.

Activity: This provides information on the aim, the materials required and steps to carry out the activity. It is intended to provide hands-on experience for the learners and test the learned theory or to draw generalization and build concepts.

Do you know? This is provided as additional information to add to general knowledge in science. This is not for testing.

Questions: Where appropriate, the questions are provided to immediately test the concepts learned. This will help learners to test their understanding.

Exercise: This is provided to check the understanding of the concepts learned in the chapter. It has different sets of questions to test learning in terms of scientific knowledge, skills, and values and attitudes.

Model Question Paper: This is provided at the end of the textbook to help learners familiarize with the type of questions that are expected in the terminal examinations. It provides cues of the range of cognitive level of learnings, skills, the values and attitudes that the science curriculum is expected to achieve.

The realization of the curriculum aspirations and intends is determined by the way the curriculum is implemented. So, the use of various strategies that allows learners to explore diverse strategies will help realize the curriculum's intent besides fostering scientific aptitude and attitude in the learners. The provision of avenues to arouse curiosity will go a long way in fostering intellectual development and enhancement of overall performance. If the right tools and strategies are being used, this science curriculum will provide a limitless avenue for the learners to explore continuously on and beyond the scientific concepts embedded in this book.

STEM Unit, CDC
Royal Education Council

Chapter 1

Cell

Our surrounding is full of different kinds of living organisms. All living organisms are made up of cells. Generally, cells are so small that they cannot be seen with naked eyes. They can be seen only with the help of a microscope. Some organisms are made up of a single cell while others are made up of many cells. Cells vary in shape and size. Inside a cell, there are several essential structures which carry out different functions.

1. Cell – the building blocks of life

Learning Objectives

On completion of this topic, you should be able to:

- describe cell as the building blocks of life.
- categorise living things into unicellular and multi-cellular organisms.
- use a compound microscope to observe an animal cell and a plant cell.
- draw the structure of an animal cell and a plant cell .

Just as bricks are the building blocks of a house, cells are the building blocks of a living organism. This means the living organisms are made up of cells. These cells form the structure of an organism and carry out all the functions to keep the organism alive. Our body is also made up of cells which carry out different functions to keep us alive. Therefore, **cell** is the structural and functional unit of all living organisms.

The branch of science that deals with the study of cell is known as **cytology**. Some organisms are made up of single cell. Such organisms are called **unicellular organisms**. For example, yeast, *Amoeba, Chlamydomonas* and bacteria as given in Figure 1.1.

Reprint 2024

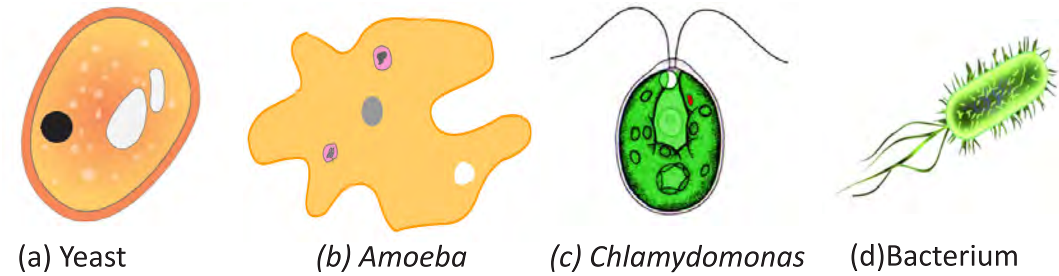


Figure 1.1. Unicellular organisms.

Organisms like human ,fish,bird, tree, and insect are made up of many cells. Such organisms are called **multicellular organisms** as shown in Figure 1.2.

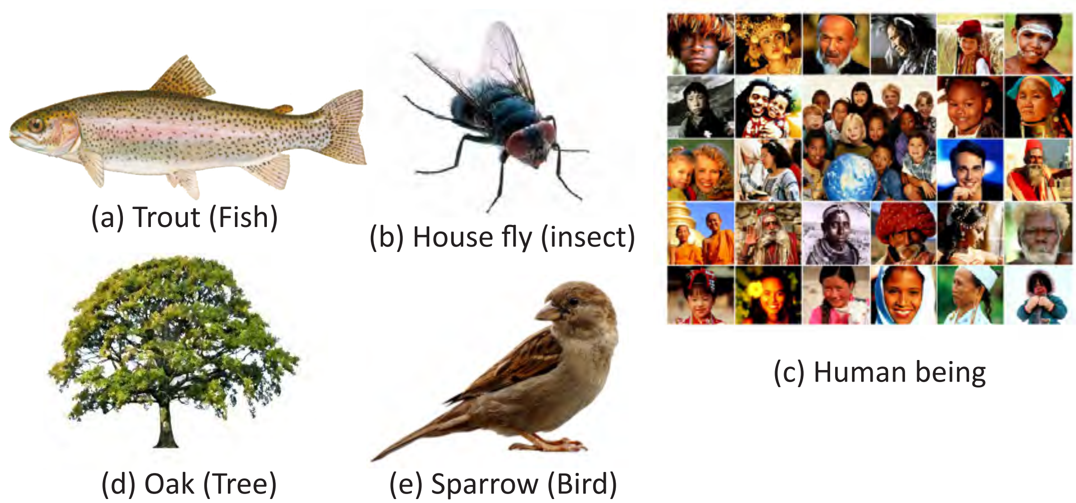


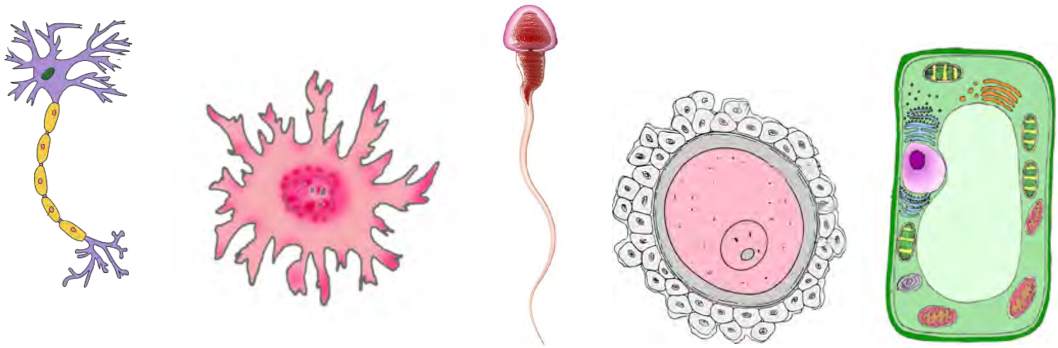
Figure 1.2. Multi-cellular organisms.

Cell was first discovered in a thin slice of cork by Robert Hooke. He found that the cork was made up of many tiny 'honey-comb like' compartments. Later, similar structures were observed in wood and other plants. He named these structures as cells.

a. Shape and size of cells

Cells vary in shapes and sizes. They are spherical, oval, rectangular, cylindrical or irregular in shape as shown in Figure 1.3. Most of the cells are very small and are seen only with a microscope. However some cells, like bird's egg is large enough that we can see with our naked eyes.

Reprint 2024



Nerve cell Bone cell Sperm cell Ovum cell Plant cell

Figure 1.3. Shapes of different cells.

Do You Know?

The ovum (female reproductive cell) is the biggest human cell. It is about the size of a dot which can be seen by naked eyes. All other human cells are microscopic.

Activity 1.1. Using microscope to observe plant , and animal cell

Materials required

Compound microscope, permanent slide of human RBC, permanent slide of T.S of monocot stem.

Precaution

Do not let the objective lens touch the glass slide while using the microscope.

Procedure

Step 1. Take a clean permanent slide of human RBC.

Step 2. Place the slide on stage of microscope with the mount of the specimen over the aperture and clip it.

Step 3. Adjust 10X power objective lens to the specimen.

Step 4. Open the diaphragm.

Step 5. Look through the eye piece and adjust the mirror to reflect light on the slide.

Reprint 2024

Step 6. With the help of coarse adjustment knob, focus the specimen. Adjust the slide if required.

Step 7. For precise focusing and clear view, use fine adjustment knob.

Step 8. Repeat Step 1 to Step 7 using permanent slide of T.S of monocot stem.

Answer the following question.

i. Draw what you observe under the microscope in each case.

ii. What is the shape of RBC and cell of monocot stem?

Activity 1.2. Preparing temporary slide

Materials required

Onion, knife/blade, mounting needle, forceps, microscope, glass slide, cover slip, watch glass, water, iodine solution, blotting paper, and dropper.

Precaution

Handle knife and blade with care!

Procedure

Step 1. Cut the onion bulb into small pieces as shown in Figure 1.4 (a).

Step 2. Using the forceps, remove a thin peel from the concave side of onion piece as shown in figure 1.4 (b).

Step 3. Place the peel in the watch glass containing a few drops of water.

Step 4. Add a few drops of iodine to stain the peel.

Step 5. Place a peel on the center of glass slide with the help of forceps as shown in figure 1.4(c).

Step 6. Place a cover slip over the peel with the help of a mounting needle as shown in figure 1.4 (d) and (e).

Step 7. Make sure that there is no air bubble in between the cover slip and glass slide. Remove the excess fluid with the help of a blotting paper.

Step 8. Observe the slide under low power of the microscope.

Reprint 2024

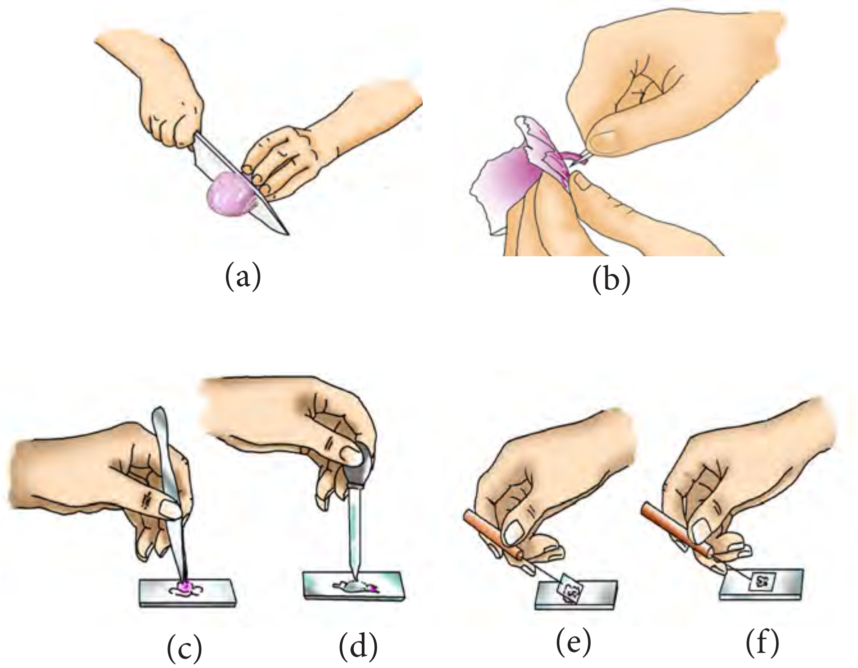


Figure 1.4. Steps for preparing temporary slide.

Answer the following questions.

i. Draw what you observe under the microscope.

ii. What is the shape of the structures that you see in the onion peel? What are they called?

iii. Is the onion a unicellular or multi-cellular organism? Give reason to support your answer.

Questions

1. Define cell.
2. Why do you observe cell under a microscope?
3. Categorize the given organisms into unicellular and multicellular.
   (mosquito, mango, paramecium, euglena, hydra)

Reprint 2024

2. What is inside a cell

Learning Objectives

On completion of this topic, you should be able to:

- identify the basic structures of animal, and plant cell.
- identify the similarities and differences between animal, and plant cell.
- draw and label the basic structures of animal, and plant cell.
- make a model of plant and animal cell.

You have learned that all organisms are made up of cell. Each cell consists of a number of specialized parts. The three basic parts in a cell are cell membrane, cytoplasm and nucleus.

a. Structure of an animal cell

An animal cell contains various cell organelles as shown in Figure 1.5.

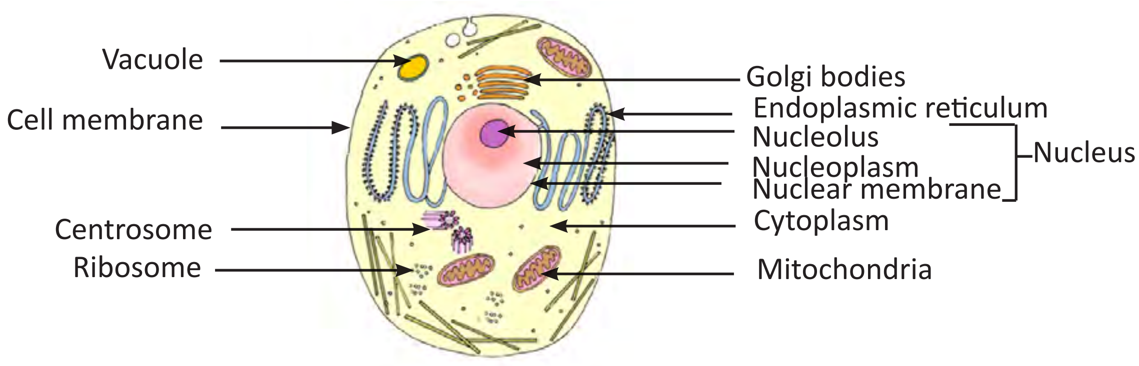


Figure 1.5. Animal cell.

i. Cell membrane (plasma membrane): It is a semi-permeable living membrane that forms the outer most layer in the animal cell. It encloses various cell structures and cytoplasm.

ii. Cytoplasm: It is a semi-liquid, colourless and translucent substance. It occupies most part of the cell within the cell membrane. There are various specialized bodies found within the cytoplasm. These bodies are called **cell organelles**.

Reprint 2024

Some cell organelles are described below.

Endoplasmic Reticulum**:** It is an irregular network of membranes connecting the plasma membrane and the nuclear membrane.

Mitochondria***:*** These are spherical, oval or rod shaped organelles with double membrane.

Ribosome***:*** It is a small organelle found either scattered in the cytoplasm or attached to the membranes of the endoplasmic reticulum.

Golgi bodies***:*** These are very small vesicles of different shapes, and are located near the nucleus. They consist of flattened tubes and round structures.

Centrosome***:*** It is a star-like structure located near the nucleus. It is found only in animal cells.

Vacuoles***:*** These are large cavities filled with a fluid called **cell sap**. In animal cells, the vacuoles are usually smaller and fewer than in plant cells.

iii. Nucleus: It is an oval shaped organelle present somewhat in the centre of the cytoplasm. It is surrounded by double layered **nuclear membrane**. Nucleus is filled with a dense semi fluid substance called **nucleoplasm**. One or two small spherical bodies, called nucleoli (singular nucleolus), lie within the nucleus.

WEBLINK
http://www.kscience.co.uk/animations/animal_cell.htm

Reprint 2024

b. Structure of a plant cell

Plant cells have all the structures that are present in the animal cells except the centrosome. However, they have the following additional structures:

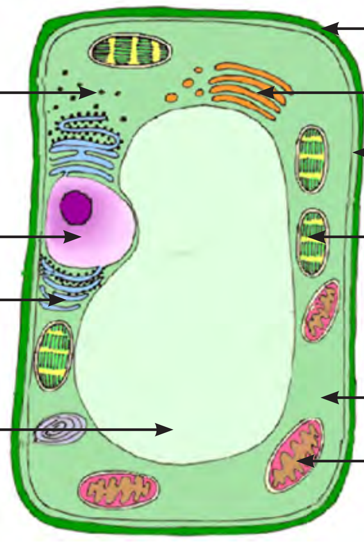


Figure 1.6. Plant cell.

i. **Cell wall:** In plant cell, the cell membrane is surrounded by a rigid structure called **cell wall**. It is a non-living layer made up of **cellulose.**

ii. **Plastid:** It is a large organelle surrounded by double membranes. It is of three types based on the type of pigments it contains.

Chloroplast**:** It contains green pigment called chlorophyll. It is found in leaves, stems, and buds.

Chromoplast**:** It contains pigments of various colours that give colours to flowers and fruits.

Leucoplast**:** It is colourless and contains no pigment. It is found in endosperm, tubers, and cotyledons.

WEBLINK http://www.kscience.co.uk/animations/plant_cell.htm

Reprint 2024

Activity 1.3. Comparing animal cell and plant cell

Open the link and use the simulation to compare plant cell and animal cell.

https://sepuplhs.org/high/sgi/teachers/cell_sim.html

i. Write their similarities.

ii. Write their differences.

Activity 1.4. Making models of animal cell and plant cell

Use image editing software (MS paint, Inkscape, Edraw, etc.) to design a 2D model of plant cell and animal cell. Present your work to the class.

Questions

1. Figure 1.7 shows a plant cell.

Figure 1.7.

   Identify the three basic structures of the cell.

2. Differentiate between cell wall and cell membrane.
3. Draw a labelled diagram of an animal cell.

Reprint 2024

Exercise

Fill in the blanks

1. A ………………carry out all the functions to keep an organism alive.
2. Cell was first discovered in tiny compartment in a piece of ....
3. Irregular network of membranes inside a cell is……………………
4. Nucleolus is present inside a …………………………of a cell.
5. The red colour of a rose is due to the presence of …………………

Check whether the following statements are True or False. Correct the false statements.

1. The substance present in the cell wall is protein.
2. Both animal and plant cells have cell membrane.
3. An ant is a unicellular organism.
4. The study of cell is called histology.
5. The colourless plastid present in potato is chromoplast.

Match the Following

Column A	Column B
1. Outer layer of a plant cell	A. multicellular
2. Structural and functional unit	B. chlorophyll
3. Green colouration in leaves	C. cell membrane
4. Paramecium	D. cell wall
5. Living, semi permeable membrane	E. cell
	F. unicellular

Reprint 2024

Multiple Choice Questions

1. The examples of multicellular organisms are
   A. Bacteria, tiger and deer.
   B. Bacteria, tiger and sugarcane.
   C. Tiger, Paramecium and sugarcane.
   D. Tiger, deer and sugarcane.
2. Which is not a part of animal cell?
   A. Nucleus
   B. Cell wall
   C. Ribosomes
   D. Cell membrane
3. Cells are best seen with
   A. hand lens.
   B. naked eye.
   C. simple microscope.
   D. compound microscope.
4. Cell sap is found in
   A. nucleus.
   B. plastids.
   C. vacuole.
   D. cytoplasm.
5. Cells are of various shapes and sizes. The biggest single cell known is the
   A. amoeba.
   B. bacteria.
   C. egg of an ostrich.
   D. human ovum.

Reprint 2024

Answer the following questions

1. Answer question i and ii based on the information given below.

   In biology laboratory, Tashi observed a cell under a microscope. While focusing on the cell, his attention was drawn to a tiny star like body close to a large dense spherical body at the centre. He also observed many rod shaped structures scattered inside the cell.

   (i) Identify the cell organelles observed by Tashi.

   (ii) Is it a plant cell or an animal cell?

3. Study the diagram of a cell in Figure 1.8 and answer the following questions.
   i. In which group of organisms would you find this cell? Give reasons to support your answer.
   ii. Name the parts labelled A, B, C, and D.

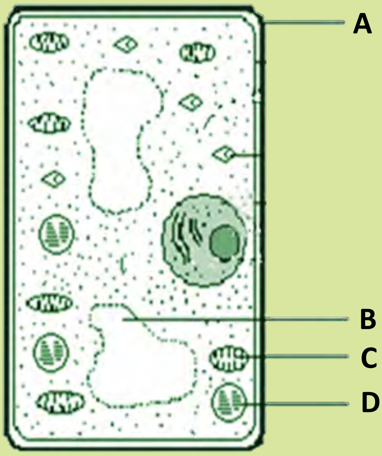


Figure 1.8.

4. Cell is the structural and functional unit of living organisms. Explain.

5. Identify the centrosome, ribosome, nucleus, and endoplasmic reticulum in figure 1.9.

Figure 1.9.

Reprint 2024

6. A student is making a temporary slide as shown in Figure 1.10.

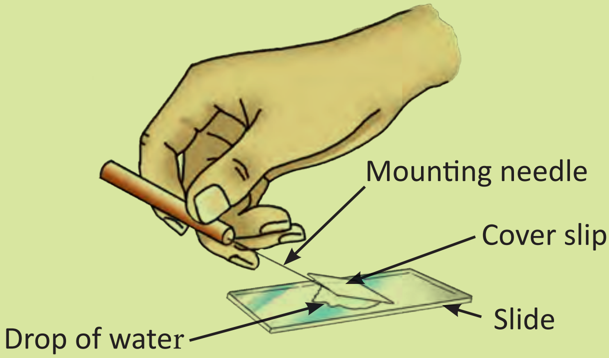


Figure 1.10.

(i) Why should the student make sure that the edge of the cover slip touches the drop of water before setting the cover slip onto the glass slide?

(ii) Why did the student use the cover slip?

Reprint 2024

Chapter 2
Human as Organism

Human beings are one of the most highly developed and complex organisms amongst all the living organisms. The human body has different types of cells that make different organs and organ systems like the skeletal system, respiratory system, nervous system, and the reproductive system. In order to keep our body healthy, a variety of foods including minerals and vitamins are needed. Good health also depends on physical exercises and personal hygiene. Lack of nutrients and unhygienic conditions can cause various diseases.

1. Food and Nutrients

Learning Objectives

On completion of this topic, you should be able to:

- define nutrients and nutrition.
- identify different types of nutrients and their importance.
- identify deficiency diseases.
- carry out food test.

All living organisms need food to live and grow. The process of intake of food, and converting it into energy and other vital nutrients which are used by the body is called **nutrition**. In order to be healthy, we need to take a diet containing all the necessary nutrients in right amount. A **nutrient** is a particular substance contained in a food. Most of the food contains a mixture of different nutrients. Each nutrient has a role to play in keeping the body healthy. Lack of proper nutrients can cause deficiency diseases.

The nutrients in food can be classified into carbohydrates, fats, proteins, minerals and vitamins.

Reprint 2024

a. Carbohydrates

Many of us eat rice, maize, potato, fruits, bread, and jam. All these food items contain carbohydrates. They are organic compounds containing carbon, hydrogen and oxygen. They are the main source of energy for all living beings. Food rich in sugar and starch are grouped as carbohydrates. Glucose is the smallest and simplest unit of carbohydrates.

Activity 2.1. Which foods contain carbohydrates?

Materials required

Raw potato, rice flour, maize flour, wheat flour, petri dish, iodine solution, dropper and knife.

Procedure

Step 1. Take the raw potato and cut it into two halves with the knife.
Step 2. Place one half of the potato in a petri dish.
Step 3. Using the dropper, add two drops of iodine solution on the cut surface of the potato. Observe what happens?
Step 4. Try the similar test with the rice flour, maize flour and wheat flour and record your observations in Table 2.1.

Precaution

Be careful while using knife.

Table 2.1 *Carbohydrate Test*

Food Item	Observation
Rice flour	
Wheat flour	
Maize flour	

Answer the following questions based on activity 2.1.

i. What is the common observation?
ii. What conclusion can you draw?

Reprint 2024

b. Fats

Fats are made of carbon, hydrogen and oxygen. Compared to carbohydrates, fat contains less proportion of oxygen but more carbon and hydrogen. Fatty acid and glycerol are the smallest units of fats. Fats produces energy for organisms to carry out their metabolic activities. They also protect the body against loss of heat. Butter, cream, egg, seed and nut, dry fruit, cheese, meat, fish, vegetable oil, etc. are some examples of fats.

Activity 2.2. Which foods contain fats?

Materials required

Vegetable oil, walnut, hair oil, butter, paper, dropper and tongs.

Procedure

Step 1. Put a few drops of vegetable oil on the paper and dry it.

Step 2. Hold the paper to the light with the tongs and look through it.

Step 3. Try applying rest of the food items on the paper and record your observations in Table 2.2.

Table 2.2 *Fat Test*

Food Item	Observation
Walnut kernel (crushed)	
Hair oil	
Butter	

Answer the following questions based on activity 2.2.

i. What is the common observation?

ii. What conclusion can you draw?

iii. How different are the results with each food item?

Reprint 2024

c. Proteins

Proteins are organic compounds containing carbon, hydrogen, oxygen and nitrogen. The simplest unit of protein is **amino acid**. There are different types of amino acids, which combine together to produce varieties of proteins.

Protein helps in growth, repair and replacement of injured parts of the body. Fish, meat, milk, egg, beans, peas are the major sources of protein.

We take different types of food to provide us with different nutrients essential for growth and energy. Deficiency of protein, carbohydrates and fats results in Protein Energy Malnutrition (PEM). **Malnutrition** is a condition caused due to unbalanced intake of nutrients. PEM causes two types of malnutrition in children, **kwashiorkor** and **marasmus**.

Figure 2.1. A child suffering from Kwashiorkor.

Kwashiorkor is a form of malnutrition that occurs in children when there is not enough protein in the diet. This disease is characterised by pot belly, thin legs, and ugly patches on skin, mental retardation, and slow physical growth. A protein rich diet obtained from animals or from soya bean can cure kwashiorkor.

Marasmus is a disease in children caused by deficiency of protein, carbohydrate and fats. Children suffering from this disease have loose folds of skin, very thin arms and legs, slow growth of body, and they become lethargic. It can easily be prevented and controlled by taking enough carbohydrates and proteins.

Figure 2.2. A child suffering from marasmus

WEBLINK

1.http://www.agritech.tnau.ac.in/nutrition/nutri_dfcnydse_protein.html
http://www.agritech.tnau.ac.in/nutrition/nutri_dfcnydse_vitamin.html

Reprint 2024

Activity 2.3. Which nutrient is present in egg-white?

Precaution

Acids are corrosive.

Materials required

Egg-white, test-tube, droppers, dilute nitric acid lentils, and milk.

Procedure

Step 1. Take a small amount of egg white in the test tube.

Step 2. Using a dropper, add a few drops of dilute nitric acid on it.

Step 3. Record your observations in Table 2.3.

Table 2.3 *Protein Test*

Food Item	Colour Change with Dilute Nitric Acid
Egg white	

Try similar tests with lentils and milk.

Answer the following questions based on activity 2.3.

i. What is your observation?

ii. What conclusion can you draw?

iii. Why is egg white good for health?

d. Minerals

Minerals are needed by the body in small amounts. It forms about 4% of our body weight. Over a dozen elements are essential for a healthy body. These include sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), phosphorus (P), chlorine (Cl), copper (Cu), iron (Fe), iodine (I), zinc (Zn), cobalt (Co), manganese (Mn), flourine (F), etc.

Deficiency of minerals causes different types of diseases. Table 2.4 shows different types of minerals, their sources, importance, and their deficiency diseases.

Reprint 2024

Table 2.4 *Minerals in Food*

Mineral	Sources of Mineral	Importance	Deficiency Disease
Iron	Liver, red meat, beans, green vegetables, etc.	Formation of red blood cells.	Anaemia.
Iodine	Sea food, iodised salt, etc.	Formation of thyroxin.	Simple goitre.
Calcium	Milk , dairy products, vegetables, etc.	Formation of teeth and bones.	Poor growth of bones and teeth.
Fluorine	Water, milk, tooth-paste, etc.	Maintains healthy bones and teeth.	Tooth decay.

e. Vitamins

Vitamins are essential nutrients required in minute quantities in our diet for keeping the body healthy. They are protective food and do not provide energy. They differ in their functions, and are classified as fat soluble and water soluble vitamins. Fat soluble vitamins include vitamins A, D, E and K, while water soluble vitamins include vitamins B and C. Lack of vitamins in the diet causes deficiency diseases, which affect the skin, hair, bones, eye and general growth of the body.

Table 2.5 *Vitamins in Food*

Vitamin	Sources of Vitamin	Importance	Deficiency Disease
A	Carrot, liver, milk, papaya, green vegetables, butter	Essential for good vision and visual health, skin, and immune functions	Xerophthalmia (Night blindness)
B complex (Group of vitamins)	Cheese, meat, eggs, liver, milk, bread, grains, green vegetables	carbohydrate metabolism, break down of amino acids, synthesis of fatty acids	Beriberi

Reprint 2024

C	Fruits like lemons, oranges, grapes, fresh vegetables like potato, tomatoes	Wound healing, reduction in allergic responses, cardiovascular health, development of connective tissue components	Scurvy
D	Fish, liver, butter, cheese, eggs, milk	Muscle functioning, bone mineralisation and stability, and multiple immune functions	Rickets
E	Milk and green vegetables	Promote cardiovascular health, skin repair, proper blood flow, and clotting	Sterility
K	Fresh and leafy vegetables	Process of blood clotting, bone metabolism and development	Delays blood clotting

Do You Know?

Your body produces up to 10,000 units of vitamin D in a 20 minute period on a sunny day. That's 50 times more than the daily recommendation of 200mg (which is equivalent to drinking approximately 10 tall glasses of milk each day).

f. Water

Up to 60% of the human adult body is water. It does not yield energy, but its absence can lead to death. Water helps in digestion of food and transportation of substances in our body. It is regularly lost from the body through sweat and urine. Therefore, it must be constantly replaced by drinking a minimum of 2 litres of water daily.

g. Roughage

Roughage, known as fibre, is indigestible fibrous part of the food. It is not a nutrient but an essential content in our diet, which helps the process of digestion. It also prevents constipation and helps bowel movement. Fruits, green vegetables, unpolished rice, whole grains food are important sources of roughage.

WEBLINK
http://www.wisegeek.com/what-is-roughage.htm

Reprint 2024

Questions

1. Differentiate between kwashiorkor and marasmus.
2. Table 2.6 shows a mess menu of Mendrubling Middle Secondary School. Study, and answer the questions that follow.

Table 2.6 *Menu*

Days of a week	Breakfast	Lunch	Dinner
Monday	Bread, jam, egg and milk	Rice, **dal**, beef, vegetable curry and fruits	Rice, **dal** and mixed vegetable curry
Tuesday	Rice, **suja** and fried vegetable	Rice, **dal**, and vegetable curry	Rice, vegetable curry
Wednesday	Rice, **chick pea** and milk tea	Rice, **dal** and vegetable curry	Rice, pork and vegetable curry
Thursday	Fried rice and milk tea	Rice, **dal**, **emadatsi** and fruits	Rice, **dal** and vegetable curry
Friday	Rice, fried vegetable and **suja**	Rice, **dal**, pork, and fruits	Rice, **dal**, **papad** and vegetable curry
Saturday	Bread, jam and milk tea	Rice, **dal** and vegetable curry	Rice, **dal** and **Kewadatsi**
Sunday	Fried rice, **chick pea** and milk tea	Rice, **dal**, fish, vegetable curry and fruits	Rice, **kewadatsi**, fish, curd and fruits

i. On which days do the students get more protein?

ii. Which is the most common nutrient in the menu? Identify its source.

iii. What nutrients would be missing if the vegetables were not on the menu?

iv. What deficiency disease are students likely to get if fruits are missing from the menu?

Reprint 2024

2. The Human Skeleton

Learning Objectives

On completion of this topic, you should be able to:

- identify the parts of human skeleton.
- draw and label the parts of human skeleton.
- write the functions of the parts of human skeleton.

The human body is supported by a framework of bones called skeleton. Bones are hard and strong. They are made of protein collagen, and are heavily deposited with salts of calcium and phosphorus. The functions of the skeleton are to provide support, give shape, produce blood cells and protect organs.Soft substance contained in bone' cavities called **bone marrow** produces blood cells.

The skeleton also provides attachment for muscles that helps in movement. Figure 2.3 shows the human skeletal system. Human skeleton is divided into Axial skeleton and Appendicular skeleton.

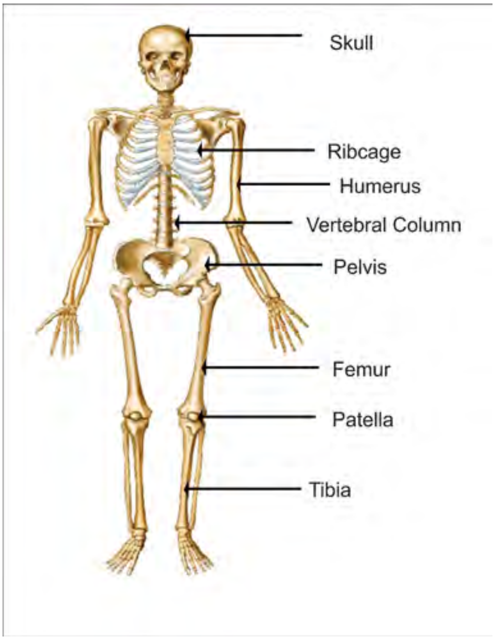


Figure 2.3. Human skeleton.

Reprint 2024

Activity 2.4. Labelling of skeleton

Materials required

3D model of Human Skeleton

Use 3D model and study the parts given in Table 2.7. Answer the questions that follow:

Table 2.7 *Parts of Skeleton and their Functions.*

	Parts	Bone	Number of Bone	Function
Axial Skeleton (80 bones) 	Skull	Cranium	8	Protects brain from external shocks and injuries
		Facial bones	14	Controls facial expressions and chewing
	Ribcage	True Ribs	14	Protects the heart, lungs and enable breathing
		Floating Ribs	10	
		Sternum	1	
	Vertebral column	Backbone	33	Protects the spinal cord
Appendicular skeleton (126 bones) 	Pectoral girdles	Clavicle	2	Provides support to the front part of the body and movement of forearms
		Scapula	2	
	Pelvic girdles	Hip bone	2	Support the skeleton and hind limbs Protects the organs such as kidneys, urinary bladder, large intestine and reproductive organs in females
		Sacrum		
		Coccyx		
	Limbs	Forelimbs	60	Allow us to do a variety of tasks such as lifting and using objects
		Hind limbs	60	Use for walking

i. Which bone protects the heart?

ii. Name two bones that help in lifting things.

iii. Why is skull important?

Reprint 2024

3. The Human Respiratory System

Learning Objectives

On completion of this topic, you should be able to:

- identify the parts of human respiratory system.
- draw and label the parts of human respiratory system.

What does the body require to perform various activities in our day to day life? It requires energy derived from the food that we eat. However, energy is not available to the cells directly. Cells carry out a process called **respiration** which uses oxygen to release energy from food. Oxygen is obtained from the air through the process of breathing. Breathing and respiration are continuous processes that take place in all organisms.

Breathing and Respiration

Breathing is a process in which animals take in oxygen rich air (inhalation) and give out air containing more carbon dioxide (exhalation).

Figure 2.4 shows the organs of respiratory system in human beings.

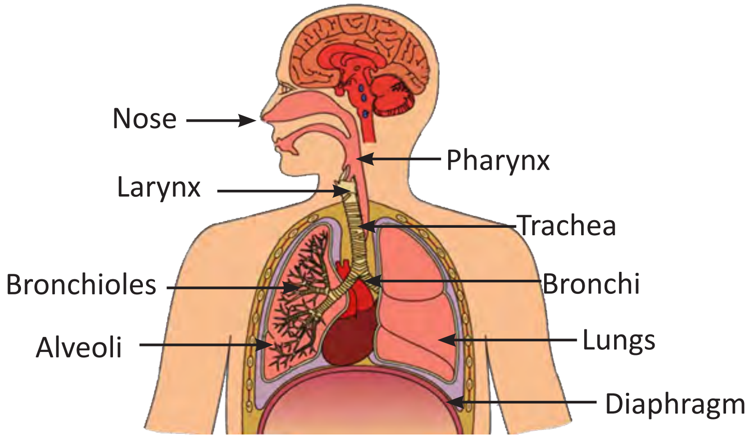


Figure 2.4. Parts of respiratory system.

Nose: The respiratory system begins with the nose, which leads to large air filled space called nasal chamber (air passage). Hairs present in the nostrils trap dust particles and purify the air to some extent.

Pharynx: It is the passage that carries air and food, and is commonly called throat.

Reprint 2024

Trachea or wind pipe: It is a tube that connects throat to the lungs. Trachea consist of 16 to 20 C-shaped cartilages (ring like), which keeps it open all the time. A thin flap of tissue called the **epiglottis** is present at the opening of the trachea. It allows air to pass through the larynx and into the rest of the respiratory system. When swallowing food or drink, it covers the entrance to the larynx to prevent food and drink from entering the trachea. The **larynx** or voice box is located at the upper end of the trachea. It contains two vocal cords, which vibrate to produce sound.

Lungs: A pair of lungs is located in the thoracic cavity on either side of the heart. They are soft, spongy and elastic organs. Right lungs consists of three lobes and the left lungs has two lobes. The lower end of trachea divides into two tubes called bronchi (singular, bronchus). These bronchi enter the lungs and further divide into smaller tubes called **bronchioles**. The bronchioles end as the air sacs known as **alveoli** (singular: alveolus). The air sacs are surrounded by blood vessels where exchange of gases takes place. The oxygen present in the air we breathe in, reaches the cells through blood vessels. The carbon dioxide released by the cells as waste reach the air sacs through the blood vessels. It is then exhaled during breathing. Breathing is a result of contraction and expansion of muscles called **diaphragm**.

Do You Know?

The lungs contain over 300 million of alveoli. Every minute nearly 6 litres of air is breathed in and out.

Questions

Choose the most appropriate answer.

1. In which process is oxygen used to release energy?
   i. Photosynthesis
   ii. Circulation
   iii. Respiration
   iv. Reproduction

Questions

2. Which sequence is the correct route of the air getting into the lungs of humans?
   i. nose → trachea → nasal cavity → alveoli → bronchioles → bronchus
   ii. nose → nasal cavity → trachea → bronchus → bronchioles → alveoli
   iii. nose → nasal cavity → trachea → bronchus → alveoli → bronchioles
   iv. nose → nasal cavity → bronchus → trachea → bronchioles → alveoli

3. The main function of the lungs is to
   i. break down foods for absorption into the blood.
   ii. release energy from sugars within the cells.
   iii. exchange oxygen and carbon dioxide.
   iv. carry nutrients to all parts of the body.

4. Figure 2.5 shows that animals are dependent on the plants for food and shelter.

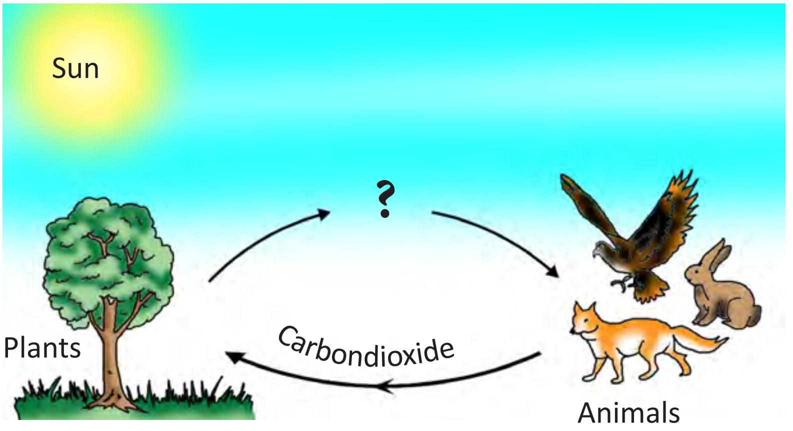


Figure 2.5.

   Identify one other way in which animals are dependent on plants.

5. The walls of trachea do not collapse even when there is less air in it. Why?

WEBLINK
http://people.eku.edu/ritchisong/301notes6.htm

Reprint 2024

4. The Human Reproductive System

Learning Objectives

On completion of this topic, you should be able to:

- identify the parts of male and female human reproductive system.
- draw and label the parts of human reproductive system.
- write the changes that occur during puberty.
- describe the phases of menstrual cycle.
- Recognize ways of maintaining personal health and hygiene during menstruation.

Reproduction is the process by which living organisms produce young ones of their own kind. Reproduction maintains continuity of life on Earth. There are two basic types of reproduction: asexual reproduction and sexual reproduction. In **asexual** reproduction, an organism reproduces by the process which does not involve meiosis, or fertilization. In **sexual** reproduction, a new individual is produced by the fusion of male and female gametes.

The gamete produced by male is called **sperm** and by female is called **ovum** (plural: ova).

Human beings are unisexual organisms**.** The male and female have separate reproductive system. The onset of sexual maturity in an individual is called **puberty**. It usually starts at around 11 to 13 years of age. Puberty is accompanied by the development of secondary sexual characteristics. Some of the secondary sexual characteristics in male include:

- the growth of pubic hair, beard, and moustache on the face.
- deepening of voice.
- development of muscles.
- broadening of shoulders.

In female, the changes include:

- development of breasts.
- high pitched voice.
- widening of hips.

Reprint 2024

- growth of pubic hair.
- onset of menstruation (monthly bleeding).

The Male Reproductive System

The male reproductive system consists of a pair of testes, sperm ducts (Vas deferens), accessory glands, urethra, and penis.

Testes are located outside the body sac of skin called **scrotum**.

Sperms are produced in large number inside the testes.

They are carried into the urethra by a pair of long tubes called **sperm duct**.

The secretion from accessory glands such as Cowper's gland, seminal vesicles and prostrate gland mix with sperm to form **semen**.

The semen is released through the penis into the vagina during sexual relation.

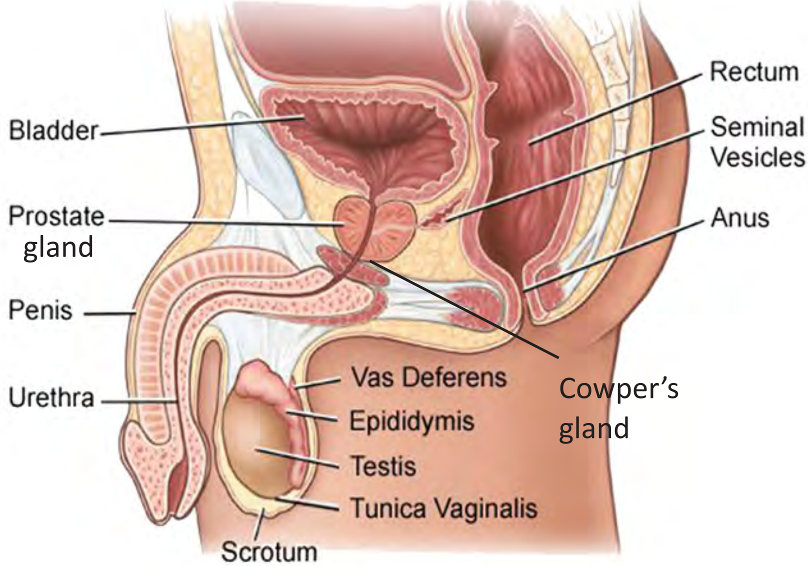


Figure 2.6. The male reproductive system.

Do You Know?

The smallest cell in human is the sperm.

http://www.kscience.co.uk/animations/lungs.htm
http://www.innerbody.com/

Reprint 2024

The Female Reproductive System

The female reproductive system consists of a pair of ovaries, fallopian tubes, uterus and vagina. Ovaries are located in the lower part of the abdominal cavity. Each ovary produces one ovum every month alternately. An ovum is released into the fallopian tube. During sexual relation, millions of sperms are deposited into the vagina with the help of the penis. The sperms travel up the vagina and uterus and reach the fallopian tube where fertilisation occurs.

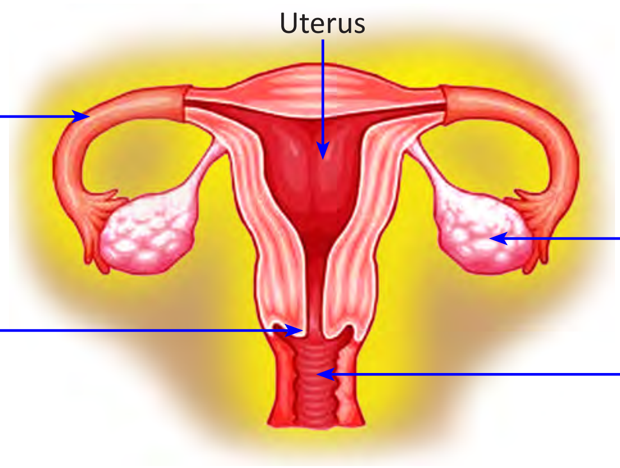


Figure 2.7. The female reproductive system.

Menstrual Cycle

The ovary usually releases an ovum once in about 28 days. The release of ovum from the ovary is called **ovulation**. Before the release of an ovum, the walls of the uterus become thick with increased blood supply in preparation to receive the fertilised egg (zygote). After fertilisation the zygote gets implanted in the uterus. If the ovum is not fertilised, it is discharged through the vagina along with the lining of the uterus and blood. This outflow of blood together with the lining of uterus is called **menstruation**. It usually last for about 3 to 5 days.. The whole process of discharge of blood (menstruation phase), release of hormone called Follicle Stimulating Hormone (follicular phase), release of egg into the ovary (ovulation phase) , and the egg starting to produce progesterone to prepare the body for a potential pregnancy (luteal phase) is called **menstrual cycle**.

Menstruation starts at puberty and puberty, and may stop at about the age of 45 to 50. The onset of menstruation is called **menarche,** and the stoppage of menstruation is called **menopause**.

Reprint 2024

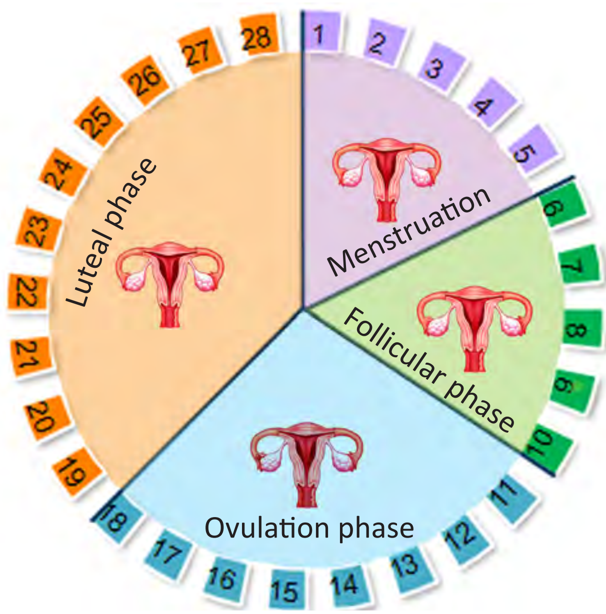


Figure 2.8. The phases of menstruation cycle.

Work in groups

Design an activity to create awareness on ways to maintain personal health and hygiene during menstruation. This can be done through advertisement/songs/poems/posters/arts and crafts, etc. Present your work to the class.

Fertilisation

The fusion of sperm and ovum is called **fertilisation**. Fertilisation results in formation of a single celled structure called **Zygote**. The zygote then begins to divide and forms an **embryo**.The embryo is implanted in the uterus. The embryo starts to grow at a rapid rate by cell division. The walls of the uterus become thick with increased blood supply to nourish the growing embryo. After six weeks the embryo is called **foetus**. The foetus takes about 280 days (gestation period) for it to develop completely.

Reprint 2024

Questions

1. What are the differences in the secondary sexual characteristics of male and female?
2. Define the following terms:
   i. Zygote
   ii. Menstruation
   iii. Semen
   iv. Reproduction
   v. Ovulation

Reprint 2024

5. Human Nervous System

Learning Objectives

On completion of this topic, you should be able to:

- identify the parts of human nervous system.
- write the functions of the brain, spinal cord and nerve.

Activity 2.5. Recognise and remember

Work in groups

Materials required

A bag(opaque) and some objects

Procedure

Step 1. Show all the objects to the group members.
Step 2. Put the objects in the bag.
Step 3. Take turns to identify the objects by feeling them in the bag.

Now answer the following questions.

i. List down the objects you could identify.
ii. How are you able to recognise the objects in the bag?
iii. How does the brain recognise the objects?
iv. Which part of the nervous system is involved in carrying the impulses from hand to the brain?

The human body carries out many activities, consciously or unconsciously, for example, breathing, beating of heart, lifting off hands on touching a hot object, or kicking a ball. All these activities occur in a coordinated manner. The nervous system helps to coordinate the activities of the human body. The nervous system includes the brain, spinal cord and the nerves.

WEBLINK
1.http://www.kscience.co.uk/animations/lungs.htm
http://people.eku.edu/ritchisong/301notes6.htm

Reprint 2024

Brain: The brain is a very delicate organ, well protected inside the brain box (cranium) of the skull. It is covered by a membrane called **meninges**. The brain is divided into three parts – the **cerebrum**, **cerebellum** and the **medulla oblongata**. The cerebrum is the largest part of the brain. It controls thinking, reasoning, memory, speech and vision. The cerebellum is situated at the base of the cerebrum. It coordinates muscle movements and maintains balance of the body. The medulla oblongata is the lowest portion of the brain. It controls activities, which are not under our will such as heartbeat, breathing, sneezing and digestion.

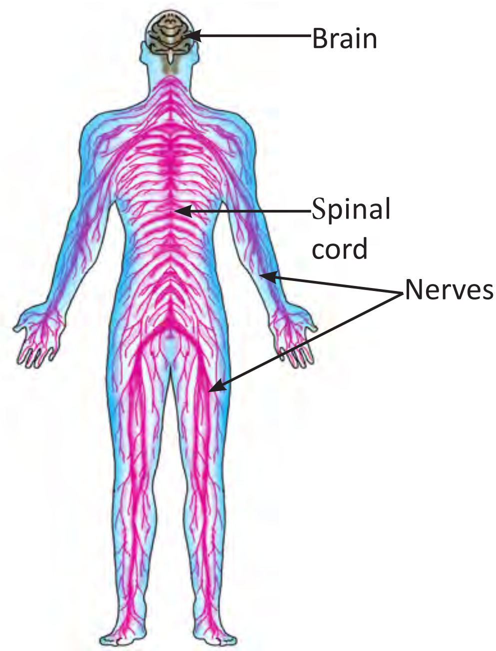


Figure 2.9. The human nervous system.

Spinal cord: It is a cylindrical structure that arises from the brain and runs along the vertebral column (backbone). It carries messages from the muscles and skin to the brain. It also carries messages from the brain to the muscles of the limbs and other parts of the body.

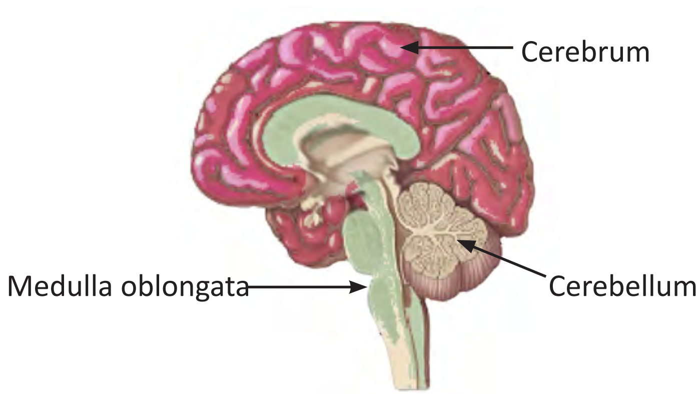


Figure 2.10. The human brain.

Nerve: A nerve is a thread-like structure arising from the brain and spinal cord, and spreading to the different parts of the body. It is formed by a bundle of neurons. A **neuron** is a single nerve cell. It is the functional and structural unit of nervous system responsible for carrying impulses. Depending upon the direction in which they carry the impulse, nerves are of three types.

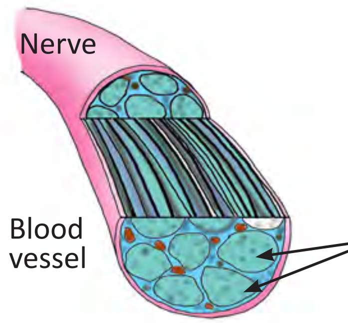


Figure 2.11. Nerve.

Sensory nerves carry messages (impulse) from sensory organs (eyes, ears, tongue, nose, and skin) to the brain.

Motor nerves carry messages (impulse) from the brain to the different parts of the body.

Mixed nerves consist of both sensory and motors nerves.

Questions

1. Copy Figure 2.12 in your note book, and make the boundaries of cerebrum, cerebellum and medulla oblongata.

Figure 2.12.

2. Why do you think it is not wise to hit hard on someone's back?
3. Tshewang fell down from the staircase. He could neither walk properly nor remember what had happened to him after the fall. Which parts of the brain do you think were affected?

WEBLINK http://people.eku.edu/ritchisong/301notes6.htm

Reprint 2024

6. Health and Diseases

Learning Objectives

On completion of this topic, you should be able to:

- explain health and disease.
- identify some of the common diseases prevalent in Bhutan.
- explain symptoms and preventive measures of common diseases.
- explain the importance of personal hygiene.

According to the World Health Organization (WHO), human health is defined as a "state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity". A disease is a condition in which there is an abnormal functioning of the body. Some diseases are present from the birth, whereas some diseases are acquired during lifetime. Diseases can be communicable or non-communicable.

a. Communicable Diseases

These diseases are transmitted from one person to another. They are always caused by disease causing organisms called pathogens. Based on the types of pathogens, communicable diseases are of the following types:

i. Diseases caused by bacteria

Bacteria are present in air, water, soil, and in living and non-living things. They cause many diseases, some of which are:

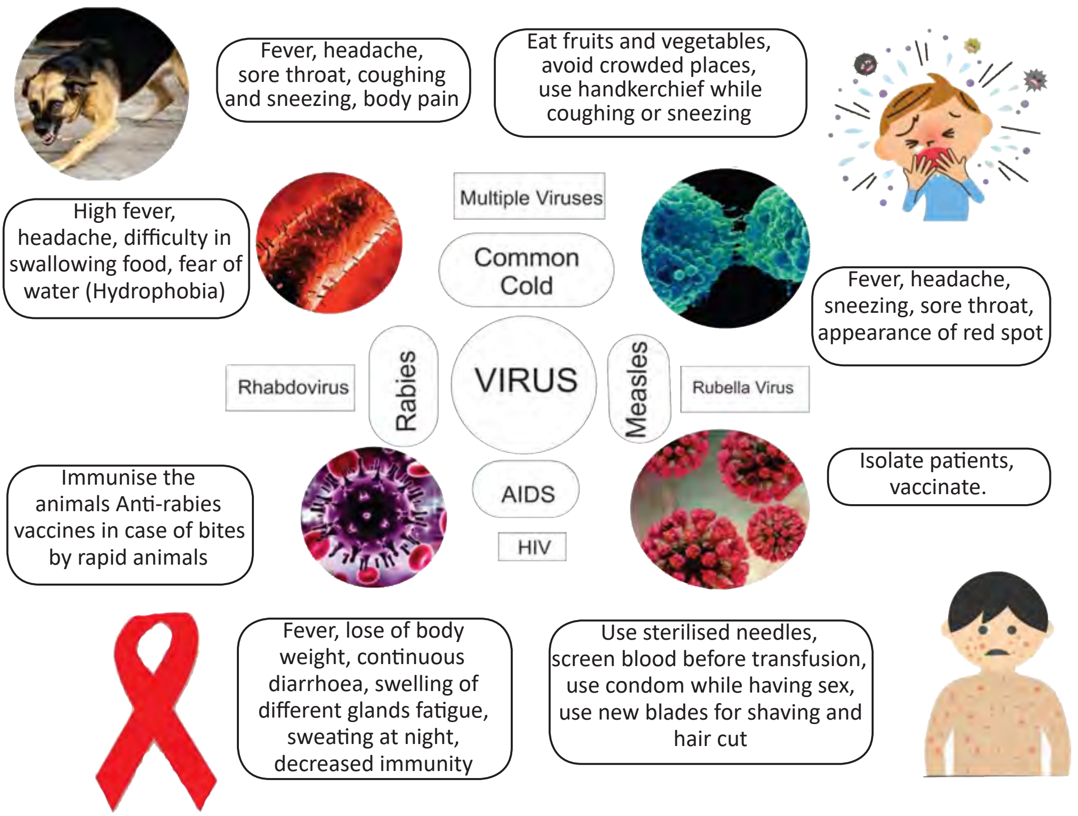
Figure 2.13. Tuberculosis bacteria.

Reprint 2024

Table 2.8 *Diseases Caused by Bacteria*

Name of disease	Caused by	Symptom	Prevention	Diagram
Tuberculosis	*Mycobacterium tuberculosis*	Fever, cough, sputum containing blood, pain in the chest, loss of weight, loss of appetite, and tiredness	Immunising the child with BCG (bacillus of calmette and Guerin) vaccine, Disinfecting the utensil and other materials used by the patient	
Typhoid	*Salmonella typhi*	High fever, vomiting, headache, abdominal pain, and diarrhoea	Proper sanitation, regular hand washing and keeping the flies under control	
Cholera	*Vibrio cholerae*	Acute diarrhoea, vomiting, abdominal pain, and rapid dehydration	Safe drinking water, eating properly cooked food and covering the edibles	
Diarrhoea	Protozoa, virus and bacteria	Loose watery stool, abdominal cramp, abdominal pain, fever, blood in the stool, mucus in the stool, and bloating	Wash your hands with soap for at least 20 seconds Use hand sanitizer when washing isn't possible, Cover the edible items, maintain hygiene	

ii. Diseases caused by Virus



Do You Know?

AIDS is not spread through insect bite, hugging, sharing meals, toilets, clothing, utensils, shaking hands, coughing, sneezing or caring for AIDS patient.

Activity 2.6. AIDS education

Design a video to create awareness on AIDS using block programming or any other software and present to the class.

iii. Diseases caused by protozoa

Protozoa is a unicellular organism that can only multiply within a body of another organism. An example of the disease caused by protozoa is malaria.

Malaria

Malaria is a common disease caused by the protozoa called *Plasmodium vivax*. In Bhutan, it is mostly prevalent in the southern region. Female *Anopheles* mosquitoes transmit the parasite from an infected person to an uninfected person. Some of the common symptoms are high fever, shivering, muscle pain, profuse sweating, headache, loss of appetite, and fatigue. Malaria can be prevented by using insecticide treated mosquito nets, mosquito repellents, covering exposed parts of your body during evening or night, keeping the surrounding clean, preventing pooling of water, and covering water containers.

iv. Disease caused by parasitic worms

Parasitic worms are those worms that live inside the body of animals. Round worm (*Ascaris*) is an example of parasitic worms. The *Ascaris* has elongated body with tapering ends. It causes a disease called **Ascariosis**.

Ascariosis

Ascariosis is an infection of the intestinal tract in humans by *Ascaris*. The worm derives the food from the intestine causing damages to it. The disease makes a person weak and anaemic (less number of red blood cells). It causes pain in the stomach, vomiting and diarrhoea. The eggs of female worm pass out along with the stool and contaminate soil, food and water. When a person takes contaminated food and water, the eggs enter his or her intestine where they hatch and grow.

Ascariosis can be prevented by drinking safe water, washing fruits and vegetables with clean water before eating, and washing hands properly before and after eating.

v. Disease caused by fungi

Fungi are large group of organisms which do not have chlorophyll. They include mushrooms, yeasts and moulds. Fungi cause number of diseases in humans. Some of the diseases caused by fungi are:

Reprint 2024

Ringworm


Figure 2.14. Ringworm infection.

It is an infectious disease of the skin caused by fungus. It produces a ring shaped patch on the skin; hence, the name ringworm. It can be transmitted from an infected person through contact of infected skin, and sharing combs, brushes, and other personal items. The infected area of the skin becomes red, inflamed and scaly. It may be mildly irritating or very itchy.

It can be prevented by avoiding contact with infected person and not sharing personal items. It is also important to maintain personal cleanliness and clean surroundings. It can be treated by using anti-fungal creams, which can be obtained from hospitals or BHUs.

Athlete's foot


Figure 2.15. Athelete's foot.

It is a fungal infection that affects skin between the toes and sole of the foot. It can spread from infected person through direct skin contact, and indirectly, through towels, socks, shoes and floors. The infected area becomes red and scaly with small blisters. Some of the preventive measures are washing the feet everyday and allowing them to dry before putting on shoes and socks. Wearing sandals, leather shoes, woollen or cotton stockings are also some of the preventive measures. It can be treated by using anti-fungal creams and powders.

vi. Disease caused by mites

If you have itchy rashes between fingers, palms, soles and genitals, this infection is due to the skin disease called **scabies**. It is caused by itch mites (*Sarcoptes scabiei)*. Scabies is spread from an infected person to another person through skin to skin contact, and by sharing clothing or bedding.

Maintaining personal hygiene can be the best prevention from contracting scabies.

Reprint 2024

b. Non-Communicable Diseases

Diseases, which do not spread from one person to another are called **non-communicable diseases** or **non-infectious diseases**. They are not caused by pathogens. Some examples are allergies, diabetes, night blindness, asthma and heart diseases.

Use your school library or browse internet to find out more about non-communicable diseases and make a display of the information in the class.

c. Personal Health and Hygiene

Good personal health and hygiene is one of the most effective ways to protect us from illness. The major aspects of personal health and hygiene are:

Cleanliness: It involves taking bath daily, washing hands before eating and after visiting the toilets, washing clothes regularly, etc. It also involves brushing the teeth once in the morning and before going to bed, clipping nails, and keeping hair tidy.

Rest and sleep: Our daily activities make our body tired. Therefore, for proper mental and physical health, children should sleep at least 8 hours, while adults should sleep at least for 6 hours.

Avoiding bad habits: You should never indulge in bad habits like smoking, chewing **doma,** and tobacco, drinking alcohol and abusing drugs. These habits are injurious to your health.

Physical exercise: Regular physical activities are essential for proper growth and functioning of the body. They help the person to be physically healthy and mentally sound. Various games such as football, volleyball, basketball, badminton, cycling and taking regular walks (at least 30 minutes) are good physical exercises. However, with advancement of science and technology, the way we live our life has changed. These days, many people lead a sedentary lifestyle by watching television, surfing internet, playing video, games and driving cars. These increase the risk of obesity, which leads to hypertension and diabetes.

Reprint 2024

Activity 2.7. Personal health audit

Take this simple test sincerely to find out how healthy your lifestyle is. Put a score for each indicator: 2 for agree, 1 for sometimes and 0 for disagree. Total up the scores for each health area. Know your life style by comparing the grand total in each area with the scale given in Table 2.9.

Table 2.9 *Checklist for Personal Habits*

Health Indicator		Agree (2)	Sometimes (1)	Disagree (0)	Total
Drugs					
1	I do not chew **doma**				
2	I do not chew tobacco				
3	I do not smoke cigarette				
4	I do not drink alcohol				
5	I do not abuse drugs				
Grand Total					
Eating habits					
1	I eat food on time				
2	I eat fruits and vegetables				
3	I drink 2 to3 litres of water daily				
4	I avoid fast food				
5	I avoid fizzy drinks				
Grand Total					
Exercises					
1	I play games in school				
2	I like some physical work				
3	I sleep for about eight hours				
4	I jog everyday				
5	I walk to school almost every time				
Grand Total					

Reprint 2024

Stress					
1	I sleep on time				
2	I do not like to surf internet for long hours				
3	I do not like to use cell phone everyday				
4	I do not read books continuously for hours				
5	I do not like to play video games and watch television all the time				
Grand Total					
Personal Hygiene					
1	I take bath regularly				
2	I brush my teeth regularly				
3	I wear clean clothes and dress neatly				
4	I cut my nails and groom my hair regularly				
5	I keep my room/house/surrounding clean				
Grand Total					

Scale for scores

Scores of 9 and 10

Excellent! Your scores show that you are practising good health habits. As long as you continue to do so, this area should not pose a serious health risk. You are setting a good example for your family and friends to follow.

Scores of 6 to 8

Your health practices in this area are good, but there is room for improvement.

Scores of 3 to 5

Your scores show that there are health risks in this area. It is important for you to change these behaviours quickly through help from your friends, teachers and parents.

Scores of 0 to 2

Be aware! Your scores show that you are taking serious and unnecessary risks

Reprint 2024

with your health. Perhaps, you are not aware of the risks and what to do about them. Consult a professional counselor.

Questions

1. Give reasons for the following statements:
    a. Always drink safe water.
    b. Always wash your hands before eating.
    c. Give ORS to people suffering from diarrhoea.
    d. Keep the edibles covered.
2. Study Figure 2.16 to answer questions 'a' and 'b'.

Figure 2.16.

    a. Predict the disease that the child and mother would get without the net.
    b. List other preventive measures for the disease.
3. There is an outbreak of cholera in your area. How will you protect yourselves from cholera?

Reprint 2024

Exercise

Multiple Choice Questions

1. A child shows poor physical growth with loose folds of skin, very thin arms and legs, and is very lethargic. Identify the disease.
   A. Kwashiorkor
   B. Marasmus
   C. Anaemia
   D. Goitre
2. The total number of ribs present in human body is?
   A. 10.
   B. 12.
   C. 24.
   D. 36.
3. The nasal chambers open into
   A. pharynx.
   B. trachea.
   C. oral cavity.
   D. lungs.
4. Fertilization is the process by which the zygote is formed. Where does this process take place?
   A. Uterus.
   B. Oviduct.
   C. Ovary.
   D. Vagina.
5. Dorji is solving a mathematical problem. Which part of the brain is he using?
   A. Medulla oblongata.
   B. Cranium.
   C. Cerebellum.
   D. Cerebrum.

Reprint 2024

6. A person is bitten by an animal. Which of the following diseases is he likely to be infected with?
   A. Cholera.
   B. Dysentery.
   C. Ascariosis.
   D. Rabies.
7. Scurvy is a disease that sailors often got on long voyages. It was discovered that scurvy could be prevented by eating oranges and lemons. This suggests that scurvy is a disease caused by
   A. exposure to sea air.
   B. microorganism.
   C. a nutritional deficiency.
   D. lack of exercise.

Check whether the following statements are True or False. Correct the false statements.

1. Scapula is also called as collar bone.
2. Respiration is the process of taking in oxygen rich air and giving out carbon dioxide rich air.
3. The spinal nerve arises from the brain.
4. Measles is caused by *Rhabdovirus*.
5. Deficiency of iron in a meal causes goitre.

Match the following

Column A	Column B
1. Vaccine used for treating tuberculosis.	A. Sperm
2. The main part of the skeleton that provides support to the ribs at the back.	B. BCG
3. The smallest units of the nervous system which carries impulse.	C. Alveoli
4. Special cells produced in the testes.	E. Ovum
5. The terminal ends of the respiratory system.	F. DOT
	G. Neuron
	H. Backbone

Reprint 2024

Answer the following questions

1. Define the following terms.
   a. Nutrient
   b. Axial skeleton
   c. Marasmus
   d. Disease
2. Differentiate between the following, based on what is given in the bracket.
   a. Scurvy and Rickets (deficient nutrient)
   b. Protein and carbohydrates (composition)
   c. Breathing and Respiration (process)
   d. Cerebrum and Cerebellum (function)
   e. Infectious diseases and non-infectious diseases (cause)
3. Give reasons for the following statements.
   a. During the Second World War, night pilots were fed with carrot juice.
   b. In a place where lots of polished rice was eaten, it was found that many people suffered from paralysis of limbs.
   c. A woman after menopause may not produce children.
4. Complete Table 2.10.

Table 2.10 *Minerals and Deficiency Diseases*

Minerals	**Importance**	**Deficiency disease**	**Sources**
....	....	Anaemia	Liver and meat
Iodine	....	Goitre	....
....	Bone formation	....	Milk and vegetables
Fluoride	....	Tooth decay	....

Reprint 2024

5. Copy and label Figure 2.17.

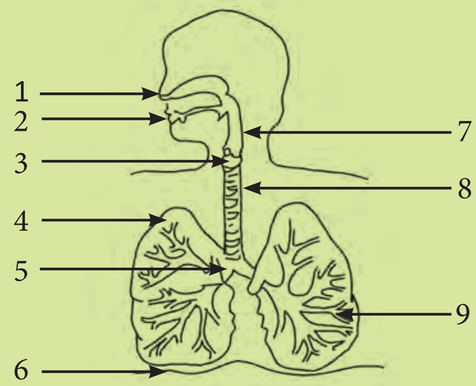


Figure 2.17.

6. Figure 2.18 shows a diagram of human reproductive system. Study it carefully and answer the following questions.

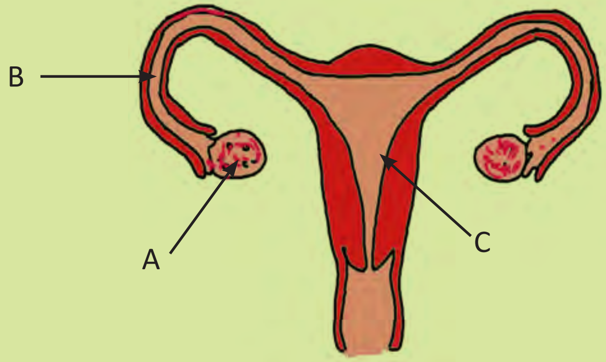


Figure 2.18.

   a. In which label does the development of embryo takes place?
   b. Write the function of the part labelled A.
   c. Name the organ system.
   d. What would happen if the part labelled B is cut off?

7. Name different types of nerves and write their functions.

8. A person is showing the following symptoms: chest pain, dry cough, loss of appetite, fever, fatigue and blood in the sputum.
   a. What could be the disease the person is suffering from?
   b. Suggest some ways to prevent this disease.

Reprint 2024

9. Case Study

HIV Infection: A Report

According to UNAIDS' estimations, there are less than 1,000 people living with HIV, and the total number identified as HIV positive in the country stands at 403 in 2015, since the first case was detected in 1993. The report mentioned that 91% of HIV infections are due to unsafe sexual practices such as multiple partners, casual sex and low condom use. Table 2.11 and Table 2.12 shows the HIV cases as per gender and the mode of transmission.

Table 2.11 *Case of HIV by Age Group*

Age group	Male	Female	Total
< 5 years	6	16	22
5-14 years	4	4	8
15-19 years	1	10	11
20-24 years	21	41	62
25-29 years	56	56	112
30-39 years	81	51	132
40-49 years	29	17	46
50+ years	6	4	10
	204	199	403

Table 2.12 *HIV Cases of HIV by Mode of Transmission*

Mode of Transmission	Total
Sexual route	91%
Mother to child	7%
Intravenous drug use (probable)	1%
Blood transfusion (outside)	1%
Other	2%
	100%

[*Source: National AIDS Control Programme, Department of Public Health, MoH.*]

Answer the following questions based on the above case study.

i. Insert the data from Table 2.12 in a spreadsheet and represent the information in a bar graph.

ii. Which age group has the highest number of AIDS patients?

iii. Identify the most prevalent mode of transmission.

iv. What are the main reasons for HIV infection?

Reprint 2024

Chapter 3
Green Plant

We know that all green plants synthesize their own food using carbon dioxide and water in the presence of sunlight. This process by which green plants manufacture food substance (glucose) from carbon dioxide and water using sunlight is known as **photosynthesis**. Hence, green plants are called producers or autotrophs.

1. Photosynthesis

Learning Objectives

On completion of this topic, you should be able to:

- explain photosynthesis.
- investigate factors that affect photosynthesis.
- write the word equation of photosynthesis.
- explain the importance of photosynthesis.

WEBLINK
http://www.biology4kids.com/files/plants_photosynthesis.html
http://dendro.cnre.vt.edu/forestbiology/photosynthesis.swf

Reprint 2024

The process of photosynthesis is represented by the following equation:

$$\text{Carbon dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Glucose} + \text{Oxygen} + \text{Water}$$

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Most green plants convert glucose into starch as soon as it is formed during photosynthesis. Several molecules of glucose combine to form starch. The major portion of the oxygen produced during photosynthesis diffuses out into the atmosphere through stomata. The water produced during photosynthesis may be used again in the process or lost in the form of vapour.

Activity 3.1. Photosynthesis

Figure 3.1 represents the process of making food by green plant. Use this diagram to answer the following questions.

i. Identify any two materials shown in the diagram that the plant needs for making food.
ii. Which part of the plant is directly involved in making food?
iii. Name the gas given out by the rat which is used by the plants in producing its food.
iv. Define the process taking place.

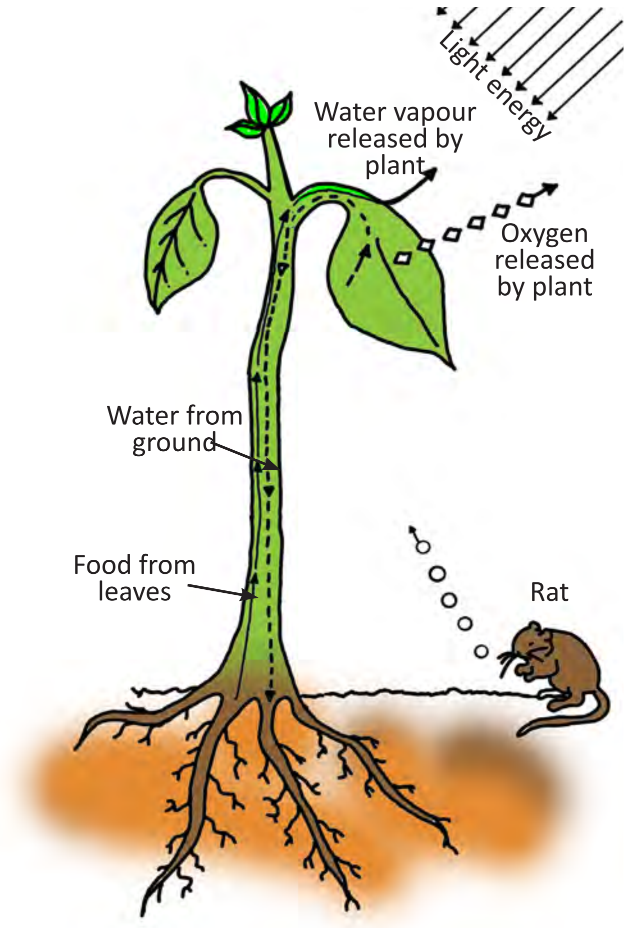


Figure 3.1. Process of making food by green plant.

Carbon dioxide from the air enters the leaf by diffusion through small openings, called **stomata**, present on the surface of the leaf. Plants absorb water from the soil through their roots. This water is then transported to the leaves through small tube called **xylem.**

Activity 3.2 Openings in a leaf

Materials required

Microscope, glass slide, water, forceps and green fleshy leaf.

Procedure

Step 1. With the help of forceps, take a peel from the dorsal side of the green fleshy leaf.

Step 2. Mount it on the glass slide containing a drop of water. Make sure it lies flat and not folded.

Step 3. Observe it under the microscope.

Step 4. Draw the bean seed shaped structures that you see. These structures are called **guard cells**. The opening between the guard cells is called **stoma** (plural: stomata).

Activity 3.3. Is sunlight necessary for photosynthesis?

Materials required

Potted plant, black paper, scissors, paper clip, iodine solution, dropper, petri dish, beaker, spirit lamp, spirit, test tube, test tube holder, forceps, water wire gauze, tripod stand and match box.

Procedure

Step 1. Keep the potted plant in a dark place for two to three days.

Step 2. Cover one of its leaves with black paper on which a design is cut as in Figure 3.2. Support the paper with the clips. The leaf should remain attached to the plant.

Step 3. Keep this plant in the Sun for 4 to 6 hours.

Step 4. Pluck the leaf covered by the black paper and test it for the presence of starch (iodine test).

Reprint 2024

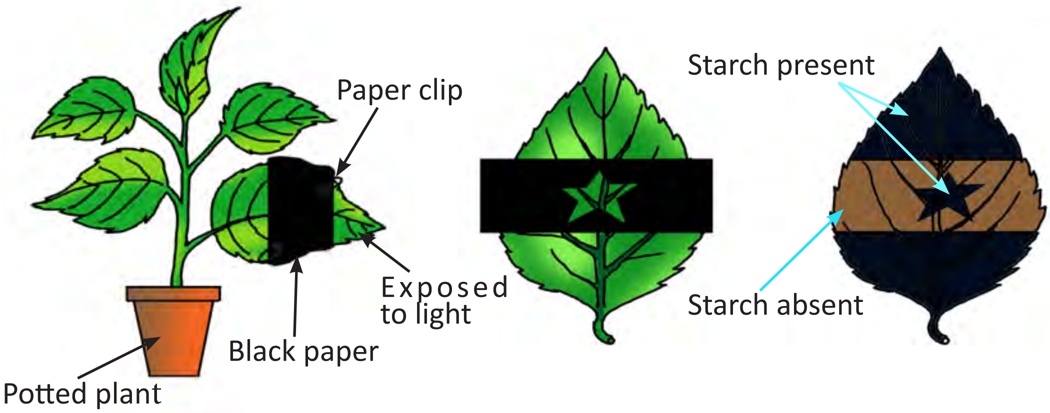


Figure 3.2. Sunlight for photosynthesis.

Answer the following questions based on Activity.3.3

i. What did you observe during the iodine test? Give reasons for your observation.
ii. What can you conclude from the experiment?
iii. Why was black paper used to cover the leaf?
iv. Why was plant kept in the dark place for two to three days?
v. Can you repeat this experiment outside with any plant from your school garden? Why?

Activity 3.4. Is carbon dioxide necessary for photosynthesis?

Materials required

Potted plant, conical flask, split cork, potassium hydroxide (KOH), iodine solution, dropper, spirit lamp, petri dish, beaker, test tube holder, forceps, water, match box, wire gauze , tripod stand and petroleum jelly.

Procedure

Step 1. Keep the potted plant in a dark place for two to three days.

Step 2. Insert one of its leaves through a split cork into the conical flask containing potassium hydroxide (potassium hydroxide absorbs carbon dioxide).The leaf should remain attached to the plant. Make the mouth of the conical

Reprint 2024

flask air tight by using petroleum jelly.

Step 3. Keep the set-up in the sunlight for 4 to 6 hours.

Step 4. Take the leaf from the conical flask.

Step 5. Take one more leaf from the same plant.

Step 6. Test both the leaves for presence of starch.

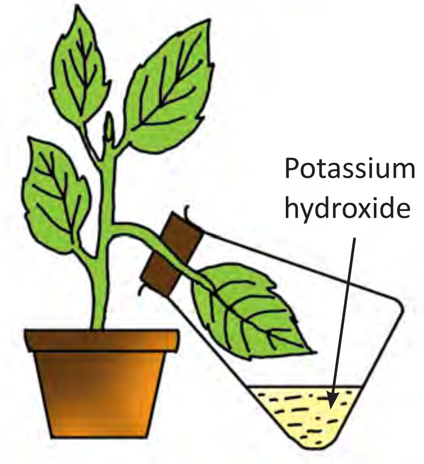


Figure 3.3. Carbon dioxide for photosynthesis.

Answer the following questions based on Activity 3.4.

i. Suggest a possible hypothesis for the experiment.
ii. Write your observations made in the two leaves during the iodine test.
iii. Give reasons for the observations.
iv. What do you infer from the experiment?
v. Why is the mouth of the conical flask made air tight?
vi. What difference will you notice in the result if sodium hydroxide is used instead of potassium hydroxide?

Activity 3.5. What gas is produced during photosynthesis?

Materials required

Beaker, beehive self , test-tube, funnel, water, glowing splint, spirit lamp, match box and aquatic plant.

Procedure

Step 1. Place the beehive shelf at the bottom of the beaker. Place the aquatic plant in such a way that its cutting ends remain towards the stem of the funnel and cover with the funnel.

Step 2. Pour water into the beaker in such a way that the stem of the funnel remains beneath the water level.

Step 3. Fill the test tube completely with water.

Step 4. Place your thumb on the mouth of the test tube so that no air enters the test tube. Carefully invert the test tube over the stem of the funnel as shown in the Figure 3.4.

Step 5. Place the apparatus in sunlight and observe it for about ten minutes.

Step 6. Lift the test tube from the water and test the gas immediately by bringing a glowing splint near the mouth of the test tube.

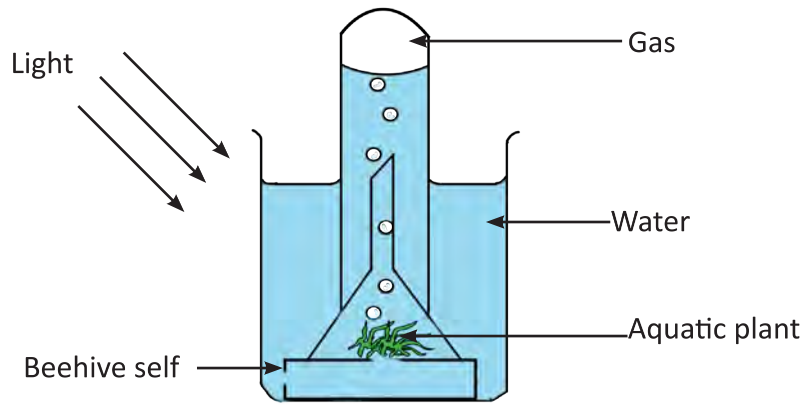


Figure 3.4. Gas produced during photosynthesis.

Answer the following questions based on Activity 3.5.

i. Suggest a hypothesis for the above experiment?
ii. What happens to the level of water in the test tube after some time? Give reason.
iii. What happens to the glowing splint when brought near to the mouth of the test tube?
iv. Name the gas collected in the test tube.
v. What precautions should be taken during the experiment?

Importance of photosynthesis

i. Provides food: Photosynthesis is the process by which food is produced for all living things.

ii. Provides oxygen: During photosynthesis oxygen is released into the

Questions

1. What is photosynthesis?
2. Life cannot be possible without green plants. Give reasons.

2. Nutrients for Plants

Learning Objectives

On completion of this topic, you should be able to:

- identify some of the essential nutrients for plants and their sources.
- categorise plant nutrients into macronutrients and micronutrients.
- identify deficiency symptoms of primary nutrients in plants.

Besides sunlight, carbon dioxide and water, plants also require certain elements for their normal growth and development. These elements are called **nutrients**. The nutrients found in the soil are absorbed by the roots of plants in the form of solution. The soil obtains these nutrients from the decayed plants and animals, or from fertilisers. When plants do not get the right amount of nutrients, they become unhealthy and show deficiency symptoms.

Plants require as many as seventeen essential nutrients for growth, which are divided into two groups: macronutrients and micronutrients.

Macronutrients are those nutrients, which are required by plants in large amounts. They are further categorized into primary nutrients and secondary nutrients.

Primary nutrients are those nutrients without which plants cannot grow at all. The primary nutrients are nitrogen (N), phosphorous (P), and potassium (K) as given in Table 3.1.

Table 3.1 *Primary Nutrients for Plants*

Nutrient	Source	Role	Deficiency Symptoms
Nitrogen	Manure, compost, leguminous plants, chemical fertilizers such as urea, ammonium nitrate	• formation of chlorophyll • proper growth of leaf and stem • formation of better quality seeds and fruits	• yellowing of leaves(chlorosis) due to decrease level of chlorophyll • stunted growth with few branches and leaves • reduced yields

Reprint 2024

Phosphorous	Bone meal*, superphosphate, ammonium phosphate, compost and manure	• proper seed germination, photosynthesis and growth of plants • formation of flower, fruit and root • increases the plant's resistance to pests and diseases	• green stems and leaves turn purple • retarded growth and maturity • poor yields of fruits and flowers • premature falling of leaves
Potassium	Compost, manure, wood ash, potash, potassium nitrate	• development of flower and fruit	• margins and tips of leaves become brown (scorching) • plants become susceptible to drought and pest

Secondary nutrients are those nutrients, which are required by plants for their proper growth and development. The important secondary nutrients, sources,their roles,and deficiency symptoms are given in Table 3.2.

Table 3.2 *Secondary Nutrients for Plants*

Nutrient	Source	Role	Deficiency Symptoms
Calcium	Gypsum, calcium sulphate	• formation of cell membrane and cell wall • development of pollen • formation of root and shoot tips	• loss of chlorophyll along the margin of young leaves • slow growth with short root and stem • premature falling of fruit

* **Bone meal:** *organic fertilizer of powdered animal bones .*

Magnesium	Manure, compost, dolomite	• formation of chlorophyll	• yellowing between leaf veins (chlorosis) • underdeveloped fruit
Sulphur	Potassium sulphate, magnesium sulphate, gypsum	• formation of chlorophyll	• yellowing of plants • stunted growth • low crop yield

Micronutrients are those nutrients, which are required by plants in small amounts only.

Activity 3.6. Micronutrients and deficiency symptoms

Find information on the roles of micro-nutrients and their deficiency symptoms. Copy and complete Table 3.3.

Table 3.3 *Micronutrients and their deficiency Symptoms*

Sl No	Nutrient	Source	Role	Deficiency Symptom
1	Iron	Iron sulphate		
2	Copper	Copper sulphate, copper chelates		
3	Boron	Manure, compost		
4	Chlorine	Fertilizers containing chlorine		
5	Manganese	Manure, forest leaf mold, manganese chloride		
6	Zinc	Zinc sulphate		
7	Molybdenum	Lime		

Reprint 2024

Activity 3.7. Investigating the deficiency of primary nutrients in plants

Materials required

Soil testing kits, soil samples and beakers.

Procedure

Step 1. Collect soil samples from three different areas where plants are grown.

Step 2. Observe the deficiency symptoms in plants grown in each of these areas.

Step 3. Carry out soil test for the three primary nutrients as per the instructions in soil testing kits.

Step 4. Tabulate the information as per Table 3.4.

Table 3.4 *Soil Test*

Soil Sample	Deficiency Symptoms in Plants (colour of leaves, strength of stem, shapes and number of leaves, etc.)	**Deficient Nutrient**	
		Predictions Based on the deficiency Symptoms	Results shown by the Soil Test
Sample A			
Sample B			
Sample C			

i. Write down the inferences you made for the investigation?

ii. What can you conclude from the experiment?

http://www.kscience.co.uk/animations/photolab.htm
http://www.awesomestories.com/assets/photosynthesis-animation-plant-biology
http://www.learnerstv.com/animation/animation.php?ani=%20179&cat=biology
http://www.kscience.co.uk/animations/photosynthesis.htm

Reprint 2024

Questions

1. Study Figure 3.5. Leaf A is a healthy leaf. Complete the following table for leaf B, C, D and E.

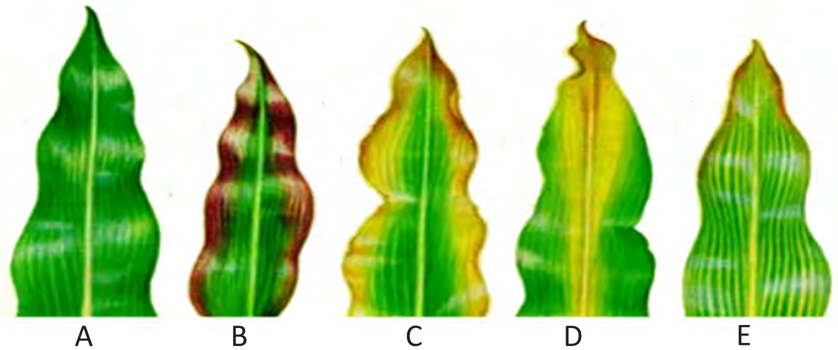


Figure 3.5.

Table 3.5

Leaf	Deficiency Symptom	Nutrient Absent
B		
C		
D		
E		

2. During a science lesson in school agriculture garden, Dorji noticed a plant X with yellow leaves. Dorji concluded that plant X lacked some nutrients, although it received enough sunlight, water and carbon dioxide.
   i. Name the nutrient deficient in plant X.
   ii. How can you improve the health of plant X?

http://www.kscience.co.uk/animations/minerals.htm

Reprint 2024

3. Respiration in Plants

Learning Objectives

On completion of this topic, you should be able to:

- explain the process of respiration.
- differentiate between aerobic and anaerobic respiration in the plants.
- investigate that oxygen is used in respiration by germinating seeds.
- investigate that carbon dioxide is produced during respiration in plants.

Like animals, plants also require energy to perform various activities. This energy is made available by the process of respiration.

In plants, all living cells of roots, stems, leaves, buds, germinating seeds, and fruits respire day and night. During respiration, the plant takes in oxygen mainly through stomata and root surfaces. The oxygen then enters the cell and diffuses into mitochondria where respiration takes place. During day, photosynthesis occurs in plants releasing oxygen, some of which is used in respiration. The carbon dioxide produced during respiration is used as one of the raw materials for photosynthesis.

Types of Respiration

Respirations in organisms are of two types:

Aerobic Respiration

Aerobic respiration is a chemical process that uses oxygen to break down digested food (glucose) to release energy. It takes place in the mitochondria of the cells. The equation for this reaction is:

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon dioxide} + \text{Water} + \text{Energy}$$

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Reprint 2024

Anaerobic Respiration

Anaerobic respiration is the respiration that does not require oxygen to oxidise food substance to produce energy. The food is not completely broken down in this process, and the end products are energy, carbon dioxide and ethyl alcohol. Example: Fermentation.

$$\text{Glucose} \xrightarrow{\text{Yeast}} \text{Ethyl alcohol + carbon dioxide + Energy}$$

$$C_6H_{12}O_6 \xrightarrow{\text{Yeast}} 2C_2H_5OH + 2CO_2 + \text{Energy}$$

Activity 3.7. What gas is used in respiration?

Materials required

Bean seeds, two conical flasks, thread, two beakers, two delivery tubes, two corks, two small test tubes, potassium hydroxide (KOH), water, cotton and petroleum jelly.

Procedure

Step 1. Take a conical flask and spread a thin layer of wet cotton in the bottom of the flask.

Step 2. Put 10 soaked bean seeds in the flask.

Step 3. With the help of a thread, suspend a small test tube containing KOH in the flask as shown in Figure 3.6.

Step 4. Insert one end of the delivery tube through the hole of the cork and dip the other end in the beaker containing water as shown in Figure 3.6.

Step 5. Make the apparatus air tight using petroleum jelly.

Step 6. Name this as set-up A.

Step 7. Similarly, arrange set-up B with 10 boiled bean seeds as shown in the Figure 3.6

Step 8. Mark the level of the water in the delivery tubes in both the set-ups.

Step 9. Keep the set-ups in a safe place for a few days and observe.

Reprint 2024

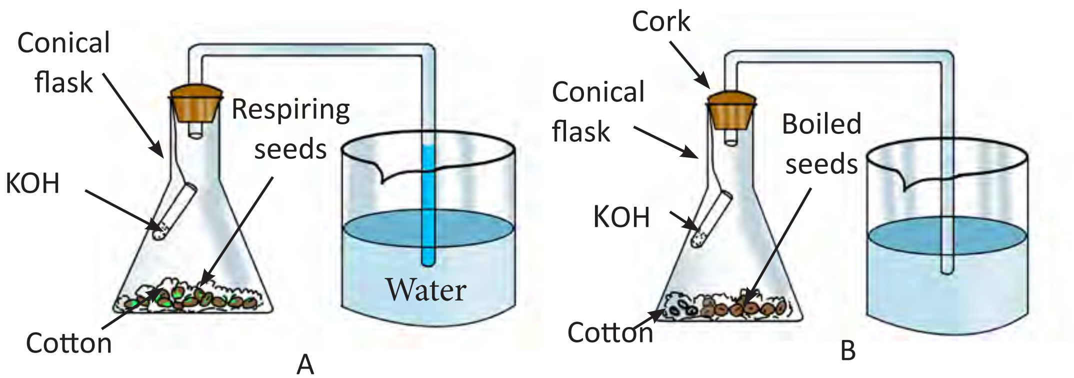


Figure 3.6. Demonstration of aerobic respiration.

i. What happens to the level of water in the delivery tubes in set-up A and set-up B?
ii. Give reasons for the observations made.
iii. Which set-up acts as a control in the experiment?
iv. Why is petroleum jelly used in the experiment?
v. What do you infer from the experiment?

Activity 3.8. What gas is given out during respiration?

Materials required

Germinating seeds, test tubes, corks, lime water, cotton, boiled seeds and water.

Procedure

Step 1. Set up the apparatus as shown in Figure 3.7.

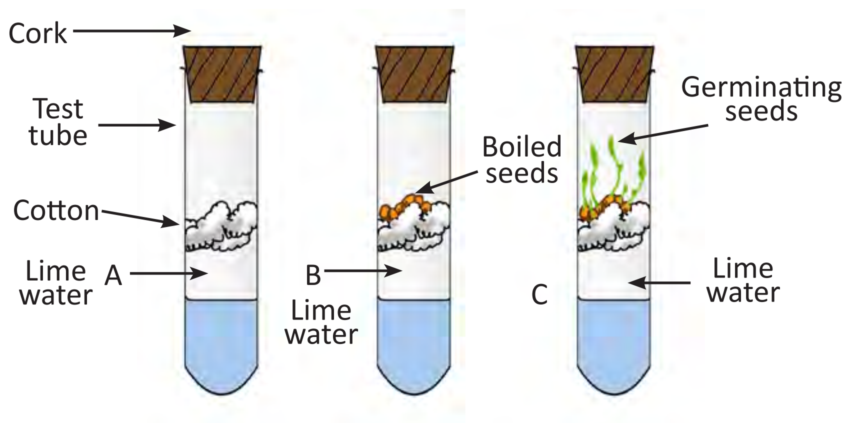


Figure 3.7. Respiration by germinating seeds.

Reprint 2024

Step 2: Leave the seeds for 2 to 3 days and make sure the seeds are kept damp.
Step 3: Observe the lime water after 2 to 3 days.

i. At the end of experiment, what changes do you observe with the lime water in test tubes A, B and C?
ii. Give reason for observation made in test tubes A, B and C.
iii. What can you conclude from the experiment?

Questions

1. What is respiration?
2. A student sets up the experiment as shown in Figure 3.8. Containers A and B contain 100 mL of water and 5 drops of methylene blue each. Methylene blue is a chemical that becomes blue when oxygen is present, but is colourless when oxygen is not present. Ten germinating mustard seeds are added to the container A. Container B has no mustard seeds.

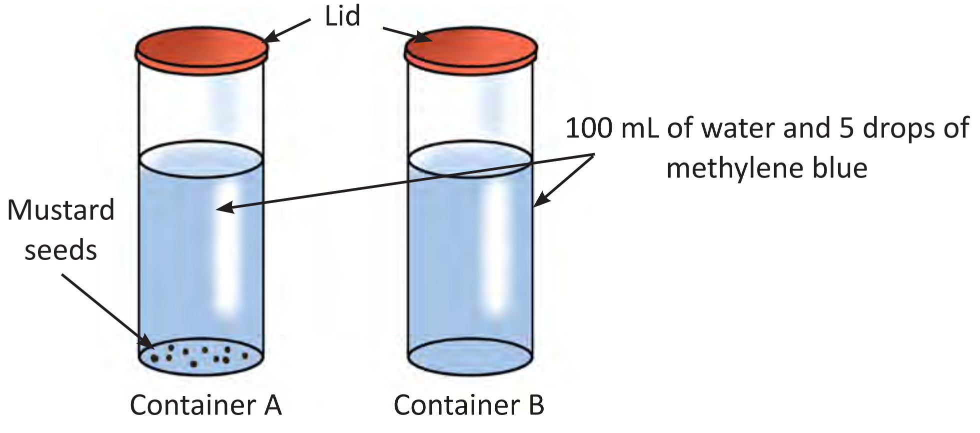


Figure 3.8.

   i. What would be the colour change of methylene blue in container A and B? Explain your observations.
   ii. What is the purpose of container B?
   iii. What conclusions can you draw from the experiment?
   iv. What is the aim of experiment?

4. Germination

Learning Objectives

On completion of this topic, you should be able to:

- explain germination.
- identify types of germination as epigeal and hypogeal.
- demonstrate epigeal and hypogeal germinations in bean and pea seeds.
- investigate conditions necessary for germination.

Seeds are the main source of reproduction in plant. Seeds contain embryo which develops into a seedling. A mature seed undergoes a period of rest called **dormancy**. It remains dormant until the conditions are favourable for the germination. **Germination** is the process by which a dormant seed grows to a young plant or seedling.

The seed consists of fleshy structures called **cotyledons**. Cotyledons store food for the developing embryo. The embryo has two parts: the **radicle** and the **plumule**. The radicle grows into the root system and the plumule grows into the shoot system of the seedling.

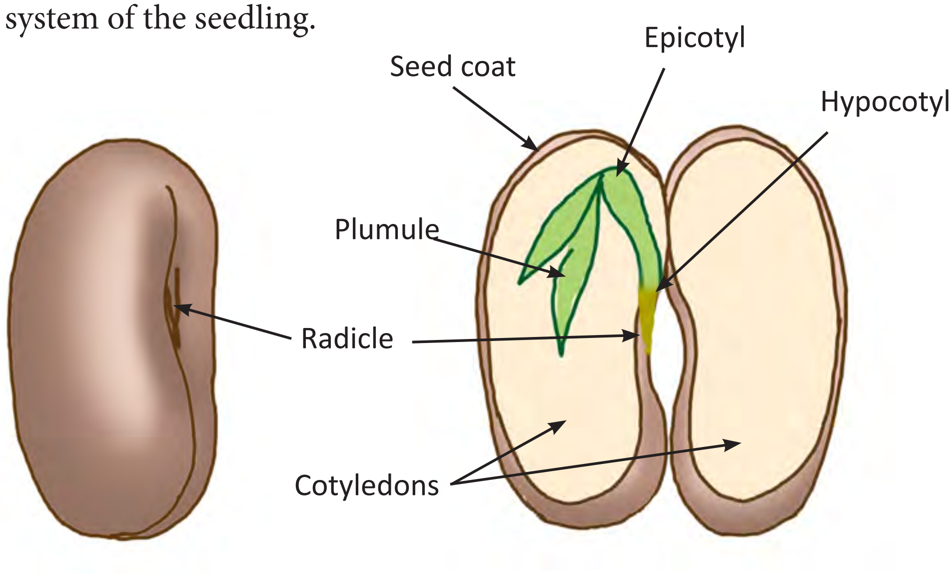


Figure 3.9. Structure of a bean seed.

1. Types of Germination

Germination of seed is of two types based on the position of the cotyledons. They are epigeal germination and hypogeal germination.

Epigeal germination is the type of germination where hypocotyl elongates first and pushes the cotyledons above the surface of soil. This type of germination is seen in the germination of seeds of castor, cotton, tamarind, papaya, etc.

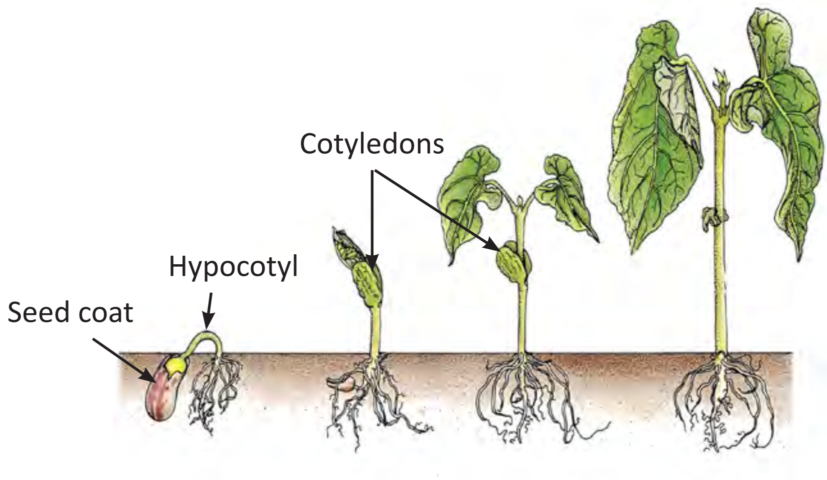


Figure 3.10. Epigeal germination.

Hypogeal germination is the type of germination where epicotyl elongates first and the cotyledons remain under the soil. Common examples of hypogeal germination are seen in the germination of seeds of pea, mango, rice, groundnut, etc.

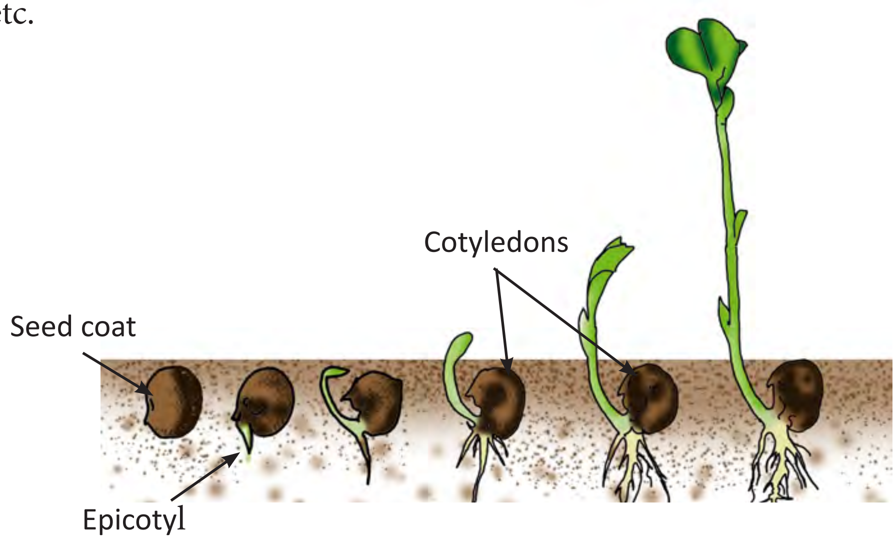


Figure 3.11. Hypogeal germination

Reprint 2024

Activity 3.9. Investigating germination

Materials required

Bean seeds, maize seeds, beaker and garden soil

Procedure

Step 1. Take two beakers and fill them with garden soil.

Step 2. Sow three to four bean seeds in one beaker and maize seeds in another, with just enough soil to cover the seeds.

Step 3. Sprinkle water to moisten the soil and keep the setups in a safe place in your class room.

Step 4. Water the soil daily to keep it moist.

Step 5. Observe the setups regularly for about a week. Once the seeds start to germinate, record your observations in Table 3.5.

Table 3.6 *Types of Germination*

Seed type	Position of Cotyledon	Type of Germination
Bean		
Maize		

Share your findings to your class.

i. Draw the bean and maize seeds to show the types of germination as per your observation.
ii. Explain the differences in the germination of seeds in the two set-ups.
iii. What is the importance of cotyledons in the germination of seeds?

http://www.passmyexams.co.uk/GCSE/biology/aerobic-and-anaerobic-respiration.html
http://science.howstuffworks.com/life/30704-assignment-discovery-germination-of-a-seed-video.htm

Reprint 2024

2. Conditions Required for Germination

Activity 3.10. Investigating conditions required for germination

Materials required

Bean seeds, glass slide, water, thread and beaker.

Procedure

Step 1. Take three bean seeds and tie it to a glass slide at three positions as shown in Figure 3.12.

Step 2. Place this slide in a beaker containing water in such a way that Seed A is out of water, Seed B in the middle is partially submerged in water where as Seed C is completely submerged in water.

Step 3. Place the set up in a warm room for a few days.

Step 4. Add water from time to time so that the level of water remains the same.

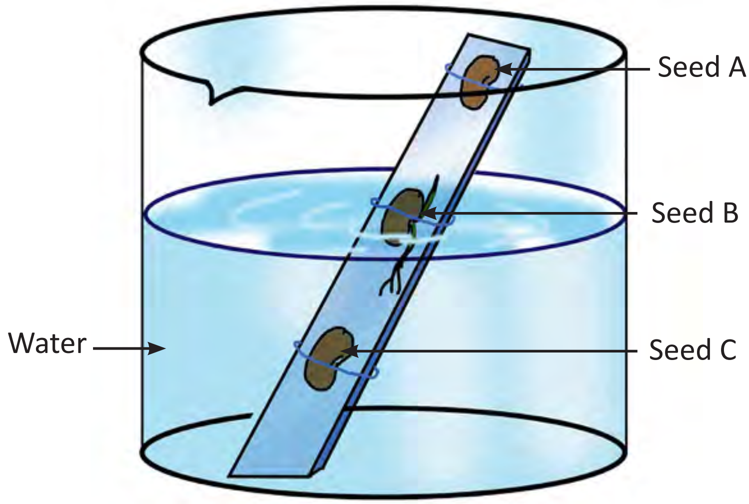


Figure 3.12. Investigating Germination.

i. What do you observe in seed A, B and C? Give reasons for your observation for each seed.
ii. What can you conclude from the experiment?

Reprint 2024

The germination of seeds occurs only in the presence of water, oxygen, suitable temperature and light.

Water: When dry seed comes in contact with water, it starts to swell and the seed coat breaks open. Then the seed starts to germinate into seedling.

Oxygen: The embryo requires energy to develop into a new plant. This energy is obtained from the food in cotyledons by the process of respiration. Therefore, oxygen is necessary for germination.

Temperature: The germination is inhibited if the temperature is too high or too low. Different groups of plants have different range of optimum temperature for the germination. The optimum temperature ranges from 15°C to 30°C.

Light: Most seeds will germinate quite easily absence of light. However, some seeds like the seeds of tobacco plant and birch tree need to be exposed to the light for a certain time before they germinate.

Questions

1. Define germination.
2. Why do you think that oxygen is necessary for the germination?
3. Study the diagram in Figure 3.13 and answer the questions that follow.

Seed A

Seed B

Figure 3.13.

   a. Identify the type of germination in seed B.
   b. Name two plants in which germination is of seed A type.
   c. In what ways, germination is different in seed A and seed B.

Reprint 2024

Exercise

Fill in the blanks.

1. The small openings in leaf through which carbon dioxide diffuses is called ....
2. The small tube through which water is transported to leaves from lower part of the plant is called...................
3. The optimum temperature for seed germination ranges from................ to...............
4. A cell organelle in which respiration takes place is ....
5. A mature seed undergoes a period of rest called...................................

Check whether the following statements are True or False. Correct the false statements.

1. Type of germination seen in pea is epigeal.
2. Anaerobic respiration is the type of respiration that does not require oxygen.
3. Macronutrients are those nutrients which are required by plants in small quantities.
4. Oxygen is given out during seed germination.
5. The role of potassium hydroxide is to absorb carbon dioxide produced during respiration in the experiment.

Match the Following

Column A	Column B
1. Nitrogen	A. Dolomite
2. Phosphorous	B. Gypsum
3. Potassium	C. Bone meal
4. Calcium	D. Wood ash
5. Magnesium	E. Urea

Reprint 2024

Answer the following questions

1. Name the following:
   i. The category of organisms that prepare their own food from basic raw materials.
   ii. The food substance which is oxidised during respiration.
   iii. The part of the embryo which develops into root system.
2. Study the food chain given below:

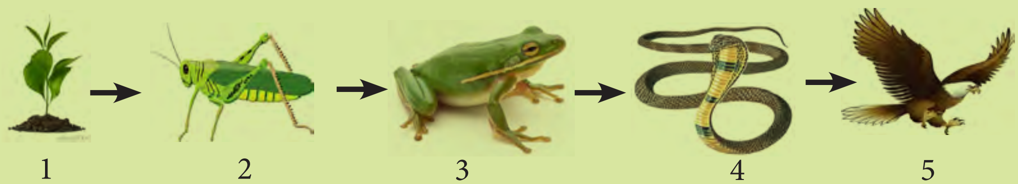


Figure 3.14.

   i. Which biological process is the starting point of the whole chain?
   ii. Name one natural element produced by organism 1, which is required by all the other organisms for their survival.
3. Does photosynthesis occur in mushroom? Give a reason to support your answer.
4. Based on Figure 3.15, frame a word equation of the process.

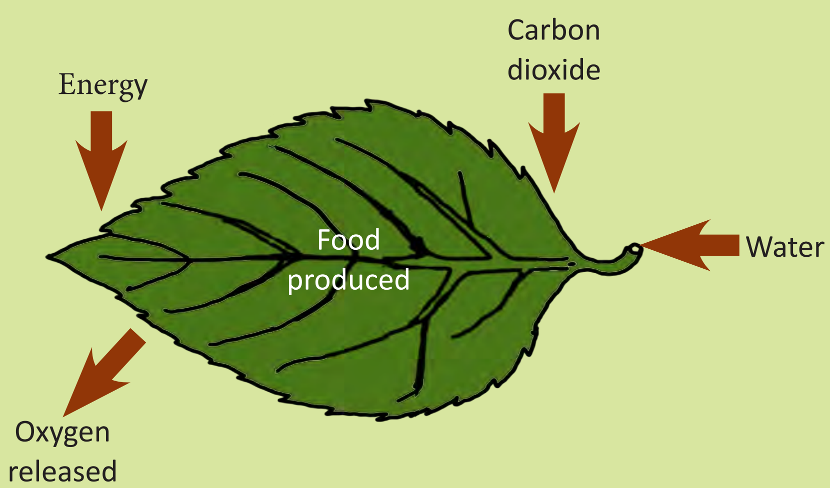


Figure 3.15.

Reprint 2024

5. A student set up an experiment to learn about plant growth. The student added different amount of water to four identical containers, each containing four seeds in 100 cubic centimetres of dry soil as shown in Figure 3.16. All of the containers were placed in the same sunny location.

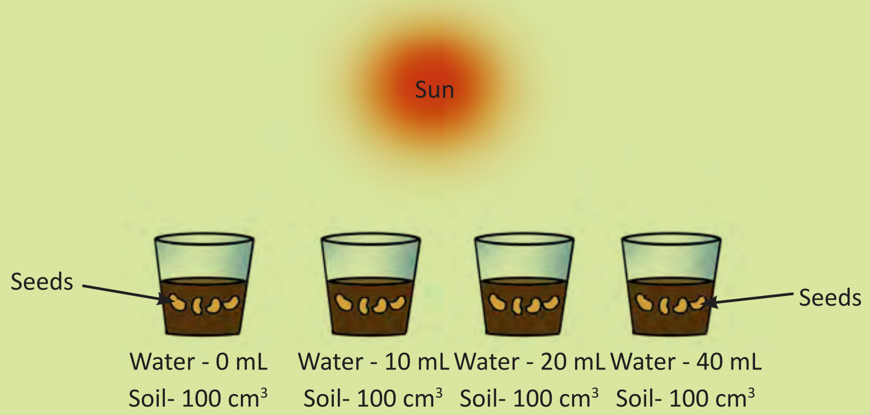


Figure 3.16.

i. State a hypothesis being tested in this experiment.
ii. Identify one variable that is being held constant in this experiment.
iii. Explain why this variable needs to be held constant.

Chapter 4
Living Things and their Environment

The Earth is a living planet with variety of organisms. These organisms have complex relationships amongst each other. The variety of life on Earth and its patterns of natural phenomena are the results of billions of years of evolution. It is the combination of all life forms and, their interactions with each other and with the rest of the environment that has made the Earth, a unique place.

All organisms have adaptive features that help them to survive on the Earth. Living organisms must adapt to the constantly changing environment of the Earth. Organisms that are better adapted to their environment survive and reproduce, while those that are not well adapted to their environment either struggle to survive or die.

1. Adaptation and Variation

Learning Objectives

On completion of this topic, you should be able to:

- explain adaptation and variation.
- identify adaptive features of some animals.
- explain species and evolution.

In lower classes, you have learnt about different types of habitats and adaptations in plants and animals. A habitat is a place where organisms survive and reproduce. Each organism is adapted to live in a particular habitat. Everything that surrounds an organism and has influence on their life is known as its environment.

Reprint 2024

a. Adaptation

Did you ever think why yaks survive in the high altitudes? Yaks survive in high altitude due to their adaptive features. The ability of an organism to adjust suit with their changing environment is called **adaptation**. Plants like cactus are adapted to grow in dry conditions, while lotus are adapted to grow in water. Animals such as fish and turtle are adapted to live in water where as camels are adapted to live in desert. How are birds adapted to fly?

Some animals have adaptive features to overcome the extreme cold, like the polar bear. They undergo a long resting state (inactive) during winter called **hibernation**. Similarly, there are animals like salamander and crocodile that overcome the heat in summer by undergoing a resting state called **aestivation**.

What are the special features that enable us to survive?

Activity 4.1. Identifying adaptive features

1. Identify the birds given in Figure 4.1 base on their adaptive features.

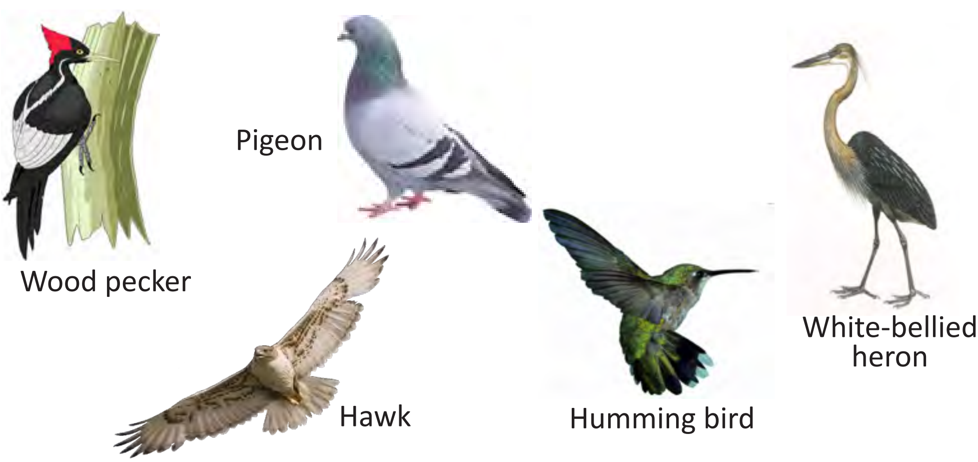


Figure 4.1. Adaptive features of birds.

   a. Climbs the tree trunk and picks insects from cracks in the bark.
   b. Feeds on grains.
   c. Feeds on fish.
   d. Feeds on smaller animals.
   e. Feeds on nectar of flowers.

2. Write the adaptive features that enables each bird to feed on the particular type of food.

Reprint 2024

b. Variation

Figure 4.2. Variation among individuals.

Variation is the occurrence of differences amongst the individuals of a species.. Each one of us is different from the other. Even the offspring of same parents are different. For example, faces of two children of the same parents may be different. Variation arises in nature due to change in cellular materials. Generally, this change in cellular materials are brought about by change in environment.. Variation over a long period of time leads to formation of new species of organisms. The formation of new species is called **evolution**. It is a slow and long process that changes animals and plants. For instance, human evolution took approximately six million years.

Species is a group of organisms that resemble one another, and are able to breed and reproduce fertile offspring among themselves. For example, all dogs are of same species (*lupus familiaris*) and they can interbreed and produce fertile offspring. However, horse (*caballus*) and donkey (*africanus asinus*) are of different species, which can interbreed but do not produce fertile offspring.

Activity 4.2 Understanding Variations

Compare the features of two cows in your locality and complete Table 4.1.

Table 4.1 *Variation in Cow*

Sl No.	Questions	Yes/No
1	Do they have same hair colour?	
2	Do they have same eye colour?	
3	Do they have same sized horn?	
4	Do they have same face structure?	
5	Do they have same body size?	

i. What differences do you see between the cows?

ii. What can you conclude?

Reprint 2024

Questions

1. A list of description of plants and animals faced with special conditions that require adaptation in order to survive. Imagine and draw a plant or animal using MS paint or any other drawing software with special adaptive features as per the description given.
   - i. An animal that lives in an area with heavy snowfall.
   - ii. A plant that lives in a region with less rainfall.
   - iii. A bird that is a predator.
   - iv. An animal which lives in water.
2. Deer and goat look similar, but they do not belong to the same species. Why?

WEBLINK

http://www.britannica.com/EBchecked/topic/5263/adaptation

2. Ecosystem and its Components

Learning Objectives

On completion of this topic, you should be able to:

- explain ecosystem.
- identify a few ecosystems in your locality.
- identify food chains in a food web.
- represent food chains using pyramids of numbers.
- explain how humans affect the balance of nature.

The ecosystem is a community of living things and their surroundings. It consists of two components: biotic and abiotic. Biotic components include all the living organisms like plants and animals, while abiotic components include non-living components like air, water, light, etc.

Biotic components of an ecosystem can be classified into three groups:

Producer: They include all green plants, which can prepare their own food by the process of photosynthesis. They are also called autotrophs. They are the main source of food for other organisms.

Consumers: They are the organisms that depend directly or indirectly on producers. They are also called heterotrophs. Consumers can be herbivores, carnivores, omnivores and decomposers.

Decomposers: They are organisms that consume and break down dead and decaying organisms. Bacteria and fungi are some examples of decomposers.

In nature, there are many types of ecosystems. These ecosystems can be categorised into two broad systems.

Natural ecosystem: It consists of terrestrial and aquatic ecosystem such as forest, grassland, desert, hillside, pond, river, lake and ocean.

Man-made ecosystem: It is an ecosystem created by human beings. Some examples are garden, park, crop field and aquarium.

Reprint 2024

Activity 4.3. Your campus, your classroom

Step 1. Go around the school campus.

Step 2. Identify different ecosystems.

Step 3. Choose one of the ecosystems and list down what you see.

Answer the following questions.

i. From the list prepared, categorise them into biotic and abiotic components.

ii. How are biotic and abiotic components dependent on one another?

a. Food Chain

The Activity 4.3 shows, how the biotic and abiotic component of ecosystem are depended on each other? One of them is through the food chains. It is a feeding relationship, which represents the flow of energy between living organisms in an ecosystem. A food chain always begins with a producer followed by a herbivore and then a carnivore.

In a food chain, each step represents a trophic level. A **trophic level** is the feeding position in a food chain such as producers, herbivore, carnivore, etc. Green plants form the first trophic level. Herbivores form the second trophic level, while carnivores form the third and the higher trophic levels.

Trophic levels and the energy flow from one level to the next in a food chain can be shown graphically. This graphical representation is called **ecological pyramid**. Ecological pyramids are of three types: pyramid of numbers, pyramid of biomass and pyramid of energy.

You have learnt in class six that the pyramid of number shows the decrease in number of organisms as you move to higher trophic levels.

By referring Figure 4.3, explain the pyramid of biomass and pyramid of energy.

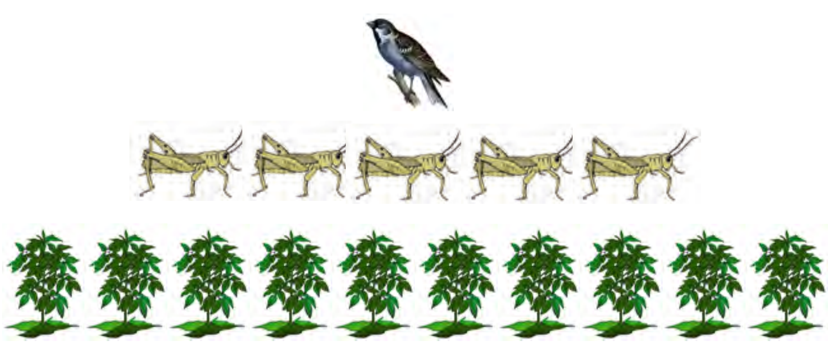


Figure 4.3. Pyramid of number.

Reprint 2024

Activity 4.4. Constructing food chain.

Procedure

Step 1. Visit your school garden.

Step 2. List down plants and animals that you see around.

Step 3. Construct two food chains from the list.

Questions

Read the information about feeding relationship carefully and answer the following questions.

a. Greenflies and moth larvae feed on oak tree leaves.
b. Ladybirds feed on greenflies.
c. Woodpecker feeds on greenflies, moth larvae and ladybirds.
d. Hawks prey on woodpecker.

i. Draw a food chain using the information from a to d.
ii. Identify the producer.
iii. What will happen if ladybirds, moth larvae and green flies are removed from the food chain?
iv. Construct a pyramid of biomass using the organisms from the food chain.

b. Food Web

In nature, an organism feeds upon several organisms of the lower trophic level, or, the same organism is eaten by several organisms of a higher trophic level. All the food chains are inter-connected and they intersect with each other like the web of a spider, forming a complete feeding relationship. This inter-connection of food chains is called **food web**. Figure 4.4 represents a food web.

Reprint 2024

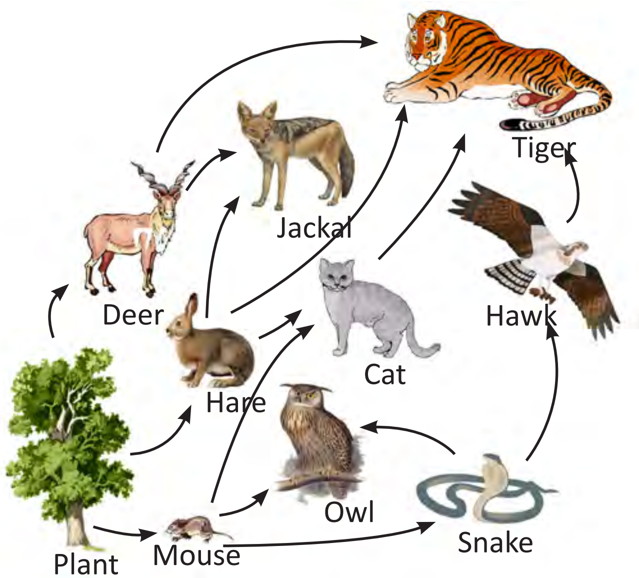


Figure 4.4. Food web.

Activity 4.5. Identifying feeding relationships

Procedure

Step 1: Copy Figure 4.5 representing different feeding habit of organisms and fill in the circle with an example each.

Step 2: Draw arrows to find different feeding relationships among them.

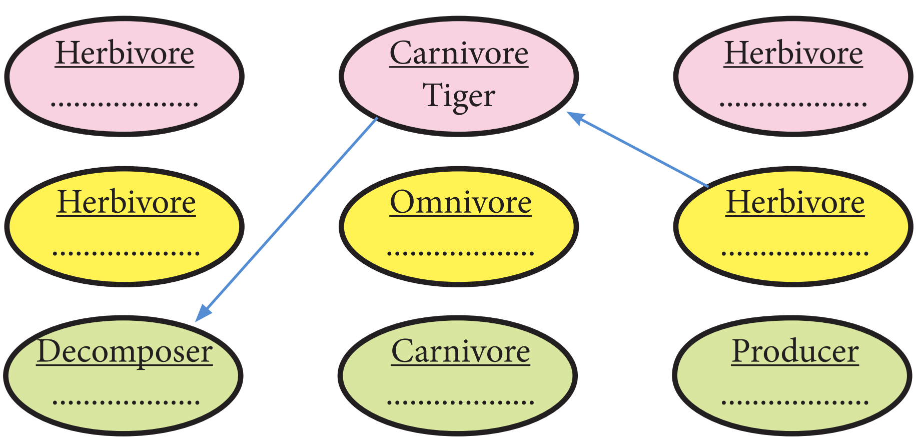


Figure 4.5. Feeding habits.

1. How does the figure look like after all arrows have been drawn? Suggest a name for it.
2. Which organisms have the maximum feeding options?

c. Balance in nature

The balance in nature is maintained by the interaction of both living and non living thing. Nature tries to maintain the balance in the ecosystem where organisms coexist without affecting the existence of others. This is called ecological balance. For example, plants are grown by farmers in a field. These plants are eaten by insects. The insects in turn are eaten by birds. Birds are eaten by other predators. This food chain and such other inter relationships create balance in the ecosystem. On the other hand, if the number of birds is decreased, the population of insects will increase. Consequently, there will be more number of insects feeding on the plants in the field causing more damage to the crops. If the crops are destroyed, humans and other animals will not get sufficient food. Therefore, if any part of the ecosystem is disturbed, it causes ecological imbalance in the nature.

The natural balance in the ecosystem is disturbed by various human activities such as deforestation, mining, dam construction, establishment of industries, use of chemical substances in farming, including ineffective waste management.

Activity 4.6. Identifying threats to ecological balance due to human interference

Go to the school library or browse internet to find out information for the following questions.

i. Identify five prominent threats to the ecological balance brought about by human activities in Bhutan.
ii. What are the perceived consequences of the above threats on the lives of Bhutanese?
iii. Explain the strategies adopted by the government to minimize each of the threats.

Reprint 2024

Figure 4.6. Climate Change and Bhutan.

Figure 4.7. Climate Change and Bhutan.

Reprint 2024

Activity 4.7. Climate change and Bhutan

Questions

Study Figure 4.6 and Figure 4.7 in small groups and answer the following questions.

1. Explain global warming and climate change.
2. Identify the sources that emit GHG.
3. What are the human activities, which lead to global warming?
4. How would global warming affect our country?
5. In 1994, there was a flash flood in Punakha which caught the headline of our national newspaper. Relate this to global warming and suggest and explain a possible hypothesis.
6. As a responsible citizen, suggest three to four ideas of how you can contribute towards minimizing the factors causing global warming.

Reprint 2024

Exercise

Look at the ecosystem given in Figure 4.8 and check whether the following statements are True or False. Correct the false statements.

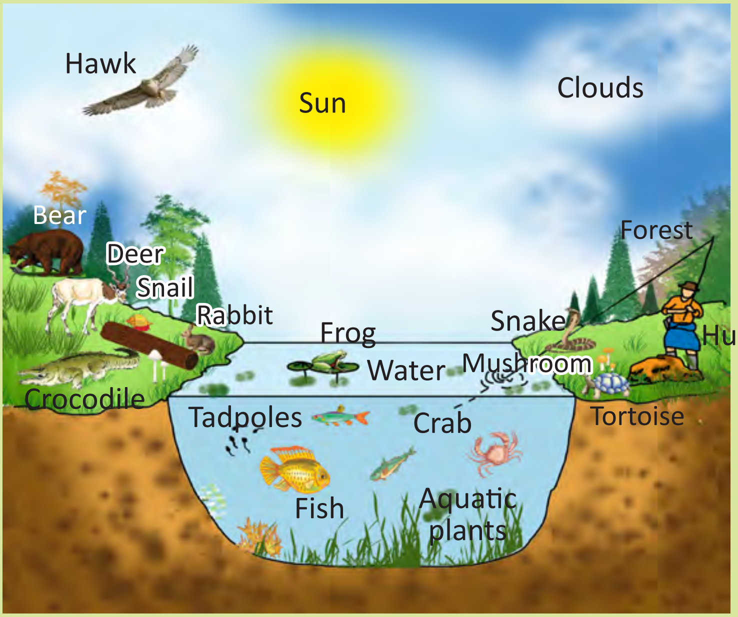


Figure 4.8. Ecosystem

Check whether the following statements are True or False. Correct the false statements.

1. Figure 4.8 is a man-made ecosystem.
2. Bear undergoes aestivation in winter.
3. The webbed toes in a frog are an adaptive feature to live in water.
4. The occurrence of differences among the same species of fish is called evolution.
5. Humans are omnivore

Fill in the blanks.

1. The biggest herbivore is.................................
2. A food chain begins with a............................
3. Grass $\longrightarrow$............. $\longrightarrow$ Hawk
4. The inter-connection of feeding relationships in an ecosystem is ....
5. Grass in a food chain forms the .... trophic level.

Match the Following

Column A	Column B
1. Autotroph	A. Cloud
2. Carnivore	B. Bear
3. Omnivore	C. Algae
4. Abiotic	D. Mushroom
5. Decomposer	E. Hawk
	F. Deer

Multiple Choice Questions

1. Sharks are great swimmers because they have ………................... as adaptive features to swim.
   A. teeth
   B. gills
   C. fins
   D. scale
2. Our personal physical characteristics are the result of
   A. genetic inheritance.
   B. environmental forces shaping our bodies as we grow to adulthood.
   C. genetic inheritance and the environmental forces.
   D. random chance or luck.
3. Porcupine's main defence is their sharp quills. This is ……………… feature.
   A. variation
   B. adaptative
   C. evolution
   D. camouflage
4. Ability of animals to blend in its surrounding is……………………
   A. hide.
   B. mask.
   C. symmetry.
   D. camouflage.
5. Black necked cranes come to Bhutan only in winter from North. This adaptive behaviour of animal is called…………......

Reprint 2024

A. flying.
B. hunting.
C. migration.
D. hibernation.

Answer the following questions

1. Name two types of ecosystems. Construct a food chain for each ecosystem.
2. Draw a pyramid of number for one of the ecosystems.
3. Predict, what will happen if all the plants and algae are removed from pond.
4. What impact will it have to a forest ecosystem if large number of tigers are introduced?
5. One season, a farmer observed insects destroying his crops in the paddy field. He removed the insects by spraying insecticides in his field. What do you think are the ecological consequences of using the insecticides in the field?
6. "Spiritual beliefs may contribute in maintaining the ecological balance". Write one of your beliefs that help in maintaining the ecological balance.
7. Study the three pyramids given in Figure 4.9 and answer the following questions.

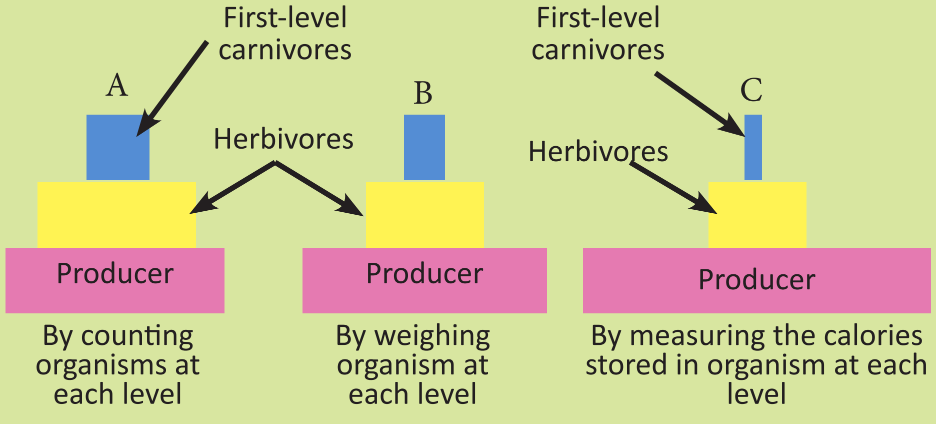


Figure 4.9.

i. Identify the types of pyramids represented by A, B and C.
ii. Why does each level in the pyramids decrease in size as we move upward?
iii. What is the role of carnivores in pyramid A?

Reprint 2024

Chapter 5
Classifying Material

All the materials that make up the universe are termed as matter. Matter is made up of very tiny particles irrespective of their size, colour and form. The arrangement and nature of these particles determine the physical and chemical properties of matter. The states of matter and its inter-conversion can be explained on the basis of particle theory.

Matter can be classified as elements, compounds, or mixtures based on its composition and properties. Metals and non-metals can be either elements or mixtures.

1. Particle Theory of Matter

Learning Objectives

On completion of this topic, you should be able to:

- explain the states of matter based on particle theory.
- investigate gas pressure and diffusion based on particle theory.
- relate the knowledge of gas pressure in everyday life.

We can see many things of different shapes, sizes, colours and forms around us. For example, food, water, air, cloud, clothes, animals, trees, etc. All these things are matter as they have mass and occupy space. Therefore, matter is anything that has mass, occupies space and can be perceived by our senses.

Matter can be classified as solid, liquid and gas. These states differ from each other in the arrangement of their particles. On the basis of arrangement and behaviour of particles, scientists have put forward the particle theory of matter. This theory helps us to explain the composition and properties of three states of matter.

Reprint 2024

a. Statements of Particle Theory

i. Matter is made up of tiny particles called atoms or molecules.
ii. Each substance has unique particles that are different from the particles of other substances.
iii. Particles are always in motion. The kinetic energy of particle increases with the rise in temperature.
iv. There are spaces between the particles called inter-particle or inter-molecular spaces.
v. Particles are attracted to each other and held by an attractive force. This attractive force can be weak or strong.

Activity 5.1. Investigating inter-molecular space in liquid

Carry out the following activity and answer the questions that follow.

Materials required

Beaker, measuring cylinder, spatula, glass rod, sugar, sand, and water.

Procedure

Step 1. Take two beakers with 50 mL of water in each and label them as beaker 1 and beaker 2.
Step 2. Add five spatula of sugar slowly into the first beaker, and five spatula of sand in the second beaker.
Step 3. Stir both the beakers well with the glass rod.
Step 4. Record your observations in Table 5.1.

Table 5.1 *Inter-molecular space*

Sl.No	Property	Beaker 1	Beaker 2
1	Volume		
2	Solubility		

i. What happens to the volume of water in beaker 1 and beaker 2?
ii. Explain your observations.
iii. How can you make sugar dissolve faster?
iv. What are dependent, independent and controlled variables in the experiment?

Reprint 2024

Solid, liquid and gas differ on the basis of arrangement of particles, energy of the particles, and the force of attraction between the particles. Table 5.2 shows the characteristics of different states of matter based on the particle theory.

Table 5.2 *Matter and their Characteristics*

Characteristics	Solid	Liquid	Gas
Particle arrangement	Closely arranged	Loosely arranged	Far apart
Intermolecular force	Strong	Weak	Negligible
Shape and volume	Definite shape and volume	Define volume but shape changes based on the shape of the container.	Does not have definite volume and shape.
Compressibility	Incompressible	Compressible	Highly compressible
Energy	Possess least kinetic energy	Possess more kinetic energy	Possess maximum kinetic energy

Activity 5.2. Investigating particles arrangement in matter

Carry out the following activity and answer the questions that follow.

Materials required

Computer and internet.

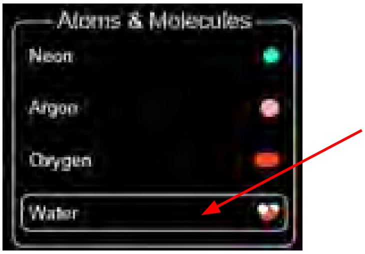
Procedure

Step 1. Step 1. Open the given link.

https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html

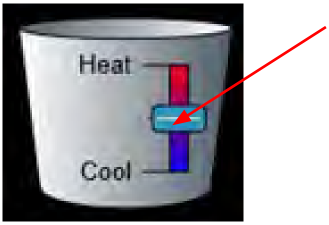
Step 2. Double click on 'states' as shown below.

Step 3. Select water from list of 'atoms and molecules'.



Step 4. Click on 'solid' or 'liquid' or 'gas' one at a time and observe the arrangement of particles.

Step 5. Vary the temperature with the help of temperature control button and observe the changes



Step 6. Try out other substances

Answer the following questions;

1. Compare the arrangement of particles in solid, liquid, and gas.
2. Why did particles move farther apart when you increased the temperature?
3. Why did particles come closer when you decreased the temperature?

b. Inter-conversion of Matter

Matter can change from one state to another without changing their composition. Such a phenomenon is called **inter-conversion** of matter. For example, on heating, ice changes into water and water into water vapour. On cooling, water vapour changes into water and water into ice. Such changes can be explained on the basis of the particle theory of matter.

In solids, particles are held tightly by strong attractive force. On heating, these particles gain kinetic energy to overcome the force of attraction, which helps them to move away from each other. This increases the inter-molecular spaces and solid starts expanding. Generally, when solids are heated to a very high temperature, it reaches its melting point. Thus, the solid changes into liquid.

Reprint 2024

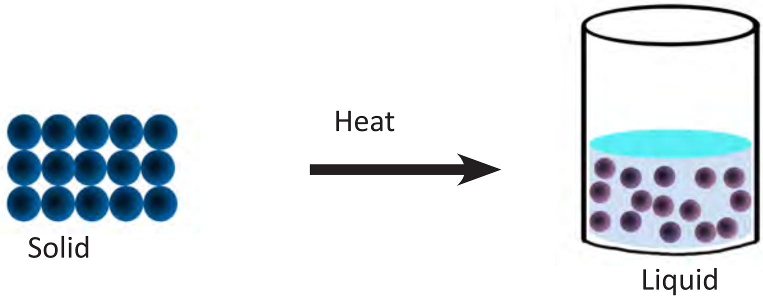


Figure 5.1. Change of state from solid to liquid.

When the liquid is heated further, particles gain more kinetic energy and move away from each other. This increases the inter-molecular spaces and the liquid expands. At boiling point of liquid, particles gain so much energy that they move further away from each other. As a result, liquid changes into gas.

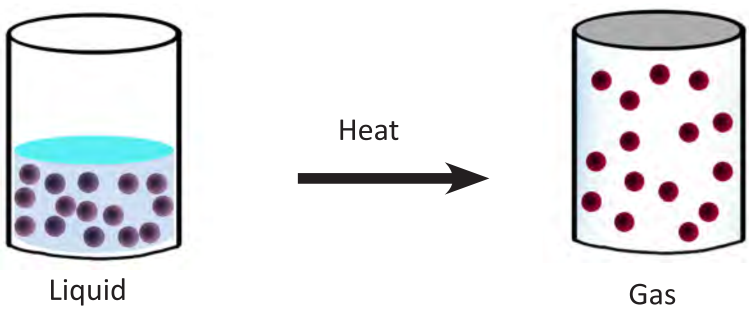


Figure 5.2. Change of state from liquid to gas.

In gaseous state, the particles possess maximum kinetic energy and move very fast. On cooling, the gaseous particles lose some of their kinetic energy. As a result, particles come closer decreasing the inter-molecular spaces. This changes the gas back to liquid.

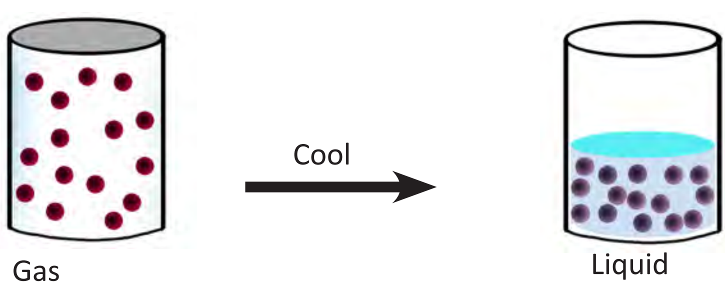


Figure 5.3. Change of state from gas to liquid.

Reprint 2024

On cooling this liquid, the kinetic energy of the particles decreases further. With decrease in kinetic energy, particles come closer together; decreases the inter-molecular spaces and particles are strongly attracted to each other. Thus, particles stop moving except for a slight vibration. This results in the change of liquid back to solid.

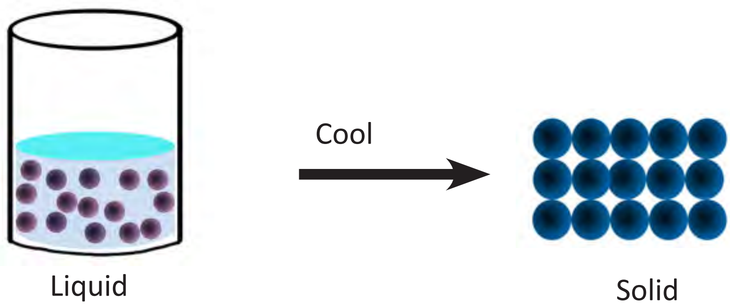


Figure 5.4. Change of state from liquid to solid.

Usually in solids, particles are attracted by strong force of attraction. However, in some solids, particles are attracted by weak force of attraction. On heating, particles in such type of solids gain high kinetic energy to change the solid directly into gas. On cooling, the particles lose the same amount of kinetic energy, and the gas directly changes back to solid. This inter-conversion of state is called **sublimation.**

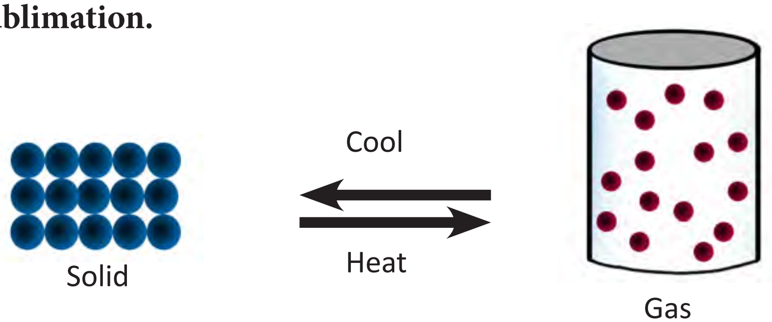


Figure 5.5. Sublimation.

c. Gas Pressure

The gas particles inside a container can move freely in all the directions. They collide with each other, and also with the inner walls of the container exerting an outward force. For example, a football when inflated becomes hard due to the force exerted by the gas particles on the inner wall of the football. Similarly, a balloon when blown for a long time expands and then finally bursts. The force exerted by gas particles on the walls of the container is called **gas pressure**.

Gas pressure is important in our daily life. It helps us to ride bicycle, drive vehicles, use droppers, use life jackets, etc.

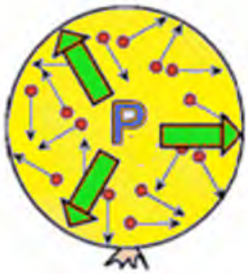


Figure 5.6. Gas pressure in a balloon.

Activity 5.3. Investigating gas pressure

Carry out the following activity and answer the questions that follow.

Materials required

Transparent plastic bag, volatile liquid (ethanol or spirit), tray, hot water, and thread.

Procedure

Step 1. Take two small transparent plastic bags.
Step 2. Pour 10 mL of ethanol or spirit in one of the plastic bags.
Step 3. Tie the open end (mouth) of the plastic bags with a thread.
Step 4. Place them in two separate trays as shown in Figure 5.7 (a).
Step 5. Pour hot water over one of the plastic bags only as shown in Figure 5.7 (b).

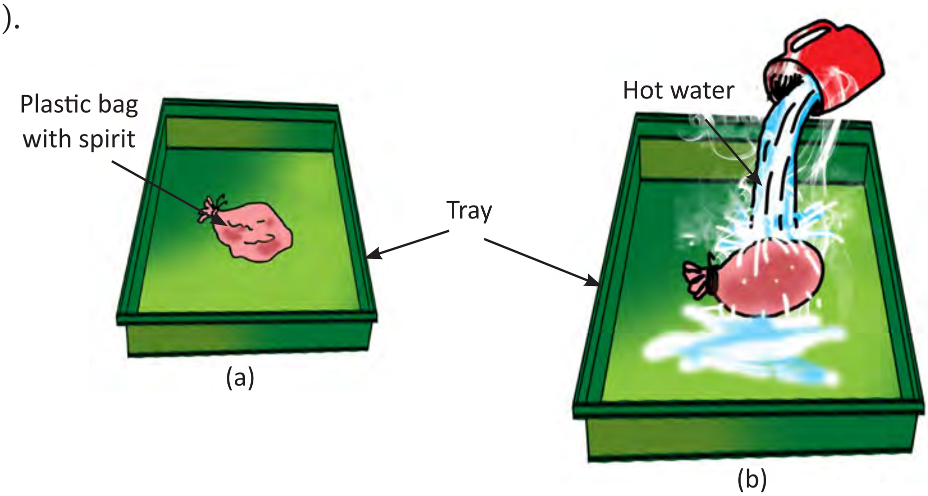


Figure 5.7. Demonstration of gas pressure.

i. What do you observe?
ii. Explain your observations.
iii. Why do you tie the mouth of the plastic bags?
iv. Why do you pour hot water over one of the plastic bags only?
v. Name one incident in which you observed this phenomenon.

Precaution

Take care while handling hot water.

d. Diffusion

In our everyday life, we often experience that when we burn an incense stick in an altar, fragrance slowly spreads to other rooms. This is due to the movement of particles until they are evenly distributed throughout. The phenomenon in which the particles move from a region of higher concentration to a region of its lower concentration until they are evenly mixed is called **diffusion**.

Diffusion is not very common in solids because the particles are closely packed. Liquids diffuse easily into one another due to more inter-molecular spaces. Gases diffuse more easily than liquids because the inter-molecular spaces are large.

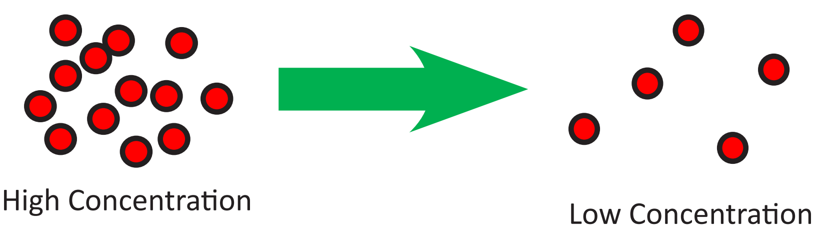


Figure 5.8. Diffusion.

Reprint 2024

Activity 5.4. Investigating diffusion in liquids

Carry out the following activity and answer the questions that follow.

Materials required

Beaker, dropper, measuring cylinder, water, and coloured solution.

Procedure

Step 1. Pour 50 mL of water in the beaker.

Step 2. Add two drops of coloured solution on the surface of water with the help of a dropper.

Step 3. Leave the beaker undisturbed and observe carefully.

- i. What do you observe?
- ii. Give reason for your observation.
- iii. What would you observe if you reduce the volume of water by half?
- iv. How is this phenomenon important in our everyday life?

Questions

1. Why does ice change into water on heating?
2. Based on the particle theory, explain why smoke flows easily in all the directions.

Reprint 2024

2. Elements and their Symbols

Learning Objectives

On completion of this topic, you should be able to:

- define element and symbol.
- identify the atomic number and mass number of an element.
- write symbols of the first 30 elements and arrange them in the periodic table.

The universe is made up of large number of substances. These substances are classified either as pure substances or mixtures depending upon their composition. A pure substance is a substance in which all the molecules or atoms are of the same kind. A pure substance can be either an element or a compound.

a. What is an element?

Every substance is made up of very small particles called atom. These atoms can have independent existence or can combine with other atoms to form molecules. A substance may be composed of one or more than one type of atoms. A pure substance made of only one type of atoms is called **element**. All the atoms of an element are identical. Most of the elements occur naturally, while others are obtained artificially.

Hydrogen, oxygen, carbon, nitrogen, iron, copper, gold, and silver are common examples of elements. At present, there are about 118 elements. Each of the elements is given a name and a symbol unique to it. A symbol is the short form or abbreviated name of an element. The symbol actually represents the atom of an element. Along with the symbol, we use atomic number and mass number to represent the elements as shown in Figure 5.9.

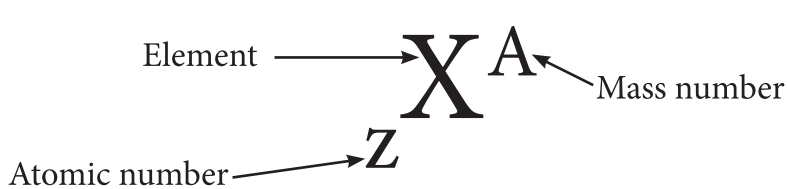


Figure 5.9. General representation of an element.

Reprint 2024

For example, carbon is represented as $_{6}C^{12}$. 'C' is symbol, 6 is the atomic number and 12 is the mass number of carbon.

All the known elements are arranged in increasing order of their atomic numbers. Table 5.3 shows the symbols, atomic numbers and mass numbers of the first twenty elements.

Table 5.3 *First 20 Elements*

Name of Element	Symbol	Atomic Number	Mass Number	Name of Element	Symbol	Atomic Number	Mass Number
Hydrogen	H	1	1	Sodium	Na	11	23
Helium	He	2	4	Magnesium	Mg	12	24
Lithium	Li	3	7	Aluminum	Al	13	27
Beryllium	Be	4	9	Silicon	Si	14	28
Boron	B	5	11	Phosphorus	P	15	31
Carbon	C	6	12	Sulphur	S	16	32
Nitrogen	N	7	14	Chlorine	Cl	17	35.5
Oxygen	O	8	16	Argon	Ar	18	40
Fluorine	F	9	19	Potassium	K	19	39
Neon	Ne	10	20	Calcium	Ca	20	40

WEBLINK
http://www.goldenkstar.com/periodic-table-software-school-chemistry.htm

b. Atomic Structure

An atom is the smallest particle of an element. It consists of sub-atomic particles namely electrons, protons and neutrons. These sub-atomic particles are found in the distinct regions of the atom. Protons and neutrons are found in the centre of an atom called **nucleus**. Hydrogen is the only element without a neutron.

Reprint 2024

Electrons are found revolving around the nucleus of an atom in a fixed path called **shell**. The nucleus is very small compared to the size of the atom.

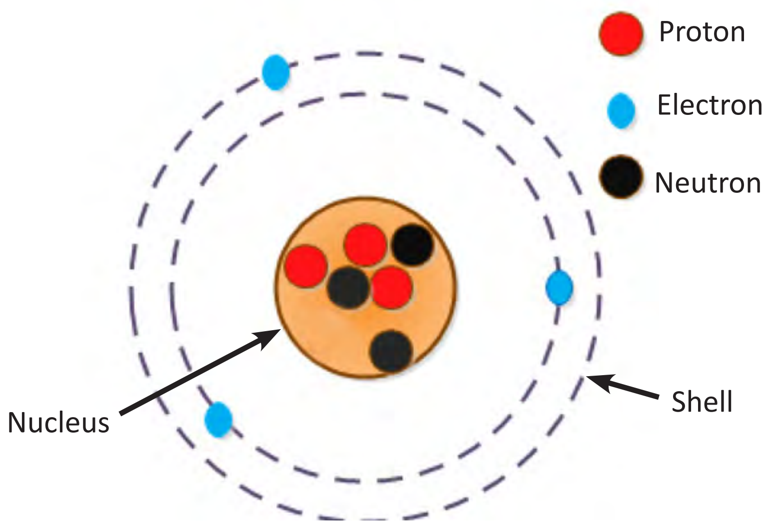


Figure 5.10. Structure of an atom.

Questions

1. Define an element. Give at least five examples.
2. An element with symbol 'Y' is represented as ${}_{30}Y^{65}$. What is the atomic number and mass number of this element?
3. An atom consists of electrons, protons and neutrons. Where are these sub-atomic particles located?

WEBLINK
http://hyperphysics.phy-astr.gsu.edu/hbase/pertab/metal.html

3. Metals and Non-metals

Learning Objectives

On completion of this topic, you should be able to:

- classify elements into metals and non-metals.
- describe some of the properties of metals and non-metals.
- relate the conceptual knowledge of metals and non-metals in everyday life.

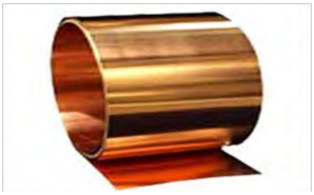
Out of 118 elements discovered so far, 94 are naturally occurring elements and rest are synthesized artificially. Based on the properties, elements are further classified into metals and non-metals. Humans have been using metals and non-metals for thousands of years for making tools, machines, utensils, houses, jewelleries, etc. The usefulness of metals and non-metals depends on their properties.

a. Properties of Metals

Activity 5.5. Investigating the properties of metals

Copper is one of the metals which is widely used for various purposes. Look at the pictures in Table 5.4 and write down the properties based on each of its uses.

Table 5.4 *Uses of Copper*

 **a**	 **b**	 **c**
 **d**	 **e**	 **f**

Reprint 2024

Generally, metals are those substances which are hard, lustrous, malleable, ductile, have high melting point, and can conduct heat and electricity.

Examples of metal: Aluminium (Al), Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Gold (Au), Silver (Ag), Tin (Sn), etc.

Mercury

Gold

Sodium

Figure 5.11. Examples of metal.

Work in Groups:

Select one metal. Study its properties and uses. Use programing language to create an advertisement on the product made out of the metal.

Present it to the class.

b. Properties of Non–metals

The following are some of the physical properties of non-metals:

- may be solid, liquid or gas.
- are softer than metals except diamond.
- are generally non-lustrous.
- are bad conductor of heat and electricity except graphite.
- have low melting and boiling point.
- are neither malleable nor ductile.
- are not sonorous.

A non-metal is a substance that is generally soft, has low melting point, and does not conduct heat and electricity. It is neither malleable nor ductile.

Examples of non-metal: Carbon (C), Sulphur (S), Nitrogen (N), Oxygen (O), Chlorine (Cl), Iodine (I), etc.

Reprint 2024

Sulphur

Iodine

Diamond

Figure 5.12. Examples of non-metal.

Activity 5.6. Classifying materials as metals and non-metals.

Carry out the following activity and answer the questions that follow.

Materials required

Copper wire, aluminium wire, graphite or pencil lead, charcoal, hammer and triangular file or sand paper.

Procedure

Step 1. Scratch the surface of each material with sand paper or iron file, and note down its appearance.

Step 2. Hammer each material and note down your observations in Table 5.5.

Table 5.5 *Physical Properties of Materials*

Materials	Appearance (Shiny or Dull)	Brittle or Malleable
Copper wire		
Charcoal		
Aluminium wire		
Pencil lead		

Reprint 2024

i. List down all the materials which show:
   a. metallic properties
   b. non–metallic properties

ii. Differentiate between metals and non-metals based on your findings.

Questions

3. Select the most suitable answer from the elements given in the box.

Gold, sulphur, zinc, tin, chlorine, hydrogen, iron, sodium, oxygen, carbon, lead, diamond

   i. A metal which is expensive and used to make ornaments.
   ii. Two non-metals that combine to form water.
   iii. A metal which is used in making cans to store foods.
   iv. A non-metal present in pencil lead.
   v. A metal widely used in construction of building.

2. Why is copper used in household wirings?

Do You Know?

- *Zinc is neither malleable nor ductile.*
- *Bromine is a liquid non-metal.*
- *Diamond is non-metal and the hardest naturally occurring substance.*
- *Some of the elements have both the properties of metals and non-metals, they are called metalloids.*

Example : boron, silicon, germanium, arsenic, antimony, etc.

Reprint 2024

Exercise

Check whether the following statements are True or False. Correct the false statements.

1. The symbol of sodium is 'So'.
2. The force of attraction between the particles is greater in ice than in water.
3. Mercury is liquid at room temperature.
4. Particles are always in the state of rest.
5. Nucleus of an atom consists of proton and neutron.

Fill in the blanks.

1. The smallest unit of an element is called.....................................
2. A non-metal that is a good conductor of electricity is........................
3. On .... gas changes to liquid.
4. When milk freezes, the inter-molecular force becomes ....
5. The handle of some cooking utensils is made of wood because it is .... of heat.

Match the Following

Column A	Column B
1. Non-metal that shines brilliantly and used in jewelleries	A. Copper
2. Metal that is used in thermometer	B. Carbon
3. An element that is used in making cooking utensils	C. Mercury
4. An element used in pencil lead	D. Diamond
5. An element which is brownish and is a good conductor of electricity.	E. Aluminium
	F. Gold

Reprint 2024

Multiple Choice Questions

1. Which of the following has fixed volume and shape?

   A. Water.

   B. Oil.

   C. Paper.

   D. Air.

2. Figure 5.13 shows the sample of arrangement of gas particles at room temperature.

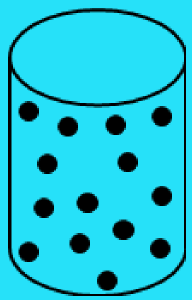


Fig 5.13.

Which diagram among the following best shows the result of removing heat from this sample until it freezes?

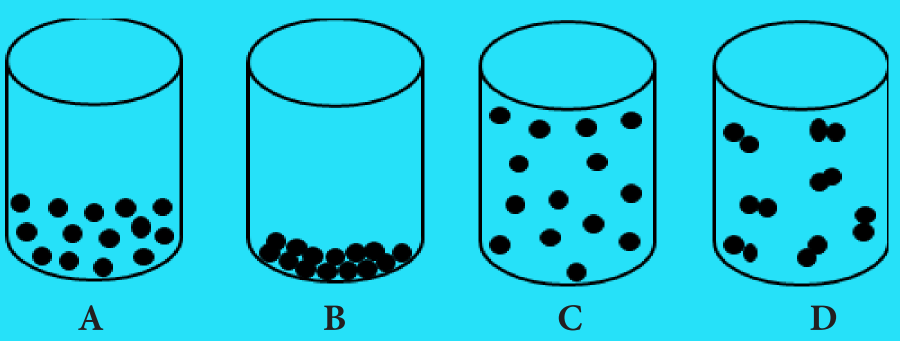


Fig 5.14.

3. Which of the following statement is correct?

   A. All metals are ductile.

   B. All non-metals are ductile.

   C. Generally metals are ductile.

   D. Some non-metals are ductile.

4. All the atoms contain neutron EXCEPT in
   A. oxygen.
   B. nitrogen.
   C. hydrogen.
   D. chlorine.
5. The perfume used by one of your friends is smelt in the classroom. This is due to
   A. conduction.
   B. evaporation.
   C. diffusion.
   D. sublimation.

Answer the following questions

1. Leakage of Liquid Petroleum Gas (LPG) can be detected by a person from a distance. Name the process and write two applications of this process in our day-to-day life.
2. Write down the names and the symbols of elements that are present in your classroom.
3. Imagine that you are a particle of water. Describe your experiences during evaporating, diffusing, and freezing.
4. ${}_{20}X^{40}$ is an element. Identify the element and write down its symbol, mass number and atomic number.
5. Write down the symbols for the following elements. Sort them as metals or non-metals.
   a. Zinc
   b. Copper
   c. Sulphur
   d. Oxygen
   e. Iodine
   f. Sodium

Reprint 2024

6. Read the following paragraph and answer the questions.

   As winter comes to an end, we put away our woollen clothes with naphthalene balls in between them. However, we find that naphthalene balls become smaller and finally disappear with timethat the naphthalene balls become smaller in size and finally disappear.

   a. Name the physical process responsible for the change in size of the naphthalene balls.
   b. Mention one advantage of naphthalene ball in this application?
   c. How is the process of change of state in the naphthalene balls different from the melting of ice?

Reprint 2024

Chapter 6
Patterns in Chemistry

Many attempts were made by chemists to classify the discovered elements. Many a time, their classifications failed to facilitate the study and correlate the properties between the elements. However, a breakthrough came in when Mendeleev put forward his ideas of a periodic table by which, he arranged the elements in the increasing order of the atomic mass. This was later modified by Moseley, and is now known as the modern periodic table. In this periodic table, elements on the left hand side are metallic in nature, and those on the right hand side are non-metallic in nature. Metallic elements form basic oxides and non-metallic elements form acidic oxide.

1. Periodic Table

Learning Objectives

On completion of this topic, you should be able to:

- describe the historical development of the modern periodic table.
- use periodic table to identify the characteristics of elements.
- differentiate between the groups and the periods as the fundamental layout of the periodic table.

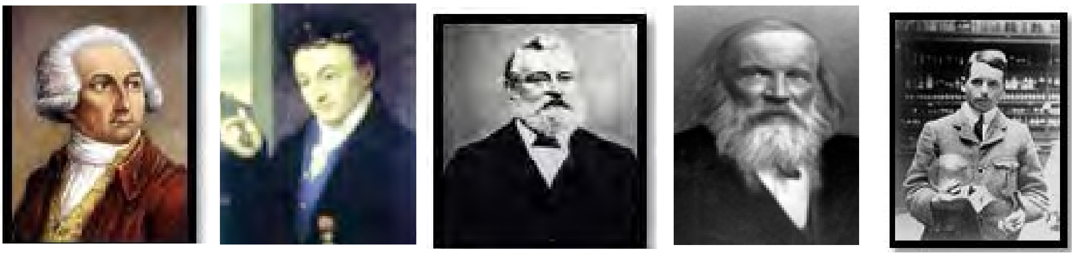
A very few elements were known in the early eighteenth century. Therefore, it was easy to study the properties of these elements. But with the discovery of more and more new elements, study of individual elements became difficult. This led to the classification of elements. Elements with similar properties were grouped together, and dissimilar elements were separated from one another. Grouping elements with similar properties is called **classification of elements**.

Reprint 2024

a. Early Attempts in Classification

Table 6.1 *History of Classification of Elements*

Year	Scientist	Classification	Demerits
18th Century	Antoine Lavoisier	Classified elements into metals and non-metals	Some elements contains properties of both metals and non-metals
1829	J.W. Dobereiner	Classified elements into sets of three chemically similar elements called triads.	Majority of elements could not form similar triads.
1864	John Newlands	Classified elements in increasing order of atomic mass, every eight element share similar properties	Failed with heavier elements beyond calcium.
1869	Dmitry Ivanovich Mendeleev	Classified elements in increasing order of atomic mass, similar properties appeared in regular intervals.	Some similar elements were separated and dissimilar elements were place together
1913	Henry Moseley	Classified elements in increasing order of atomic number and elements with similar properties repeats after regular intervals. Modern periodic law states that the physical and chemical properties of elements are periodic function of atomic number.	



Antoine Lavoisier J.W. Dobereiner John Newlands Dmitry Ivanovich Mendeleev Henry Moseley

Figure 6.1. Scientist.

Reprint 2024

Table 6.2: *Modern Periodic Table*

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 **H** 1.00794 Hydrogen																	2 **He** 4.002602 Helium
3 **Li** 6.941 Lithium	4 **Be** 9.012182 Beryllium											5 **B** 10.811 Boron	6 **C** 12.0107 Carbon	7 **N** 14.0067 Nitrogen	8 **O** 15.9994 Oxygen	9 **F** 18.9984032 Fluorine	10 **Ne** 20.1797 Neon
11 **Na** 22.989769 Sodium	12 **Mg** 24.3050 Magnesium											13 **Al** 26.9815386 Aluminum	14 **Si** 28.0855 Silicon	15 **P** 30.973762 Phosphorus	16 **S** 32.065 Sulfur	17 **Cl** 35.453 Chlorine	18 **Ar** 39.948 Argon
19 **K** 39.0983 Potassium	20 **Ca** 40.078 Calcium	21 **Sc** 44.955912 Scandium	22 **Ti** 47.867 Titanium	23 **V** 50.9415 Vanadium	24 **Cr** 51.9961 Chromium	25 **Mn** 54.938045 Manganese	26 **Fe** 55.845 Iron	27 **Co** 58.933195 Cobalt	28 **Ni** 58.6934 Nickel	29 **Cu** 63.546 Copper	30 **Zn** 65.38 Zinc	31 **Ga** 69.723 Gallium	32 **Ge** 72.64 Germanium	33 **As** 74.92160 Arsenic	34 **Se** 78.96 Selenium	35 **Br** 79.904 Bromine	36 **Kr** 83.798 Krypton
37 **Rb** 85.4678 Rubidium	38 **Sr** 87.62 Strontium	39 **Y** 88.90585 Yttrium	40 **Zr** 91.224 Zirconium	41 **Nb** 92.90638 Niobium	42 **Mo** 95.96 Molybdenum	43 **Tc** [98] Technetium	44 **Ru** 101.07 Ruthenium	45 **Rh** 102.90550 Rhodium	46 **Pd** 106.42 Palladium	47 **Ag** 107.8682 Silver	48 **Cd** 112.411 Cadmium	49 **In** 114.818 Indium	50 **Sn** 118.710 Tin	51 **Sb** 121.760 Antimony	52 **Te** 127.60 Tellurium	53 **I** 126.90447 Iodine	54 **Xe** 131.293 Xenon
55 **Cs** 132.9054519 Cesium	56 **Ba** 137.327 Barium	57-71 Lanthanides	72 **Hf** 178.49 Hafnium	73 **Ta** 180.94788 Tantalum	74 **W** 183.84 Tungsten	75 **Re** 186.207 Rhenium	76 **Os** 190.23 Osmium	77 **Ir** 192.217 Iridium	78 **Pt** 195.084 Platinum	79 **Au** 196.966569 Gold	80 **Hg** 200.59 Mercury	81 **Tl** 204.3833 Thallium	82 **Pb** 207.2 Lead	83 **Bi** 208.98040 Bismuth	84 **Po** [209] Polonium	85 **At** [210] Astatine	86 **Rn** [222] Radon
87 **Fr** [223] Francium	88 **Ra** [226] Radium	89-103 Actinides	104 **Rf** [267] Rutherfordium	105 **Db** [268] Dubnium	106 **Sg** [271] Seaborgium	107 **Bh** [272] Bohrium	108 **Hs** [270] Hassium	109 **Mt** [276] Meitnerium	110 **Ds** [281] Darmstadtium	111 **Rg** [280] Roentgenium	112 **Cp** [285] Copernicium	113 **Uut** [284] Ununtrium	114 **Uuq** [289] Ununquadium	115 **Uup** [288] Ununpentium	116 **Uuh** [293] Ununhexium	117 **Uus** [294] Ununseptium	118 **Uuo** [294] Ununoctium

Lanthanides	57 **La** 138.90547 Lanthanum	58 **Ce** 140.116 Cerium	59 **Pr** 140.90765 Praseodymium	60 **Nd** 144.242 Neodymium	61 **Pm** [145] Promethium	62 **Sm** 150.36 Samarium	63 **Eu** 151.964 Europium	64 **Gd** 157.25 Gadolinium	65 **Tb** 158.92535 Terbium	66 **Dy** 162.500 Dysprosium	67 **Ho** 164.93032 Holmium	68 **Er** 167.259 Erbium	69 **Tm** 168.93421 Thulium	70 **Yb** 173.054 Ytterbium	71 **Lu** 174.9668 Lutetium
Actinides	89 **Ac** [227] Actinium	90 **Th** 232.03806 Thorium	91 **Pa** 231.03588 Protactinium	92 **U** 238.02891 Uranium	93 **Np** [237] Neptunium	94 **Pu** [244] Plutonium	95 **Am** [243] Americium	96 **Cm** [247] Curium	97 **Bk** [247] Berkelium	98 **Cf** [251] Californium	99 **Es** [252] Einsteinium	100 **Fm** [257] Fermium	101 **Md** [258] Mendelevium	102 **No** [259] Nobelium	103 **Lr** [262] Lawrencium

Alkali Metals	Alkaline Earth	Basic Metal	Halogen	Noble Gas	Non Metal	Rare Earth	Semi Metal	Transition Metal

b. Features of the Modern Periodic Table

The main features of modern periodic table are:

- elements are arranged in the increasing order of atomic numbers; and
- there are seven horizontal rows called periods, and 18 vertical columns called groups. Elements belonging to the same group constitute a family. Elements in the same group have similar properties.

Activity 6.1. Finding more about modern periodic table

Copy and complete Table 6.3 based on the description of the elements provided. Use Table 6.2 as the reference. You may need to explore for characteristics of elements.

Table 6.3 *Mystery Elements*

Sl. No	Description of the element	Element	Group	Period
1	Contains six protons. Diamond and graphite are composed of this. Present in all organic compounds; the basis of life. Makes steel when combined with iron.			
2	First element in the periodic table. One of two elements that make up water. Gaseous at room temperature. Extremely flammable.			
3	Colorless inert gas. Second lightest noble gas. Used to make attention-getting signs. Contains 10 protons.			
4	One of two elements present in salt. Found in baking soda. Alkali metal. Contains 11 protons.			
5	Shares many characteristics with sodium. Second lightest metal. Alkali metal that reacts violently with water. Found in high quantities in bananas.			
6	Used to disinfect water and swimming pools. One of two elements present in salt. Extremely poisonous. Atomic number is 17.			

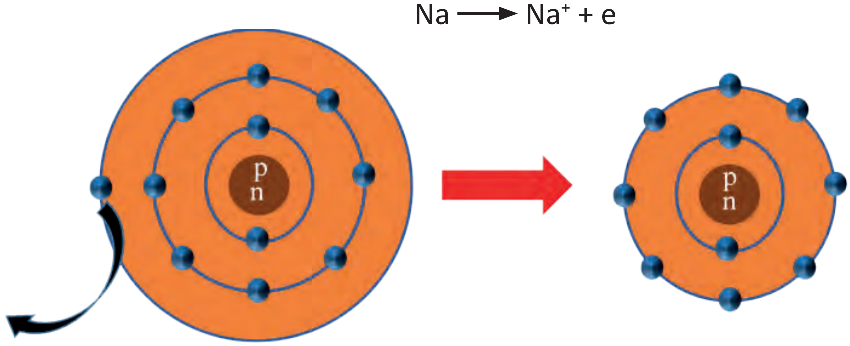
Reprint 2024

In a periodic table, as we move from left to right across the period, there is a change from metallic to non-metallic properties. For example, in third period, sodium is a metal, whereas chlorine is a non-metal. On moving down the group, the metallic character increases. Metallic character refers to the measure of reactivity of a metal. For example, in second group, magnesium is less reactive than calcium.

Metals have the tendency to lose electrons and form positive ions. Positive ions are called **cations**.

For example,

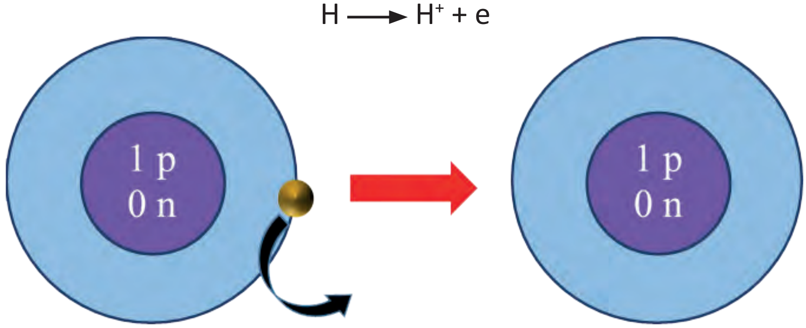
$$Na \longrightarrow Na^{+} + e$$



Sodium atom (Na) Sodium ion (Na^{+})

Figure 6.2. Formation of sodium ion.

$$H \longrightarrow H^{+} + e$$



Hydrogen atom (H) Hydrogen ion (H^{+})

Figure 6.3. Formation of hydrogen ion.

Non-metals have the tendency to gain electrons and form negative ions. Negative ions are called **anions**.

For example,

$$Cl + e \longrightarrow Cl^-$$

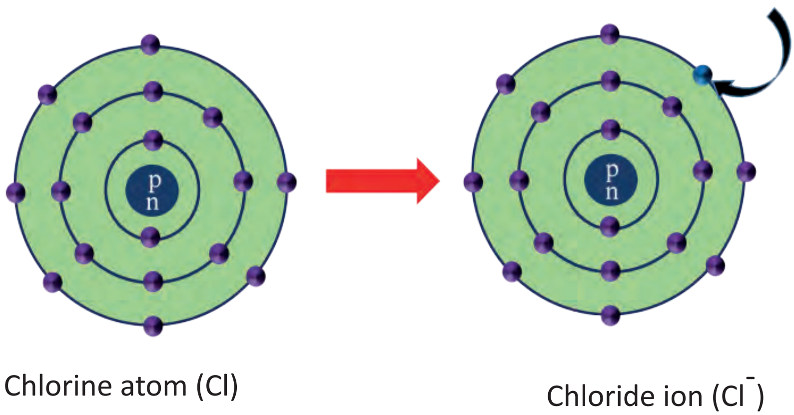


Figure 6.4. Formation of chloride ion.

$$O + 2e \longrightarrow O^{2-}$$

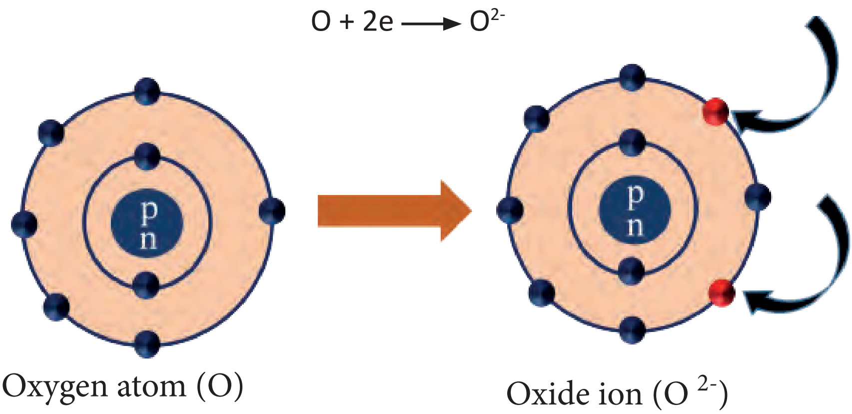


Figure 6.5. Formation of oxide ion.

Therefore, ions are either positively or negatively charged species.

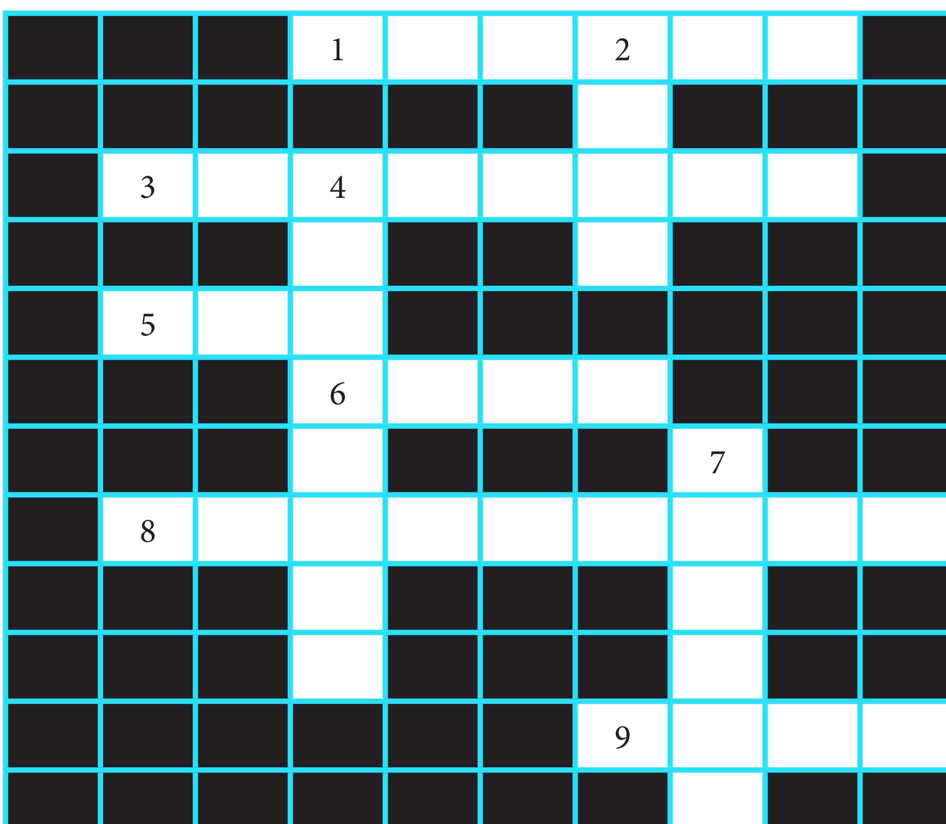
Reprint 2024

Activity 6.2. Crossword Puzzle

Use the hints given in Table 6.4 to complete the crossword.

Table 6.4 *Hints for Crossword Puzzle*

Across	Down
1. The element with mass number 23. 2. Sb is the symbol of the element. 3. An element with atomic number 50. 4. This element is used in making jewellery. 5. This element belongs to first group and fourth period. 6. An element with atomic number 82.	1. This element gets rusted easily in presence of moisture. 2. This element is used in making the filament of bulbs. 3. A white metal used in making jewelleries.



Reprint 2024

Questions

1. Several attempts had been made by eminent scientists to classify and arrange the discovered elements in the form of periodic table. State some importance of periodic table.
2. Portion of the periodic table of the elements is provided to you in Table 6.5. Study the table and answer the questions that follow.

Table 6.5

Groups

11	12	13	14	15	16	17	18
							2 **He** Helium 4
			6 **C** Carbon 12	7 **N** Nitrogen 14	8 **O** Oxygen 16	9 **F** Fluorine 19	
		13 **Al** Aluminum 27	14 **Si** Silicon 28		16 **S** Sulphur 32	17 **Cl** Chlorine 35	18 **Ar** Argon 40
	30 **Zn** Zinc 64	31 **Ga** Gallium 69	32 **Ge** Germ-anium 74	33 **As** Arsenic 75	34 **Se** Selenium 80		36 **Kr** Krypton 84
47 **Ag** Silver 107		49 **In** Indium 115	50 **Sn** Tin 120	51 **Sb** Antimony 121	52 **Te** Tellurium 130	53 **I** Iodine 127	54 **Xe** Xenon 132

a. The chemical symbols of four different elements with their atomic number are listed below.

$_{48}Cd$ $\quad$ $_{29}Cu$ $\quad$ $_{35}Br$ $\quad$ $_{15}P$

Place these elements in blank spaces in Table 6.5.

b. Categorise these four elements into metal or non-metal.

c. Mention the group to which the noble gases belong.

d. The elements such as fluorine, chlorine, bromine, and iodine are all found in the same group (17) in the table. Why are they grouped together?

Reprint 2024

2. Acid, Base and Indicator

Learning Objectives

On completion of this topic, you should be able to:

- define acid and base.
- investigate and classify the substance as acid and base
- explain the acid-base indicator and universal indicator.
- determine the acidity and basicity using pH scale.
- relate acid and base to daily life.

We come across food substances that taste sour, sweet or bitter. Anything that tastes sour contains acid, and the substances that taste bitter contains base.

The term acid, comes from the Latin word 'acere' or 'acidus', which means sour. **Acid** is a substance which has sour taste and reacts with base to produce salt and water.

Classification of Acid

Some acids are present in plants and animals, while others are either prepared artificially or obtained from the minerals on the Earth. The acids derived from plants and animals are called **organic acids,** and those derived from the minerals are called **inorganic acids**. It is sometimes called **mineral acid**. Some of the organic acids are given in Table 6.6.

Table 6.6 *Organic Acids and their Sources*

Source	**Acid Name**
Curd and milk	Lactic acid
Lemon and Orange	Citric acid
Apple	Maleic acid
Vinegar	Acetic acid
Grapes and Tamarind	Tartaric acid
Tomatoes	Oxalic acid
Urine	Uric acid
Bee sting and ant sting	Formic acid
Gooseberry (**amla**)	Ascorbic acid

Reprint 2024

Some of the inorganic acids are given in Table 6.7.

Table 6.7 *Mineral Acids and their Formula*

Acid	Chemical Formula
Hydrochloric acid	HCl
Nitric acid	HNO_3
Sulphuric acid	H_2SO_4
Carbonic acid	H_2CO_3
Phosphoric acid	H_3PO_4

Acids generally contain hydrogen. When acid dissolves in water, it produces hydrogen ion (H^+). The equations given below show the formation of hydrogen ion when acid dissolves in water.

$$\text{Hydrochloric acid} \xrightarrow{\text{in water}} \text{Hydrogen ion} + \text{Chloride ion}$$

$$HCl \xrightarrow{\text{in water}} H^+ + Cl^-$$

$$\text{Nitric acid} \xrightarrow{\text{in water}} \text{Hydrogen ion} + \text{Nitrate ion}$$

$$HNO \xrightarrow{\text{in water}} H^+ + NO_3^-$$

Properties of Acids

Activity 6.3. Exploring the properties of acids

Carry out the following activity and answer the questions that follow.

Materials required

Test tubes, test tube rack, dilute acetic acid, distilled water, dropper, dilute hydrochloric acid, dilute sulphuric acid, phenolphthalein indicator, methyl orange, blue, and red litmus paper.

Procedure

Step 1. Pour 5 mL each of dilute hydrochloric acid into four test tubes. Label

Reprint 2024

the test tube 1 to 4, and place them in the test tube rack.

Step 2. To the first and second test tubes, add a piece of blue and red litmus paper respectively. To the 3rd test tube, add a drop of phenolphthalein indicator and to the 4th test tube, add a drop of methyl orange.

Step 3. Repeat Step 1 to Step 3 with dilute sulphuric acid and dilute acetic acid (vinegar). Be sure to clean the dropper after using each acid.

Step 4. Record your observations in Table 6.8.

Table 6.8 *Test for Acid*

Acid	**Substance**				
	Blue Litmus	Red Litmus	Phenolphthalein	Methyl Orange	Magnesium Ribbon
Dil. hydrochloric acid					
Dil. sulphuric acid					
Acetic acid					

i. Name the indicator which remains colourless in acidic solution.

ii. What would happen to a red litmus if you dip it inside a lemon juice. Why?

Some other properties of acids are:

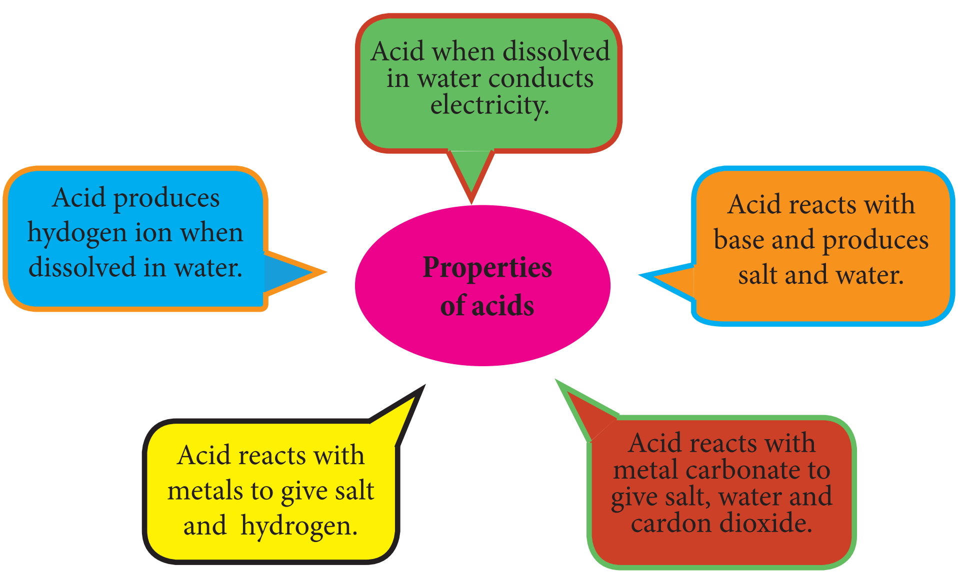


Figure 6.6. Properties of acid.

Reprint 2024

Uses of Acid

Activity 6.4. Exploring the uses of acids

Study Figure 6.7 and answer the questions that follow.

(a) Carbonated drinks (b) Car battery (c) Fire extinguisher (d) Tomato ketchup

Figure 6.7. *Uses of acids.*

i. What do all these items in the pictures have in common?
ii. Which of these items contain organic acid? Name the acid in them.
iii. What is the purpose of acid in item number (b)?
iv. Write down some other uses of acid.

Bases

Bases are substances, which are generally bitter and slippery in nature. They react with acid to produce salt and water. Some bases are soluble in water, while others are not. Soluble bases are called **alkalis**. For example, potassium hydroxide, sodium hydroxide, calcium hydroxide, ammonium hydroxide, etc.

> **Do You Know?**
>
> Acids and bases should be neutralized while disposing to prevent hazardous effect on the environment.

Bases generally contain hydroxyl ion (OH^-). When a base is dissolved in water, it produces hydroxyl ion. The equations given below show the formation of hydroxyl ions when bases are dissolved in water.

$$\text{Sodium hydroxide} \xrightarrow{\text{in water}} \text{Sodium ion} + \text{Hydroxyl ion}$$

$$NaOH \xrightarrow{\text{in water}} Na^+ + OH^-$$

Reprint 2024

$$\text{Potassium hydroxide} \xrightarrow{\text{in water}} \text{Potassium ion} + \text{Hydroxyl ion}$$

$$KOH \xrightarrow{\text{in water}} K^+ + OH^-$$

Hydrogen ion (H^+) from an acid reacts with hydroxyl ion (OH^-) from the base to form water. This reaction is called **neutralisation reaction**.

$$H^+ + OH^- \longrightarrow H_2O$$

Some examples of bases are given in Table 6.9.

Table 6.9 *Bases and their Chemical Formula*

Name of the Base	Chemical Formula
Sodium hydroxide	$NaOH$
Calcium hydroxide	$Ca(OH)_2$
Potassium hydroxide	KOH
Copper hydroxide	$Cu(OH)_2$
Ammonium hydroxide	NH_4OH
Sodium oxide	Na_2O
Copper oxide	CuO
Calcium oxide(Lime)	CaO

Properties of Base

Activity 6.5. Investigating the properties of bases

Carry out the following activity and answer the questions that follow.

Materials required

Test tube, sodium hydroxide solution, ammonium hydroxide solution, blue and red litmus paper, methyl orange, phenolphthalein, watch glass, and dropper. .

Reprint 2024

Procedure

Design and carry out an experiment to find out properties of bases using above materials.

Write the procedure carried out in the experiment.

Record your observation in Table 6.10.

Table 6.10 *Properties of Base*

Base	Property	Observation
Sodium hydroxide	Colour change in indicators	
	a. Blue litmus	
	b. Red litmus	
	c. Methyl orange	
	d. Phenolphthalein	
Ammonium hydroxide	Colour change in indicators	
	a. Blue litmus	
	b. Red litmus	
	c. Methyl orange	
	d. Phenolphthalein	

i. What properties of base can you conclude from this activity?

ii. Why do we add indicator to solution and not solution to indicator?

Precaution

Neutralise acid and alkali before disposing off to prevent hazardous effect to the environment.

Uses of Base

Activity 6.6. Exploring the uses of bases

Use a presentation software to present about the uses of bases to the class. You may use the library, internet, or get help from your teacher.

Reprint 2024

Indicators

The indicators are the group of substances that change colour when added to a solution. The colour change indicates, whether substance is an acid or a base; thus it is called **acid-base indicator**.

As discussed in the lower classes, some locally made indicators such as the extract of red cabbage, beetroot, turmeric, and flower petals change colour with acid and base, but their colours fade. There are other more reliable indicators like litmus, methyl orange and phenolphthalein that change colour with acids and bases.

Table 6.11 *pH of Substances*

Sl.No	Name of the Substance	Standard pH Value
1	Dilute hydrochloric acid	1
2	Sodium hydroxide solution	14
3	Magnesium hydroxide solution	10
4	Black coffee	5
5	Baking soda solution	8.5
6	Distilled water	7

The universal indicator is another type of indicator that also shows colour change in an acid or a base. **Universal indicator** is a mixture of several dyes that give definite colour change over a wide range. It helps us to find how strong or weak an acid or a base is by comparing the colour change with a scale called **pH scale**.

The pH scale ranges from 0 to 14 as shown in Figure 6.8. A pH less than 7 is acidic; lower the pH number, stronger is the acid. A pH greater than 7 is basic; higher the pH number, stronger is the base. A pH of 7 is neutral; example pure water. Table 6.12 shows the colour change of universal indicator at various pH ranges.

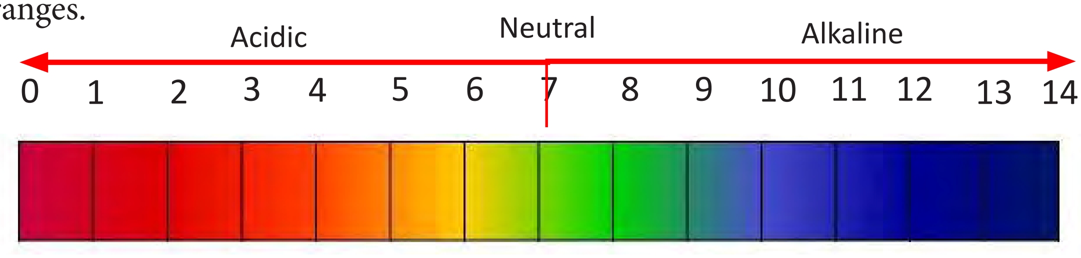


Figure 6.8. A pH scale.

Reprint 2024

Table 6.12 *pH Range*

pH Range	Description	Colour
0-3	Strong acid	Red
3-6	Acid	Orange/Yellow
7	Neutral	Green
8-11	alkali	Blue
11-14	Strong alkali	Violet/Purple

WEBLINK
http://www.funsci.com/fun3_en/acids/acids.htm

Activity 6.7. Finding the strength of an acid and a base

Carry out the following activity and answer the questions that follow.

Materials required

Universal indicator solutions or paper, carbonated drink, apple juice, ash solution, lime water, soap solution, milk, tap water, test tube, test tube stand, and dropper.

Procedure

Write the procedure carried out in the experiment.

i. Classify the above substances that are acidic or basic in nature.
ii. Which of these solutions is the most acidic?
iii. Which of these solutions is the most basic?
iv. What will be the change in colour and its pH if you mix 1 mL of lemon juice and 1 mL of lime water?

Reprint 2024

Application of pH

The pH has many important applications that make our life easier and safe. Some of the applications of pH are given below.

- **Medicine:** pH value of blood and urine are used to diagnose various diseases.
- **Agriculture:** pH has a great importance in agriculture. Soil is often tested to determine its pH. Different plants require different pH conditions. For example, rice grows in acidic soil and citrus plants grow in alkaline soil.
- **Food preservation:** Microorganisms are sensitive to a food's pH. Very low or high pH values prevent microbial growth and therefore, maintaining these pH values is important in food preservation.
- **Living organism:** Various life processes in living things occur at certain pH. For example, different stages of digestion of food occur at different pH. Saliva is alkaline and gastric juice (hydrochloric acid) is acidic; both help in digestion.

Questions

1. When you are stung by a bee, it is very painful with burning sensation. The part stung becomes red and swollen. What should you do to relieve the pain? Support your answer.
2. In an agro industry, a chemist requires to find the acidic or basic strength of unknown solution. In the laboratory, the chemist has universal indicator and acid-base indicator to find this out. Which one would the chemists prefer? Give reason.
3. A few drops of universal indicator are added to a colourless liquid. The pH value of this liquid is found to be 9.
    a. What happens if you add a few drops of phenolphthalein to this liquid?
    b. What information is indicated by the pH value of the colourless liquid?

Reprint 2024

Exercise

Check whether the following statements are True or False. Correct the false statements.

1. The elements belonging to the same period have same properties throughout.
2. Acid-base indicator is used to find the acidic or basic nature of the substances.
3. Lithium, sodium and potassium are metals of the same group, but different period.
4. About a half test tube of lemon juice (pH 5) is added to about half test tube of lime water (pH 10). The pH of the resultant solution is expected to be 7.
5. Mendeleev arranged elements based on atomic number.

Match the following

Column A	Column B
1. The property of the eighth element is the repetition of the first.	A. Hydrochloric acid
2. The type of acid present in urine	B. Maleic acid
3. The group of elements present in the eighteenth group of periodic table.	C. Newland's Law of Octaves
4. Dissimilar elements were placed together and some similar elements were separated.	D. Inert gas
5. The acid present in the gastric juice	E. Demerit of Modern periodic table
	F. Uric acid
	G. Demerit of Mendeleev's periodic table

Multiple Choice Questions

1. In the periodic table, helium, neon and argon are commonly called noble gases because they;

   A. are highly reactive.

   B. are inert.

   C. are metals.

   D. form basic oxides.

Reprint 2024

2. When a small amount of white powder is added to water, the resultant solution turns blue on adding universal indicator. This indicates that the while powder is ______________________

   A. neutral substance.

   B. alkaline substance.

   C. acidic substance.

   D. amphoteric substance.

3. Refer Table 6.13 to answer the question below.

Table 6.13

Chemicals and Household Materials	pH in Water
Baking soda	7.5
Calamine lotion	8.7
Carbonated citrus drink	3.1
Washing soda	11.5
Common salt	7

   Which of the following can be safely used to treat alkaline wasp sting?

   A. Calamine lotion.

   B. Common salt.

   C. Baking soda.

   D. Carbonated citrus drink.

4. In a soil testing laboratory, four soil samples from a horticulture farm were tested for their relative acidity and alkalinity. Quick lime is an alkaline agrochemical used to control soil pH.

   Which soil is unlikely to need quick lime to make it neutral for healthy plant growth.

   A. Soil pH 6.7.

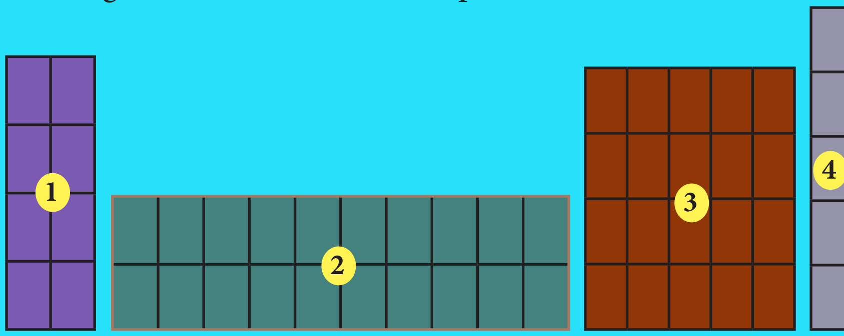
   B. Soil pH 5.2.

   C. Soil pH 4.7.

   D. Soil pH 3.2.

Reprint 2024

5. The diagram shows an outline of parts of the Periodic Table.



In which section will you find the Noble Gases?

A. Section 1.
B. Section 2.
C. Section 3.
D. Section 4.

6. Read the following statements:

a. Both acid and base change colour of all indicators.
b. If an indicator changes colour with an acid, it does not change colour with base.
c. If an indicator changes colour with a base, it does not change colour with an acid.
d. Change of colour in an acid and a base depends on the type of indicator.

Which of the above statements are correct?

A. All four.
B. a and b.
C. b and c.
D. Only d.

Answer the following questions

2. Table 6.14 shows the pH of five solutions. Study the table carefully and answer the following questions.

Reprint 2024

Table 6.14

Solution	A	B	C	D	E
pH	2	9	3	10	6

a. Which solution is the most acidic?

b. Which solution is the most alkaline?

a. Which solution is nearest to neutral?

b. Which two solutions, when mixed is likely to produce a neutral solution?

3. Some of the elements in Figure 6.9 are represented by letters A to E. Note that letters A to E do not represent the symbols of the elements.

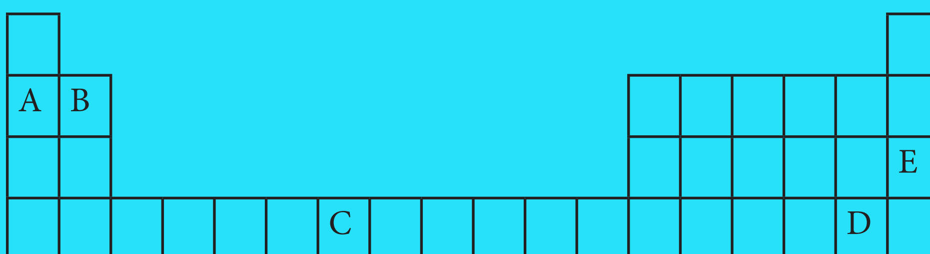


Figure 6.9.

Name the following:

a. A halogen.

b. An alkali metal.

c. An inert gas.

d. Group to which elements B and E belong.

e. Period to which elements C and D belong.

4. A chemistry laboratory assistant noticed labels missing from two reagent bottles, A and B. In order to identify these two solutions, she pours a small amount of solution A into a test tube. Next, she adds a few drops of phenolphthalein to it. The solution turns pink. However, when small amount of solution B is added to it, the pink colour disappears.

a. What is the nature of solution A and solution B?

b. What will happen if excess amount of solution A is added after the pink colour disappears?

Chapter 7
Material and Change

In our everyday life, we observe many changes taking place around us. Changes occur due to interaction of matter. This interaction results in change in shape, size, colour and composition of the matter. For example, germination of seed, flowering of plants, burning of paper, cooking of food, breaking of glasses, dissolving of salt in water, etc. are some of the changes that occur in day to day life. Some of these changes are physical changes, while others are chemical changes.

1. Physical Change

Learning Objectives

On completion of this topic, you should be able to:

- explain physical change with examples.
- investigate that mass is conserved during physical change.
- relate the importance of physical change to everyday life.

Generally, physical changes are temporary, where substance regains its original form.

Activity 7.1. Investigating physical change

Carry out the following activity and answer the questions that follow.

Materials required

Test tube, test tube holder, spirit lamp, spatula, match box, test tube rack, zinc oxide, and digital balance.

Reprint 2024

Procedure

Step 1. Take one spatula of zinc oxide in a clean, dry test tube and weigh it.

Step 2. Hold the test tube with a test tube holder and heat it gently.

Step 3. Observe the changes.

Step 4. Place the test tube in the test tube rack and allow it to cool. Observe the change again.

Step 5. Weigh the test tube again and record the weight.

Step 6. Record your observation in Table 7.1

Table 7.1 *Observing a Change*

Characteristics	Before Heating	During Heating	After Cooling
Colour			
State			
Weight		Not applicable	

i. Is there a formation of any new substance?

ii. What change do you see in the mass of the zinc oxide?

iii. What type of change is it? Write down the characteristics based on your observations.

There are other characteristics of physical change besides the ones you have learnt in activity 6.1. Physical change is generally reversible, but there are some which can be irreversible too. For example, making furniture out of wood, breaking of stone, plucking of fruit, etc., are all irreversible physical changes. During these changes, there is only change in shape and size, but composition remains same.

There are many physical changes that play an important role in our daily life. For example, drying of wet clothes, glowing of bulb, drying of vegetables and fruits, water cycle, evaporation of water from skin, melting of butter, heating of electric iron, freezing of water, magnetization of iron, bending of iron rod, etc.

Reprint 2024


Bending of iron rod


Glowing of bulb


Stretching of rubber band

*Figure 7.*1 Physical change.

During physical change, quantity of matter remains same before and after the change. Thus, mass is always conserved.

Questions

1. Dorji heats hydrated copper sulphate in a test tube. While heating, the colour changes from blue to white. After cooling, Wangmo adds a drop of water into the same test tube and the blue colour reappears.
   a. What type of change has the hydrated copper sulphate undergone? Give reasons to support your answer.
2. Physical change can be both harmful and useful. Mention some physical changes which are harmful.

Do You Know?

Generally, substances in solid state are heavier, but in case of water it is the opposite. Thus ice floats on water.

Reprint 2024

2. Chemical Change

Learning Objectives

On completion of this topic, you should be able to:

- explain chemical change with examples.
- relate chemical changes to everyday life.
- investigate chemical change.
- identify the factors affecting the chemical change.

Activity 7.2. Investigating chemical Change

Carry out the following activity and answer the questions that follow. Copy and complete Table 7.2.

Materials required

Test tubes, test tube holders, spatula, spirit lamp, sulphur, iron filings, match box, phenolphthalein, sodium hydroxide, barium chloride solution, sodium sulphate, fresh lemon or orange juice, a plain paper, and toothpick.

Preocedure

Carry out the following activity and record your observation for each in Table 7.2.

Table 7.2 *Observing a Change*

Activity	Observation
Heat mixture of iron filings and sulphur in a test tube.	
Add a few drops of phenolphthalein to a test tube containing some sodium hydroxide solution.	
Using fresh lemon or orange juice, write a word on a piece of paper with a small stick. Heat the dried paper gently over the flame without burning the paper.	
Add a few drops of barium chloride solution to a test tube containing sodium sulphate solution.	

Reprint 2024

i. What is common in your observations?
ii. Can you get back the original substances that you have used?
iii. What kind of changes are they?
iv. How are new substances formed in each of the activities?
v. Define the change that you identified in your own words.

Activity 7.2 shows that the change is permanent, where one or more new substances are formed with different composition and properties. Such type of change is called chemical change. There are some other examples that we experience in our day to day life such as burning of fuels, ripening of fruits, milk changing into curd, germination of seeds, digestion of food, rusting of iron, colour fading from clothes, photosynthesis, etc. During chemical change, the quantity of matter remains same before and after the change. Thus, mass is always conserved. The **law of conservation of mass** states that matter can neither be created nor destroyed by physical transformation or chemical reactions.

a. Characteristics of a Chemical Change

Some of the characteristics of chemical change are:

i. One or more new substance(s) is formed.
ii. The composition of the new substance formed is different from that of the original substance.
iii. A chemical change is generally permanent and irreversible.
iv. A chemical change generally involves change in energy.

(a) Rusting of iron (b) Ripening of grapes (c) Burning of wood (d) Germination of seed

Figure 7.2. Chemical changes in everyday life .

Burning of candle involves both physical and chemical change. The melting of wax is a temporary or reversible change. The process can be reversed and there is no change in the composition of wax. The burning of wick and wax results in the formation of smoke, which consists of carbon dioxide, water vapour and soot. This is a chemical change.

Justify why sublimation of ammonium chloride is both physical and chemical change.

b. Conditions for Physical and Chemical Change

There are many physical and chemical changes that occur constantly in the environment around us. These changes take place under certain conditions such as temperature, light, moisture, air, etc. Some of the examples are mentioned in Table 7.3.

Table 7.3 *Conditions for Change*

<table>
<tr><th>Examples</th><th>Change</th><th>Conditions</th></tr>
<tr><td>Rusting of iron</td><td>Chemical change</td><td rowspan="2">Moisture</td></tr>
<tr><td>Common salt getting wet during monsoon</td><td>Physical change</td></tr>
<tr><td>Colour fading from your clothes</td><td>Chemical change</td><td rowspan="2">Light</td></tr>
<tr><td>Photosynthesis</td><td>Chemical change</td></tr>
<tr><td>Drying of wet clothes</td><td>Physical change</td><td>Temperature</td></tr>
<tr><td>Respiration</td><td>Chemical change</td><td>Air</td></tr>
</table>

Activity 7.3. Making a soap

Carry out the following activity and answer the questions that follow.

Materials required

Beaker, vegetable oil, sodium hydroxide, glass rod, water, weighing balance, and measuring cylinder.

Procedure

Step 1. Take about 50 g of vegetable oil in a beaker.

Step 2. Weigh 50 g of sodium hydroxide and dissolve in 200 mL of water in another beaker.

Step 3. Add the vegetable oil slowly to the beaker containing sodium hydroxide solution with constant stirring till a curd mass is formed on the top.

Reprint 2024

Step 4. Keep the mixture undisturbed for 10-12 hours putting a glass rod in it.

Step 5. Hold the glass rod and gently take out the soap cake from the beaker.

Step 6. Cut the soap cake into desired shape and wash it under the running water before use.

i. Name two chemicals used in soap making.
ii. What type of change is involved in making the soap? Support your answer.
iii. How is the soap prepared by you different from the one that you get in the market?
iv. Why do you keep the mixture undisturbed for 10 to 12 hours?

Questions

1. Look at Figure 7.3 and answer the following questions.

   When blue crystals of copper nitrate are heated, they decompose to give black coloured copper oxide, reddish brown fumes of nitrogen dioxide, and a colourless gas of oxygen.

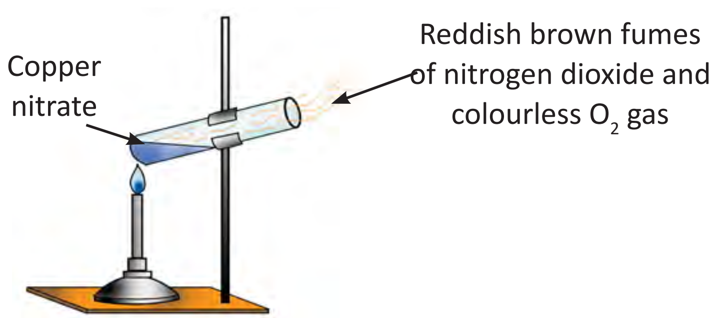


Figure 7.3.

   a. What type of change is shown by the picture? Support your answer with a brief explanation.
   b. Will there be a change in mass of copper nitrate? Justify.

2. Temperature is one of the conditions that affects both physical and chemical change. Support the statement with an example.

Precaution

Carry out the experiment in well ventilated room. Do not inhale the brown fumes of nitrogen dioxide.

Reprint 2024

3. Solution

Learning Objectives

On completion of this topic, you should be able to:

- explain homogeneous solutions.
- differentiate saturated and unsaturated solutions.
- explain the solubility of solute in solvent.

A solution is called homogeneous solution if the composition is uniform throughout. For example, salt solution and sugar solution. The amount of solute and the solvent in a solution may not be in equal proportion. If the amount of the solute dissolved in a given volume of solvent is less, it is called **dilute solution**. If the amount of solute dissolved in a given volume of solvent is more, then it is called **concentrated solution**.

We know that water can dissolve different types of solutes; therefore, water is called universal solvent. A solution which is obtained by dissolving a solute in water is called **aqueous solution**. Besides water, there are other liquids, which act as a solvent and the solution formed is called **non-aqueous solution**. Table 7.4 shows some examples of solute with their solvent.

Table 7.4 *Solute and its Solvent*

Solute	Solvent	Type of Solution
Salt	Water	Aqueous solution
Sugar	Water	Aqueous solution
Sulphur	Carbon disulphide	Non-aqueous solution
Wax or paints	Turpentine oil	Non-aqueous solution
Grease or fat	Petrol, Benzene, carbon tetrachloride	Non-aqueous solution

Solutions can also be classified into saturated and unsaturated solution.

Reprint 2024

Activity 7.4. Making saturated solution

Carry out the following activity and answer the questions that follow.

Materials required

Beaker, salt, glass rod, water, and measuring cylinder.

Procedure

Step 1. Take 100 mL of water in a beaker and add a pinch of salt.
Step 2. Stir the mixture.
Step 3. Add some more salt and keep stirring.
Step 4. Keep on dissolving more salt in the solution till no more salt dissolves.

i. What do you observe in step 2?
ii. Is water able to dissolve more salt in step 3? What do you call such type of solution?
iii. What is the type of solution obtained in step 4.
iv. Based on question ii and iii, define the two types of solutions.
v. Identify dependent, independent and controlled variables in the experiment.

a. Solubility

In Activity 7.4, certain amount of salt dissolves in water forming a saturated solution at a particular temperature. The ability of the salt to dissolve in a given volume of water at a particular temperature is called **solubility**. The amount of different solutes dissolved in same volume of a solvent is different. This is because different solutes have different solubilities in the same solvent.

Activity 7.5. Investigating solubility of sodium chloride and calcium sulphate

Carry out the following activity and answer the questions that follow.

Materials required

Sodium chloride, calcium sulphate, water, digital balance, watch glass, beaker, glass rod, spatula, and measuring cylinder.

Reprint 2024

Procedure

Step 1. Take 100 mL of water in each beaker.

Step 2. Weigh 50 g of sodium chloride and 50 g of calcium sulphate in two different watch glasses.

Step 3. Add small amount of sodium chloride in a beaker containing 100 mL of water and calcium sulphate in another beaker containing 100 mL of water with the help of spatula with constant stirring.

Step 4. Repeat the above procedure until no more salts dissolve.

Step 5. Now weigh the left over salts.

i. How much of each salt has dissolved in the water?

ii. What are the solubilities of salts in 100 mL of water at room temperature?

iii. Which salt has higher solubility at that temperature?

iv. Identify dependent, independent and controlled variables in the experiment.

Activity 7.6. Can you dissolve solute faster?

Design and carry out the experiments in three groups to investigate the factors that affect solubility of substances. At the end of the activity, students in their respective group can present their findings to the rest of the groups.

Group I: Temperature

Materials required

Beaker, tripod stand, measuring cylinder, spirit lamp, spatula, wire gauge, water, and potassium nitrate (KNO_3).

Group II: Stirring

Materials required

Beakers, spatula, measuring cylinder, glass rod, water, and potassium nitrate (KNO_3).

Group III: Size of particle

Materials required

Beakers, water, sugar cubes, measuring cylinder, and mortar and pestle.

Reprint 2024

Questions

1. You just spilled suja on your favourite dress; how will you remove the stain of smeared butter from your dress??
2. Give an example each for aqueous and non-aqueous solution.
3. Tashi wants to prepare a sugar solution in a short period of time. Mention and explain the factors that he should consider to prepare the solution.

Exercise

Multiple Choice Questions.

1. Water cycle is an example of physical change. The characteristic that best describes this change is
   A. composition changes .
   B. composition remains the same.
   C. mass changes.
   D. form remains the same.
2. Which is not a sign that a chemical change has occurred?
   A. There is a colour change.
   B. The original substance is obtained easily.
   C. A new substance with different properties is formed.
   D. Heat or light is given off.
3. Although the cooking gas, LPG (liquefied petroleum gas), exists in the form of a liquid when inside a cylinder; following changes occur during the process of cooking:
   a. it changes into gaseous form (change: A) when it comes out of the cylinder
   b. when lighted with a gas lighter or a match sticks it starts to burn (change: B).

Reprint 2024

Read the following statements pertaining to these changes, and choose the correct one.

A. Process A is a chemical change.
B. Process B is a chemical change.
C. Both processes A and B are chemical change.
D. Both processes A and B are physical change.

4. The solvent used to dissolve sulphur is

   A. petrol.
   B. water.
   C. carbon disulphide.
   D. turpentine oil.

5. Cutting off hair and nail is an example of ____________ change.

   A. chemical
   B. physical
   C. both physical and chemical
   D. neither physical nor chemical

Fill in the blanks

1. A solution which dissolves no more solute at a particular temperature is called a ....solution.
2. Substance 'A' underwent a change to form substance 'B'. The mass was found to be same before and after the change. This process is governed by the law of ....
3. Burning of fossil fuels produces ....gases.
4. Dema cuts an apple into two halves, which turns brown after sometime. The colour change is an example of .... change.
5. Dorji dissolves salt in beaker A at 30°C and B at 50°C. The solubility of salt is ....in beaker A than in beaker B.

Answer the following questions

1. Classify the following changes as physical change or chemical change.
   - Mixing of baking soda and vinegar
   - Digestion of food

Reprint 2024

- Sawing of wood
- Drying of cloth
- Fermentation
- Falling of leaf

2. Figure 7.4 shows a solid ball and a ring before and after heat is applied to the metal ring. Before heat is applied, the metal ball does not pass easily through the ring. After heat is applied to the metal ring, the metal ball passes through it.

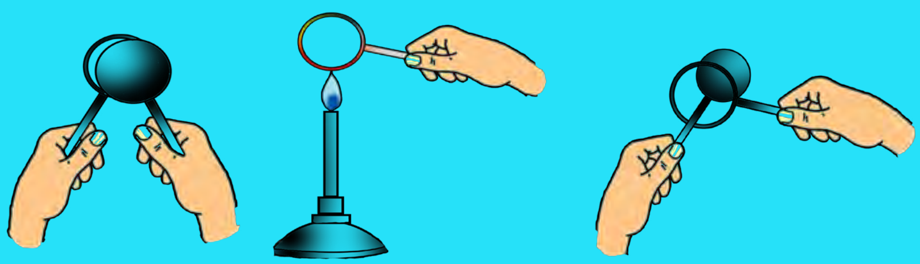


Figure 7.4.

   a. What evidence shows that a physical change took place in the metal ring?
   b. Explain, why heating the metal ring caused this physical change.
   c. Explain, why this is not an evidence of chemical change.

4. A painter does not have an orange colour, so he mixes red and yellow to obtain it. Is this a physical or chemical change? Why?
5. You must have often seen colour fading from the curtain at your home after a few months.
   i. What type of change is it?
   ii. Why has the change occurred?

Reprint 2024

Chapter 8
Mixture

In the lower classes, you have learnt that almost all the substances which occur in nature do not exist in pure form. They usually mix to form different substances called mixtures. Mixture may contain two or more components, which are physically combined and can be separated by physical means such as evaporation, filtration, decantation, sedimentation, hand-picking, sieving, magnetic separation, etc.

1. Mixture and its Type

Learning Objectives

On completion of this topic, you should be able to:

- differentiate homogeneous and heterogeneous mixture.
- prepare homogeneous and heterogeneous mixture.
- state the characteristics of mixture.

A mixture is substance which contains two or more substances combined physically in any proportion. For example: air, tooth paste, steel, soil, blood, milk, etc. The components of mixture do not lose their individual properties and can be separated by physical means.

Activity 8.1. Distinguishing homogeneous mixture and heterogeneous mixture

Materials required

Beaker, water, copper sulphate crystals, measuring cylinder, sulphur powder, and glass rod.

Procedure

Step 1. Fill 100 mL of water in each of the beakers labelled A and B.

Step 2. Add two spatula of copper sulphate in beaker A, and two spatula of sulphur powder in beaker B.

Step 3. Stir them with glass rod for 5 minutes.

Step 4. Keep the beakers undisturbed for a few minutes.

Step 5. Observe what happens.

Now answer the following questions.

i. Compare the appearance of the content of the two beakers.
ii. How are particles in beaker A distributed? Name the type of mixture.
iii. How are particles in beaker B distributed? Name the type of mixture.

Hence, on the basis of the distribution of particles of components in any mixture, the mixture can be homogeneous or heterogeneous.

a. Homogeneous Mixture

In Activity 8.1, you have observed that the particles in beaker A are evenly distributed throughout the solution. Similarly, the ice-cream you eat consists of milk fat, cream, sugar, colours, and flavour, which are also uniformly distributed throughout: in such mixture, the components cannot be distinguished. Such type of mixture is called **homogeneous mixture**. Generally, many homogeneous mixtures are referred to as solutions. Can you list down some homogeneous mixtures?

(a) Jelly (b) Coloured solutions (c) Ice cream (d) Butter lamp

Figure 8.1. Homogeneous mixture.

WEBLINK
http://www.factmonster.com/dk/science/encyclopedia/mixtures.html
http://www.ducksters.com/science/chemistry/chemical_mixtures.php

Reprint 2024

Some more examples of homogeneous mixture are fruit juice, milk and water, medicines in solution form (syrup), petrol and diesel, air, etc. Metals can also form homogeneous mixtures called **alloys**. For example, copper (Cu) and zinc (Zn) are mixed uniformly to produce brass, which is an alloy. Similarly, copper, zinc and tin (Sn) are mixed uniformly to make bronze.

b. Heterogeneous Mixture

There are many substances that do not mix. For instance, some solids do not dissolve in liquid, and some liquids do not mix with each other. Flour does not dissolve in water but forms slurry. The particles of flour are spread throughout the water and eventually settle down if left undisturbed. The curry, **bathu**, **chowmein**, **momo,** pizza, curd, etc that you eat are also examples of mixtures. In these types of mixtures, the components are not uniformly distributed and easily distinguishable. Such type of mixture is called **heterogeneous mixture.**

(a) Lentils (b) Muddy water (c)Bottled pickle (d) Oil in water

Figure 8.2. Heterogeneous mixture.

Can you list some heterogeneous mixtures? Some other examples of heterogeneous mixture are iron mixed with sulphur, soil, mixture of salt and charcoal, etc.

Activity 8.2. Investigating homogeneous and heterogeneous mixtures

Materials required

Water, beaker, glass rod , measuring cylinder, iodine, potassium dichromate, sand, and ammonium chloride.

Design and carry out an experiment to find out homogenous and heterogenous mixtures.

Reprint 2024

c. Characteristics of Mixture

Activity 8.3. Exploring the characteristics of mixture

Materials required

Beaker, watch glass, spatula, soil, ethyl alcohol, measuring cylinder, water, and glass rod.

Procedure

Step 1. Take two beakers and label them as A and B.

Step 2. Add two spatula of soil and 50 mL of water in beaker A.

Step 3. Take 50 mL of ethyl alcohol and 50 mL of water in beaker B.

Step 4. Mix the components of beakers thoroughly with the help of glass rod.

Step 5. Allow them to stand for five minutes and observe carefully.

Step 6. Copy and complete Table 8.1.

Table 8.1 *Characteristics of Homogeneous and Heterogeneous Mixture*

Sl. No	Characteristics of Mixture	Beaker A	Beaker B
1	Components		
2	How are particles distributed?		
3	Number of phases in the mixture		
4	Can be separated easily by physical means		
5	Types of mixture		

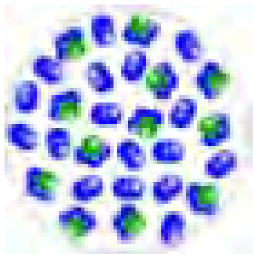
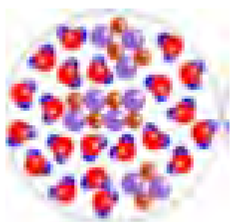
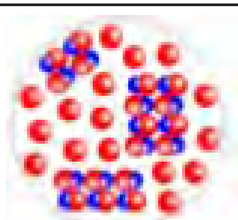
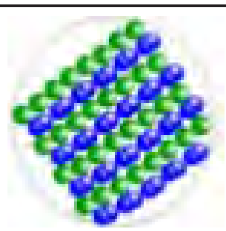
Answer the following questions.

i. Write the characteristics of mixture in beaker A.
ii. Write the characteristics of mixture in beaker B.
iii. Give two more examples of each type of mixtures.

Now, observe the following images of different materials in Table 8.2. Copy and complete the table.

Reprint 2024

Table 8.2 *Particle Arrangement in Mixtures*

Sl. No	Particles Arrangement	Homogeneous (Yes/No)	Heterogeneous (Yes/No)
1			
2			
3			
4			

Reprint 2024

Questions

1. Look at Figure 8.3. Beaker A contains lead chloride in water, and beaker B contains potassium nitrate in water. Identify the type of mixtures and write down at least three differences between the two.

A **B**

Figure 8.3.

2. Table 8.3 shows different substances. Classify each substance as mixture or pure substance. Further, classify mixture as homogeneous or heterogeneous.

Table 8.3 *Mixture and Pure Substance*

Substance	Type of Substance	Heterogeneous Mixture	Homogeneous Mixture
Tap water			
Brass			
Concrete			
Aluminium foil			
Carbonated drink			
Oxygen			
Black tea			
Salty water			
Baby milk			

http://www.kentchemistry.com/links/Matter/separation.htm
http://amrita.olabs.co.in/?sub=73&brch=2&sim=96&cnt=1

Exercise

Fill in the blanks

1. Air is a homogeneous mixture of different gases. The constituents of air are present in .... proportion.
2. Fizzy drinks are liked by most of the children. These drinks contain dissolved ....

Check whether the following statements are True or False. Correct the false statements.

1. Milk containing mixture of fats and carbohydrates is an example of heterogeneous mixture.
2. Gold is an impure substance.
3. Two different gases together make up a mixture.
4. Sodium chloride is a mixture of sodium and chlorine.

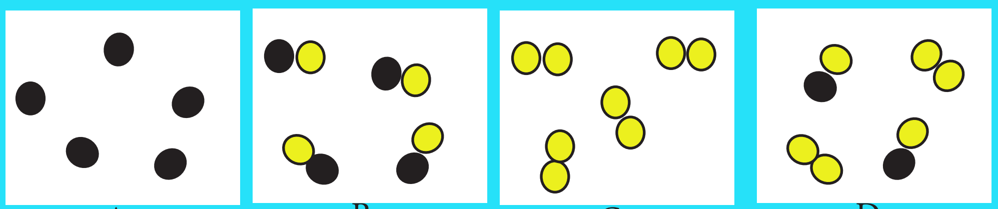
Multiple Choice Questions

1. Which of the following is not a homogeneous mixture?
   A. Smoke.
   B. Brass.
   C. Clean air.
   D. Salt solution.
2. The following are the properties of a mixture EXCEPT
   A. identity of the individual components are retained.
   B. no chemical bond is formed.
   C. new substances are formed.
   D. can be separated by a physical means.

Reprint 2024

Answer the following questions

1. In Figure 8.4, solid black circles represent the atoms of one element, while the yellow circles represent the atoms of the second element.



A B C D

Figure 8.5.

Of the four boxes shown in Figure 8.4;

i. which contain(s) chemical compounds?

ii. which contain(s) elements?

iii. which contain(s) a chemical mixture? Support your answer.

Reprint 2024

Chapter 9
Work and Energy

At a construction site, a worker carries bricks on his head. Is he doing any work? Similarly, is work being done while writing or reading?

Scientifically, work is said be done when applied force displaces the body in the direction of the force. In this chapter, you will investigate different situations where work is done and the relationship between force and displacement.

We need energy to work. Energy is the ability to do work and the energy exists in different forms. All living beings and machines use energy in different forms. Humans get energy from food which is prepared by plants. Machines get energy from electricity, coal and other sources. With the increase of population, there is tremendous pressure on the energy resources. Therefore, it is necessary for us to study about the energy resources available and their conservation.

1. Distance and Displacement

Learning Objectives

On completion of this topic, you should be able to:

- define distance and displacement.
- differentiate distance and displacement.

Distance is the actual length of the path travelled by a moving body. For example, a student going to school travels from point A to B, and then to C as shown in Figure 9.1.

Reprint 2024

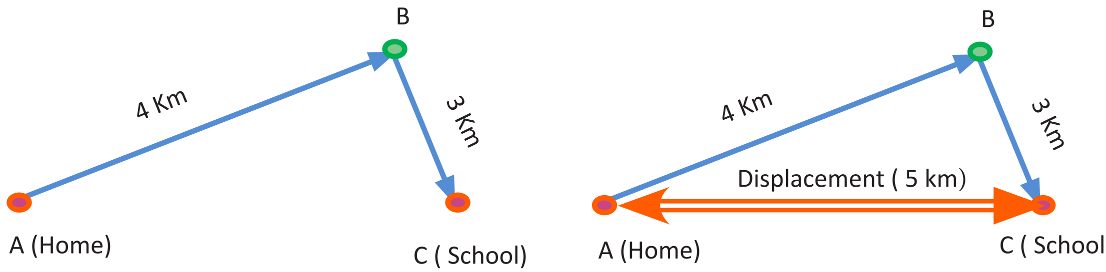


Figure 9.1. Distance and displacement.

Distance travelled = AB + BC
= 4 km + 3 km = 7 km

The total distance travelled by the student from points A to B and then to point C is 7 km. In this case, the direction in which the body travels is not considered.

The shortest distance travelled by the student is the distance between the points A and C, which is 5 km. This is called the **displacement**.

If a body moves from A to C and then back to A, the starting point and the finishing point coincide. Thus, the displacement of the body is zero. In other words, the displacement of the body may be zero even if the distance is travelled by the body. The displacement is always equal to or less than the total distance travelled.

Figure 9.2 illustrates the example of zero displacement:

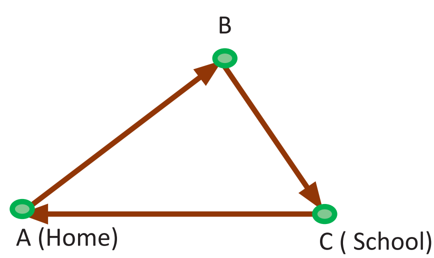


Figure 9.2. Zero displacement

Activity 9.1. Investigating the difference between distance and displacement

Materials required

Pencil, thread and metre rule.

This is Karma's village. Karma studies in class VII and goes to school on foot. Karma's house is located on the slope in the western side of the village. The

Reprint 2024

school is located on the opposite hill facing Karma's house and the Basic Health Unit(BHU) is near the stream.

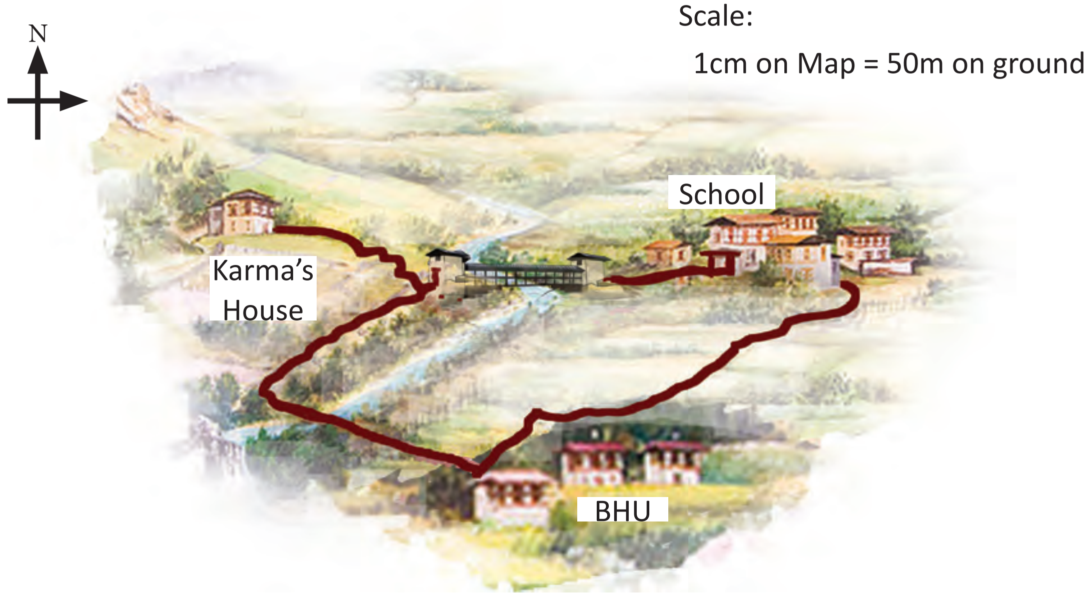


Figure 9.3. Karma's village.

Let us help Karma to explore different routes to go to the school and the BHU. Follow the given procedure to determine the distance and displacement between the places.

Procedure

Step 1. Study the map given in Figure 9.3.

Step 2. Take a thread and place one of the ends of the thread at the start point of the journey. Make sure this end of the thread is fixed on the location.

Step 3. Extend the thread exactly along the path travelled till the end point of the journey. Mark the end point on the thread.

Step 4. Now, straighten the thread and measure the length of the thread using the metre rule. This is the actual distance travelled between the two points.

Step 5. Determine the displacement by measuring the length of straight line between the two points using metre rule.

Step 6. Use the scale of the map to determine the actual distance and the displacement.

Reprint 2024

Answer the following questions.

i. What is the distance between Karma's house and his school?
ii. What is the displacement between Karma's house and his school?
iii. Which is the shortest route to BHU from Karma's house?
iv. What is the displacement between Karma's house and BHU?
v. Karma goes to school and visits BHU in the afternoon. He arrives home late from BHU. What is the total distance travelled by Karma? What is the displacement?

2. Work Done

Learning Objectives

On completion of this topic, you should be able to:

- define work and state its unit.
- give example and non-example of work.
- find the relationship between work, force and displacement.
- calculate work done.

Work is said to be done when a force is applied on a body and the body is displaced in the direction of the applied force. Look at the pictures in Figure 9.4.

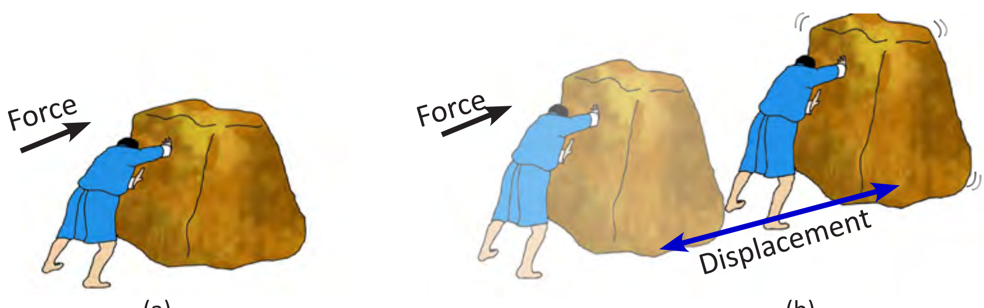


Figure 9.4. Work done

Which figure illustrates work is done by the man? Why?

In Figure 9.5 Pema stands still holding a bucket of water. She applies force to hold the bucket but the displacement is zero. Therefore, the work done is zero. However, if Pema carries the bucket of water to another location, then work is done by Pema because the force is applied and there is displacement of the object (bucket).

Therefore, work is done only if both force and displacement exist simultaneously.

Figure 9.5. Pema holding a bucket.

Activity 9.2. Investigating work done

Metre rule, carton box, chalk, and textbook.

Investigation 1

Procedure

Step 1. Mark position A on your classroom floor using a chalk.

Step 2. Measure a distance of 5 m from position A in a straight line and mark it as position B.

Step 3. Mark another position C outside the classroom at a distance of 15 m from position B.

Step 4. Put 15 science textbooks in a cartoon box and lift it.

Step 5. Carry the box from position A to position B.

Step 6. Carry the box with the same number of textbooks from position B to position C.

Answer the following questions.

i. What entity remained same in the movement of box from position A to position B and from position B to C?
ii. What has changed in moving box from position A to position B and then from position B to position C?
iii. Did you do any work while moving from position A to position B? Why?

Reprint 2024

iv. When did you do more work in moving the science textbooks? Why?
v. How is work done and displacement related?

Investigation 2

Procedure

Step 1. Mark Position A on your classroom floor using a chalk.

Step 2. Measure a distance of 5 m from position A in a straight line and mark it as position B.

Step 3. Put 10 science textbooks in a cartoon box and lift it.

Step 4. Carry the box from position A to position B.

Step 5. Add another 10 textbooks in the cartoon box.

Step 6. Carry the box back from position B to position A.

Answer the following questions:

i. What entity remained same in the movement of box from positions A to B and back?
ii. Were the forces required to move the box equal while you were moving it to and fro from positions A to B? Why?
iii. Did you do any work while moving from position A to Position B? Why?
iv. When did you do more work in moving the box? Why?
v. How are work done and force related?

The amount of work done is the result of the magnitude of force applied and the displacement of the body due to force applied. The magnitude of work done increases with the increase in the applied force (F), or the increase in displacement (S), or increase in both force and displacement.

Therefore, the amount of work done:

- is directly proportional to the magnitude of the force applied.

  i.e. $\mathbf{W} \propto \mathbf{F}$ -------- equation 1
- is directly proportional to the displacement of the body in the direction of the force applied.

  i.e. $\mathbf{W} \propto \mathbf{S}$ --------- equation 2

Therefore,

$$\textbf{Work done (W)} = \textbf{Force (F)} \times \textbf{Displacement (S)}$$

Work done is defined as the product of the applied force and the displacement of the body.

Work done is measured in **joules (J)** or **newton meter (Nm).**

One joule of work is said to be done if a force of one newton displaces a body by one metre in the direction of the force applied.

Example

A man pushes a table in a straight line with a force of 20 N. How much work is done in moving the table through a distance of 50 m?

Solution:

Given force = 20 N, distance = 50 m

Work = Force x displacement

= 20 x 50 =1000 J

Question

A bulldozer does a work of 50,000 J to move a boulder through a distance of 15 m. Calculate the force applied by it.

WEBLINK

http://www.physicsclassroom.com/mmedia/kinema/trip.cfm
http://www.physicsclassroom.com/Class/energy/u5l1a.cfm

Reprint 2024

3. Source of Energy

Learning Objectives

On completion of this topic, you should be able to:

- define renewable and non-renewable energy.
- classify the energy sources as renewable and non-renewable.

Demand for energy is on the increase with increasing technological progress day by day. We use machines for doing most of our work. Due to this, the demand for energy is growing at a tremendous rate. This growing demand for energy is largely met by the traditional sources of energy like fossil fuels, hydropower, biomass, wind, solar, etc.

Hydropower, biomass and solar are the main sources of energy available in our country. Many countries use other sources like wind, coal, geothermal, crude oil, nuclear, gas, batteries, and waves.

Activity 9.3. Source of energy

Use search engine to find information on the following.

a. Biomass
b. Geothermal energy
c. Solar energy
d. Wind energy
e. Hydropower
f. Fossil fuel
g. Nuclear energy

Present your work to the class using any presentation software.

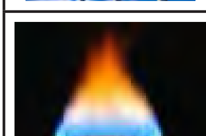
Energy sources can be either renewable or non-renewable sources depending on their ability to replenish. Non-renewable sources of energy are those energy sources, which are limited and exhaust with use over time. Renewable sources of energy are those, which can be replenished over a short period.

Reprint 2024

Activity 9.4. Classifying sources of energy

Study the pictures and read their description given in Table 9.1. Classify them into renewable and non - renewable sources of energy.

Table 9.1 *Classification of Energy Sources*

Energy Source	Description	Renewable	Non Renewable
 Hydropower	Used to generate electricity by using water.		
 Coal	It is a fossil fuel which takes long time to form.		
 Wind	Generates electricity by using wind.		
 Biomass	It is plant or animal material used for energy production.		
 Hot spring	It is geothermal energy from under ground.		
 Nuclear	Produces energy from nuclear fuel.		
 Solar	Traps solar energy.		
 LPG	Burning of petroleum gas.		

Reprint 2024

Answer the following questions.

i. Explain renewable and non-renewable sources of energy.
ii. Which sources of energy are commonly used in our country?
iii. The hydropower and fossil fuel are two sources of energy. Justify which one is eco-friendly.
iv. Why is renewable energy considered as clean energy?

Reprint 2024

Activity 9.4. Case study

Transport sector, Bhutan's biggest threat: Agriculture Minister

Bhutan's biggest threat today in terms of energy is the transport sector, agriculture minister Dr. Pema Gyamtsho said yesterday at the Delhi Sustainable Development Summit.

While Bhutan has been able to provide clean drinking water and energy to its population, most revenue it earned from selling hydropower power was spent on fossil fuel.

"Unless we transform our transport sector and look into alternative forms of energy to run them, we're going to face tremendous challenges," he said. "Pollution from use of fossil fuel is a threat ecologically and economically to Bhutan and transport sector is Bhutan's main source of pollution."

Given the potential threats to hydropower plants from GLOFs (glacial lake outburst floods) due to melting glaciers and its impact, Bhutan has put in place a comprehensive framework of renewable energy resources to have a mix of energy supply sources such as biogas, wind and solar energy.

"What is at stake is the future, the future of our generations and we need governments that can make bold decisions now rather than later," the minister said.

Director of the Earth Institute and special advisor to the secretary general of the UN Prof. Jeffrey Sachs said the world had not acted at a political level but the challenge was to harness knowledge and show the way forward.

"We are at a moment of hope and people are aware about the crisis," he said.

(Source: *Kuensel, dated 2nd February, 2013*)

Do You Know?

Petroleum is also called Black Gold, because of its importance today.

Questions

Answer the following questions based on the case study.

1. Which sector is the biggest threat to Bhutan in terms of energy?
2. Bhutan cannot rely only on hydropower as the source of energy. Justify.
3. What strategies is Bhutan adopting in reversing energy crises trend?
4. Although Bhutan produces green energy, yet we are concerned with our environment being polluted. Why do you think so?

Exercise

Fill in the blanks

1. Displacement is the shortest………………. travelled by a moving body through entire journey.
2. The work done by the man pushing fixed wall with the force of 100 N is…………
3. In Bhutan, …………..is clean and most widely used source of energy.
4. Type of energy derived from hot spring is an example of…………….. energy.

Match the following.

Column A	Column B
1. A force of 1 N produces a displacement of 1 m.	A. Zero displacement
2. Renewable source of energy	B. newton metre
3. A unit used to measure work	C. One joule
4. A boy completed the race in a 200 m circular track.	D. Fossil fuel
5. Non-renewable source of energy	E. newton
	F. Hydropower
	F. 200 m displacement

Reprint 2024

Check whether the following statements are True or False. Correct the false statements.

1. Displacement and distance travelled can be equal for a given body.
2. Nuclear energy and fossil fuel are example of renewable energy.
3. Non-renewable source of energy is exhausted over time.

Multiple Choice Questions

1. Work done = Force x ....
   A. displacement
   B. distance
   C. velocity
   D. speed
2. Distance and displacement are equal to each other if the body moves along
   A. a circular path.
   B. an elliptical path.
   C. a straight line path.
   D. a curved path.
5. The bike starts at A and goes to the points B, C and D and finally reaches A as shown in Figure 9.6. What is the distance and displacement covered by the bike?
   A. 320 km and 320 km respectively.
   B. 320 km and zero km respectively.
   C. zero km and 320 km respectively.
   D. 320 km and 220 km respectively.

Figure 9.6.

5. In which case is the work being done?
   A. A man pushing a wall.
   B. A boy running around a circular track.
   C. A girl climbing a ladder.
   D. A boy standing with his school bag.
6. Which one of the following is NOT an example of biomass?
   A. LPG.

B. Kerosene.
C. Mustard oil.
D. Diesel.

7. Which of the following is a non- renewable energy resource?
   A. Solar.
   B. Biogas.
   C. Hydroelectricity.
   D. Coal.
2. A labourer carries a load of 500 N to a distance of 100 m. The work done by him is
   A. 5 J.
   B. 50,000 J.
   C. 0J.
   D. 0.2J.

Answer the following questions

1. Define the term work and state its unit.
2. An ant is dragging a house-fly and the elephant is pushing a big tree which is not moving. Who is doing work, the ant or the elephant? Justify your answer.
3. A force of 20.5 N displaces a body by 45 m. How much work is done?
4. Sonam has done work of 1000 J while pushing a table using 300 N force. Find the distance covered by table along the direction of the force.
5. Why is it necessary to use the fossil fuels judiciously?
6. Renewable energy is an important alternate source of energy. Why?
7. Construction of wind energy farm is not ideal in places like Phuentsholing. Give reason.
8. What are the limitations of using solar panels?

WEBLINK

http://www.educapoles.org/multimedia/animation_detail/biofuels_a_green_alternative_to_oil/
http://www.sciencemuseum.org.uk/energy/site/EIZinfogr.asp
http://cset.sp.utoledo.edu/~energy/finishedflash/fossil_st3_6_6fin.swf

Reprint 2024

Chapter 10
Force and Motion

In our surroundings, objects are either at rest or in motion. Objects at rest can be set into motion or objects in motion can be brought to rest by applying forces. Force can change shape and size of an object, change the direction of motion of an object, or make a moving body move faster or slower. People have explored, devised and invented many simple machines to make the work easier.

1. Linear Motion

Learning Objectives

On completion of this topic, you should be able to:

- define speed and unit of speed.
- describe how the speed of an object along the path travelled can vary.
- calculate speed and average speed.
- describe the effects of balanced and unbalanced forces.

One of the effects of force is the change in speed of a body. This effect of force on an object can be verified by measuring the speed of a body.

a. Speed and Average Speed

When a body is in motion, it either moves fast or moves slow. The speed is the quantity which determines how fast or slow the body is moving. When a body moves from one place to another, some distance is covered in a given time. The actual path travelled by the body is called distance. It is generally represented by the symbol 'd' and its unit is metre (m). The time taken by an object to cover a certain distance is represented by symbol 't' and its unit is second (s).

Reprint 2024

Activity 10.1. Who can run fast

Materials Required

Stopwatch, measuring tape, notebook, and pen.

Investigation 1

Procedure

Step 1. Identify a race starter, 5 judges at each end point with stopwatch and a time recorder.

Step 2. Mark a start line and the finish line at about 50 m from the start line.

Step 3. Identify five runners consisting of both boys and girls.

Step 4. Conduct the race.

Step 5. Record the time taken by each runner in Table 10.1.

Step 6. Use spreadsheet to find the position of each runner based on the time taken

Table 10.1 *Observation of Time*

Sl No	Name	Distance (metre)	Time Taken (second)	Position

Answer the following questions:

i. What is the constant quantity in Table 10.1?
ii. Who stood first?
iii. Who stood last?
iv. How do you determine the position of the runners?
v. Who ran with the highest speed?

Reprint 2024

http://www.tutorvista.com/physics/animations/speed-time-graph-animation

Investigation 2

Procedure

Step 1. Exchange the roles of race starter, line judges with the earlier runners.

Step 2. Let the runners run for 5 seconds in the same direction.

Step 3. Record the distance covered by each runner in Table 10.2.

Table 10.2 *Observation of Distance*

Sl No	Name	Distance (metre)	Time Taken (second)	Position

Answer the following questions:

i. What is the constant quantity in Table 10.2?
ii. Who ran the longest distance?
iii. Who ran the shortest distance?
iv. How do you determine the position of the runners?
v. Who ran with the highest speed?
vi. What conclusion can you draw from Investigation 1 and Investigation 2?

Speed is the distance travelled by a body in equal interval of time. If a moving body travels a distance (d) in time (t), then:

i. Speed increases with an increase in distance covered in the same time, i.e, speed is directly proportional to distance for a constant time.
ii. Speed decreases with an increase in time required to cover the same distance, i.e, speed is inversely proportional to time for constant distance.

Reprint 2024

Therefore,
$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

When a body covers a distance of one metre in one second, then the speed of the body is equal to one metre per second. The unit of speed is **metre per second** which is represented as **m/s** or **ms $^{-1}$**.

$$\text{i.e, speed} = \frac{\text{1 metre}}{\text{1 second}} = 1\text{m/s}$$

Example 10.1.
If a bus covers a distance of 150 m in 5 s, we can calculate

i. speed of the bus
ii. time taken by the bus to cover a distance of 300 m at the same speed.

Solution:
i. The speed of the bus

$$\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{150\text{m}}{5\text{s}} = 30\text{ms}^{-1}$$

ii. Time taken to cover a distance of 300 m.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\therefore \text{ time taken} = \frac{\text{distance}}{\text{speed}} = \frac{300\text{m}}{30\text{ms}^{-1}} = 10\text{s}$$

Questions

1. Dorji runs to school which is at a distance of 500 m. He takes 50 seconds to reach the school. At what speed does Dorji run?
2. Dema took 2 minutes at a speed of 10 m/s to reach a shop from her house. How far is the shop from Dema's house?

Reprint 2024

Usually bodies do not move from one place to another with the same speed during the journey. A vehicle, a train or a boat will have to slow down or speed up depending upon the traffic. The speed will be high if the traffic is clear, but it will be low if the traffic is crowded. We use **average speed** to describe the rate of such motion, which has different speed at different interval of time.

Average speed of a body for a journey is calculated by comparing the total distance travelled by the body to the total time taken to complete the journey.

Average speed is the ratio of the total distance covered to the total time taken which is mathematically represented as:

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

Average speed is also measured in $\mathbf{ms^{-1}}$

Consider a car travelling from Gelephu to Tsirang as shown in Figure 10.1.

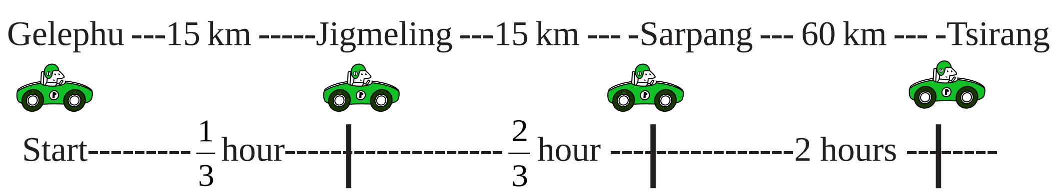


Figure 10.1. Journey from Gelephu to Tsirang

Total distance covered = 15 km + 15 km + 60 km = 90 km

$$\text{Total time taken} = \frac{1}{3}\text{h} + \frac{2}{3}\text{h} + 2\text{h} = 3\text{h}$$

$$\therefore\ \text{average speed} = \frac{\text{total distance covered}}{\text{total time taken}} = \frac{90\text{km}}{3\text{h}} = 30\text{km/h}$$

$$= 30 \text{ X} \frac{1000\text{m}}{60\text{X}60\text{s}} = 8.33\text{m/s}$$

If the average speeds of two cars travelling from Trongsa to Thimphu is 40 km/h and 25 km/h, it is understood that the first car is travelling at a higher speed than the second car and will reach Thimphu earlier.

Reprint 2024

Question

From Figure 10.2 determine the average speed of the cyclist in metre per second.

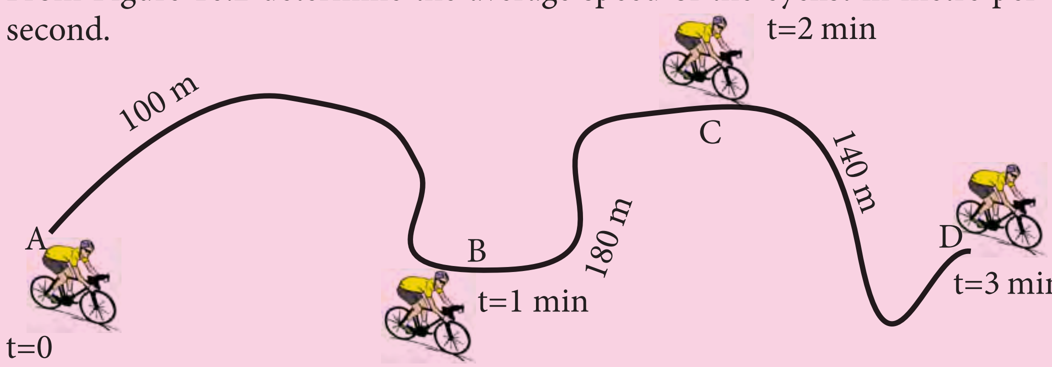


Figure 10.2.

b. Balanced and unbalanced force

Force is a physical cause that can make a body to stop, move, or change the direction of a moving body. When a single force acts on a body, the body may move or may not move. If the force is strong enough to overcome the weight of the body then the body will move. The movement of a body is determined by the magnitude of the force and the line of action of the force. Generally, a single force displaces the body in the direction of the line of action of the force as shown in Figure 10.3 (a) and (b) .

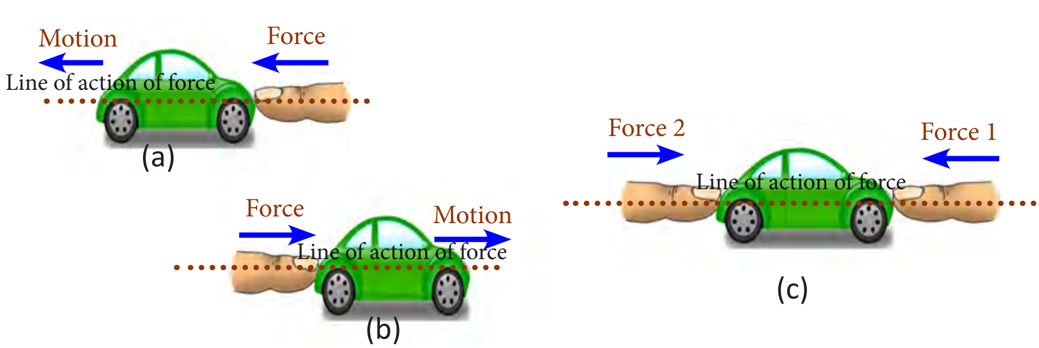


Figure 10.3. Direction of motion.

When we apply two forces of equal magnitude along the same line of action in the opposite direction to a rigid body at rest, the body does not move as shown in Figure 10.3 (c). However, when we apply two forces of equal magnitude along the same line of action in the opposite direction to a rigid body in the motion, the body continues to move with the constant initial speed in the same direction. This is because in both the cases, forces will cancel the effects of each other. Hence, the resultant force will be zero irrespective of the state of the body.

Similarly, if multiple forces act on a rigid body and if the forces cancel the effects of one another, then the resultant force will be zero. These forces are called **balanced forces**.

Balanced forces do not bring about change in the state of a rigid body, but may temporarily deform an elastic body as shown in Figure 10.4.

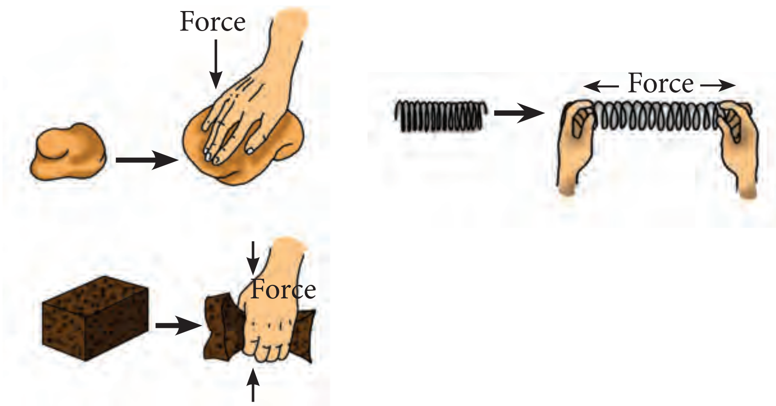


Figure 10.4. Forces acting on elastic body.

When two or more unequal forces act on a rigid body at rest, the body moves. In this case, the magnitude of the forces are not equal and therefore, the resultant force is always greater than zero. The direction of motion of the body is in the direction of resultant force. Such unequal forces that brings about motion to a body is called **unbalanced forces**.

Figure 10.5 shows a boat pulled by two forces and the direction of the resultant force.

When unbalanced forces act on a body and the motion of the body is along the straight

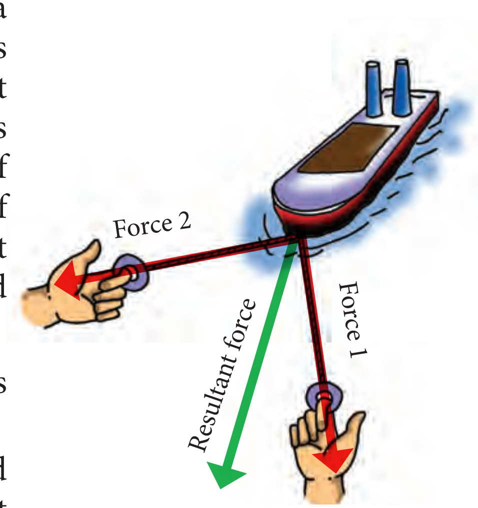


Figure 10.5. Resultant force due to unequal force.

Reprint 2024

line, the type of motion is called **linear motion** or **translational motion**. The change in position of a body will depend on the magnitude of resultant of the unbalanced forces. Linear motion is the basic of all motions.

Linear motion is of two types: uniform linear motion and non-uniform linear motion. When a body moves under the influence of unbalanced forces with constant speed along the straight line, the body is said to be in **uniform linear motion**. When a body moves under the influence of unbalanced forces with varying speed along the straight line, the body is said to be in **non-uniform linear motion.**

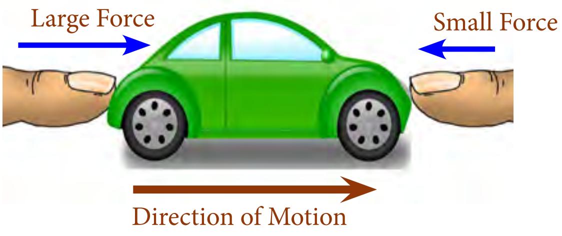


Figure 10.6. Demonstration of linear motion.

Questions

1. What factor determines the motion as uniform and non-uniform linear motion?
2. Give two examples of linear motion and two examples of non-linear motion.
3. Use the PhET simulation from the given URL and complete Table 10.3. https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html

Table 10.3 *State of Body*

Force Used by Blue Team	Force Used by Red Team	Final State of the Body	Direction of Motion	Resultant Force	Who Wins
150 N	100 N				
200 N	200 N				
50 N	150 N				

What is the state of the body when the net force is zero?

Give an examples of balanced and unbalanced force?

Reprint 2024

2. Rotational Motion

Learning Objectives

On completion of this topic, you should be able to:

- describe how forces cause objects to turn about a pivot.
- discuss a variety of examples of rotational motion.

When a force is applied to a rigid body such that the body rotates about an axis, then the body is said to be in **rotational motion**.

Some of the common examples of rotational motion, which we come across in our day-to-day lives are opening a door or a window, opening and closing of water tap, opening the lid of a water bottle, turning **mani-dungkhor** and **la-khor**.

Mani-dungkhor

La-khor

Water tap

Figure 10.7. Objects that rotate.

Activity 10.2. Investigating motions

Procedure

Step 1. Identify any two objects in the classroom that you think will rotate.

Step 2. Apply force on one of the objects so that it rotates.

Step 3. Draw diagram of the object and indicate the point of application of force, direction of motion, and the axis of rotation.

Step 4. Repeat Step 2 and Step 3 for the other object.

Reprint 2024

Answer the following questions.

i. Describe the motion observed in the two bodies.

ii. List examples of bodies that show rotational motion in your surrounding.

WEBLINK

http://www.skwirk.com.au/p-c_s-4_u-193_t-534_c-1995/WA/8/Balanced-and-unbalanced-force/Forces/Forces/Science/

http://eschooltoday.com/science/forces/resultant-forces.html

Reprint 2024

3. Simple Machines

Learning Objectives

On completion of this topic, you should be able to:

- describe mechanical advantage and efficiency of a simple machine.
- explain how simple machines multiply force, gain speed and gain efficiency.

Simple machines are tools that make work easier. They have a few or no moving parts. These machines usually use less energy to work and increase the efficiency of the work done. Therefore, simple machines are those devices that multiply force and distance, change the speed or help to apply force at a convenient point and direction.

a. Mechanical Advantage of Simple Machines

Simple machines are designed and built for specific tasks. The amount of force involved can be calculated by comparing the force applied on the machine (**effort**) with the force overcome by the machine (**load**). This value of the comparison is termed as **mechanical advantage (MA)** of a machine.

Mathematically,

$$\text{Mechanical Advantage (MA)} = \frac{\text{Load}}{\text{Effort}}$$

The value of the mechanical advantage of simple machine can be one, greater than one or less than one. It has no unit of measurement.

For example, if a man applies force of 250 N at the end of crowbar and moves a rock of 1000 N, then the load is 1000 N and effort is 250 N.

Therefore, the mechanical advantage of using the crowbar is

$$\text{Mechanical Advantage (MA)} = \frac{\text{Load}}{\text{Effort}} = \frac{1000\text{N}}{250\text{N}} = 4$$

Reprint 2024

Questions

1. What does MA of 4 mean?
2. Will the effort decrease or increase if MA becomes 4? By how much?
3. MA has no unit of measurement. Why?

d. Velocity Ratio of Simple Machines

Simple machines not only multiply force, but also multiply distance and speed. Two examples of distance multipliers are the human arm and fishing rod. In these machines a small movement by effort produces a much larger movement of the load.

The gear on a bicycle is an example of a speed multiplier. The chain and gears on wheels in the bicycle are designed such that, movement of pedal produces faster rotation of wheels.

If we compare the distance moved by the effort to the distance moved by the load, we get the **distance ratio** or the **velocity ratio (VR)** of a simple machine.

Mathematically,

$$\text{Distance or Velocity Ratio(VR)} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

The value of velocity ratio depends only on the design of the machine and is always same for a particular machine. It has no unit.
For example,

If a load of 100 N is moved 10 m by moving effort over a distance 2 m as in Figure 10.8, then

$$\text{VR} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

$$= \frac{2}{10} = 0.2$$

Figure 10.8. VR of simple machine.

This means that a simple machine can move an object over a longer distance by simply moving effort over a shorter distance. The machine is a distance multiplier and its value of VR is less than 1.

e. Efficiency of Simple Machines

The law of conservation of energy states that the input energy is equal to the total output energy. When the output energy is measured by the work done by the machine, the output energy is always less than the input energy. The work done by a machine is called **useful work** or **useful output energy.** Some portion of energy input is consumed to overcome friction. This energy is termed as **wasted output energy**. Therefore, total output energy is equal to the sum of useful output energy and wasted output energy, that is,

Total output energy= useful output energy + wasted output energy

The performance of a simple machine is referred to as the **efficiency** of the machine. The efficiency of a machine can be found out by comparing the useful output energy, or work done by the machine with the energy input.

Mathematically,

$$\text{Efficiency (\%)} = \frac{\text{Useful energy output}}{\text{Energy input}} \times 100\ \%$$

Efficiency of a machine can be also calculated from the ratio of useful work done by the machine and the work input on the machine.

Useful work done = Load (force) X displacement of load (distance moved by load)

Work input = Effort (force) X displacement of effort (distance moved by effort)

Therefore,

$$\text{Efficiency (\%)} = \frac{\text{Load}}{\text{Effort}} \times \frac{\text{Displacement of Load}}{\text{Displacement of Effort}} \times 100\ \%$$

Or $$\text{Efficiency(\%)} = \text{MA} \times \frac{1}{\text{VR}} \times 100\ \%$$

$$\text{Efficiency(\%)} = \frac{\text{MA}}{\text{VR}} \times 100\ \%$$

Reprint 2024

A machine would be 100 % efficient if the work done on the machine is equal to the work done by the machine. A machine with 100% efficiency is termed as **ideal machine**.

When we use simple machine, a portion of the input energy is used up in overcoming friction existing among its parts. Therefore, output energy is never equal to input energy. In other words, no machine is 100% efficient.

Mechanical Advantage and Efficiency

i. Levers

A lever is a rigid bar which is capable of turning about a fixed point. The fixed point is called **pivot** or **fulcrum**. There are three classes of lever based on the position of fulcrum with respect to load and effort as shown in Figure 10.9. The lever in which the fulcrum is in between the effort and the load is classified as **First class lever**. In **Second class lever**, the load is located in between the fulcrum and the effort. The lever in which the effort is applied in between the load and the fulcrum is classified as **Third class lever**.

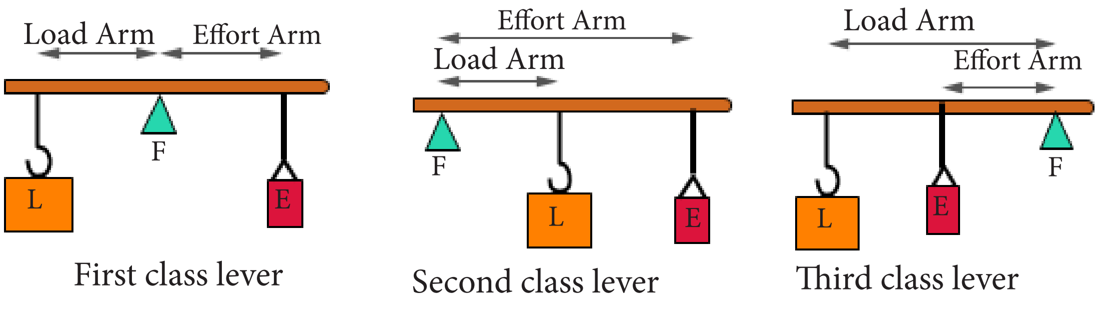


Figure 10.9. Classes of lever.

The distance from the effort to the fulcrum is called **effort arm** and the distance from the load to the fulcrum is called **load arm**.

In levers, if the load is balanced by the effort about the fulcrum then the product of load and load arm is equal to the product of effort and effort arm.

Mathematically,

$$\text{Load} \times \text{Load Arm} = \text{Effort} \times \text{Effort Arm}$$

This is known as the **principle of lever**.

Reprint 2024

Using the principle of lever, we have

$$\frac{\text{Load}}{\text{Effort}} = \frac{\text{Effort Arm}}{\text{Load Arm}}$$

Therefore, $$\text{MA of a lever} = \frac{\text{Effort Arm}}{\text{Load Arm}}$$

Thus, the mechanical advantage of a lever is determined by the ratio of effort arm to load arm.

For example, if the total length of a crowbar is 150 cm and the distance of the fulcrum from the load is 25 cm, then the mechanical advantage of the crowbar is calculated as

Load arm = 25 cm

Effort arm = 150 cm – 25cm = 125 cm

$$\text{Mechanical Advantage} = \frac{\text{Effort Arm}}{\text{Load Arm}} = \frac{125}{25} = 5$$

Thus, the MA of the crowbar is 5.

Watch video(C7_V5_Pulley, Wheel, Lever and More Simple Machines - Science for Kids) and use spreadsheet to record data for MA, VR and Efficiency.

Plot a graph to show how simple machines multiply force, gain speed, and efficiency.

Table 10.1 *Data Record of Simple Machines*

Sl No.	Type	Load	Effort	MA	Displacement of Effort	Displacement of Load	VR	% Efficiency
1								
2								
3								
4								

Answer the following questions.

i. Which machine is the most efficient?

ii. Which levers are force multiplier?

iii. Which levers are distance multiplier?

Reprint 2024

iv. Identify and explain the benefit of using each lever.
v. Explain how a crowbar, a first class lever can be used as a second class lever?
vi. A pair of scissors has short effort arm, while plier used to cut wires has long effort arm. Explain.
vii. Explain the application of principle of lever in our arms and legs.

WEBLINK
http://www.cosi.org/downloads/activities/simplemachines/sm1.html

ii. Pulley

The pulley is a wheel capable of rotating about an axis. It has grooves on the rim of the wheel along which a rope or a chain slides. A single pulley can rotate about a fixed axis or an axis that changes its position continuously making it either a fixed pulley or a movable pulley respectively. Several pulleys can also be combined together to form a block and tackle system.

Pulleys are generally used to change the direction of an effort, or to multiply force. The rope or the chain along the groove of a pulley supports the load and the effort. When a rope supports any load or effort, the rope always exerts force in the opposite direction to resist the force of the load or effort. The force exerted by the rope is called **tension**. It is directed along the length of the wire and pulls equally on the objects on the opposite ends of the wire. It is represented by a symbol **T.**

Activity 10.4. Experiencing Tension

Materials required

An empty bucket, weights or stones.

Procedure

Step 1. Find a partner to work in pairs.

Step 2. Lift the bucket 10 cm above the ground using only the right hand.

Step 3. Ask your friend to pour water into the bucket till it is half filled.

Figure 10.10. Experiencing tension.

Step 4. Identify the force acting on your arm.

Step 5. Now use both hands to lift the bucket to 10 cm above the ground.

Answer the following questions.

i. Mark all the forces as 'F' and tension 'T' in correct directions in the diagram given in Figure 10.10.
ii. What happened when the weight was increased?
iii. What happened when you used both hands? Explain.

There are several types of pulley system. Pulleys can be used as force multipliers. Each string in a pulley system exerts tension. The mechanical advantage of a pulley system is the ratio of the number of tension supporting the load to the number of tension supporting the effort.

Single Fixed Pulley

In a single fixed pulley, the wheels turn about a fixed axis as shown in Figure 10.11. The load is supported by one string, i.e, 1 T and the effort is applied through single string, i.e, 1T.

Therefore,

$$MA = \frac{\text{Load}}{\text{Effort}}$$

$$MA = \frac{1\ T}{1\ T} = 1$$

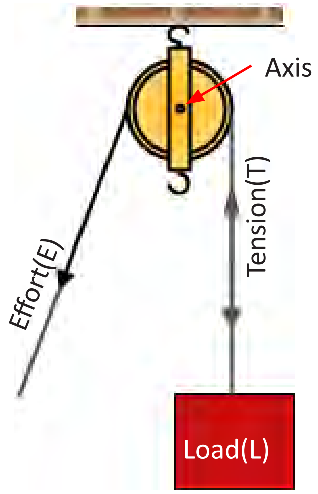


Figure 10. 11. Single fixed pulley.

Reprint 2024

The MA is 1. This means that the amount of effort required is equal to the amount of load to be lifted.

A single fixed pulley does not multiply the force. When a load is lifted by 1 m then the effort is displaced through the same distance of 1 m. Therefore,

$$VR = \frac{\text{Displacement of effort}}{\text{Displacement of load}} = \frac{1\text{ m}}{1\text{ m}} = 1$$

A single fixed pulley does not multiply the distance. Efficiency of the single fixed pulley is given by

$$\text{Efficiency }\% = \frac{MA}{VR} \times 100\% = \frac{1}{1} \times 100\% = 100\%$$

This implies that the efficiency of an ideal single fixed pulley is 100% but practically, due to the presence of friction in string and the wheel, 100% efficiency is not obtained.

Questions

1. A single fixed pulley is neither a force multiplier nor a distance multiplier. Why is it still used?
2. Mention some uses of a single fixed pulley.

Single Movable Pulley

In a single movable pulley, the axis of rotation is not fixed. The axis moves along with the movement of a load as shown in Figure 10.12. The load is supported by two strings, i.e. 2 T and the effort is applied through a single string, i.e. 1T.

Therefore,

$$MA = \frac{\text{Load}}{\text{Effort}}$$

The MA is 2. This means that the amount of

$$MA = \frac{2\text{ T}}{1\text{ T}} = 2$$

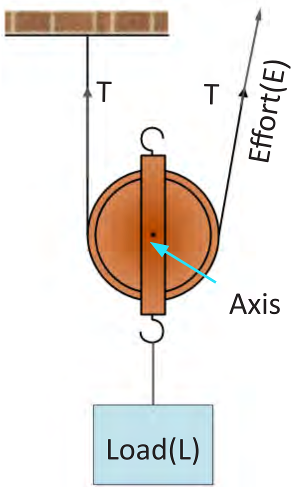


Figure 10.12. Single movable pulley.

Reprint 2024

effort applied is multiplied two times.

A single movable pulley multiply force.

When a load is lifted by 1 m, then the effort is displaced through 2 m.

Therefore,

$$VR = \frac{\text{Displacement of effort}}{\text{Displacement of load}} = \frac{2\text{ m}}{1\text{ m}} = 2$$

A single movable pulley does not multiply the distance. Efficiency of the single movable pulley is given by

$$\text{Efficiency\%} = \frac{MA}{VR} \times 100\% = \frac{2}{2} \times 100\% = 100\%$$

This implies that the efficiency of an ideal single movable pulley is 100%, but practically, due to the presence of friction in the string and the wheel, efficiency is less than 100%.

Though single movable pulley has greater advantage over single fixed pulley, it is inconvenient to use as the effort has to be applied in upward direction.

Questions

1. How would you arrange a single movable pulley such that effort is applied downward resulting in same mechanical advantage and efficiency?
2. Draw a diagram to show your arrangement of pulley in question 1.

Combination of Pulleys

Several pulleys can be combined to form a system of pulleys called block and tackle system. A block and tackle systems consist of one block of fixed pulleys and another block of movable pulleys to which load is attached. A block and tackle system is shown in Figure 10.13.

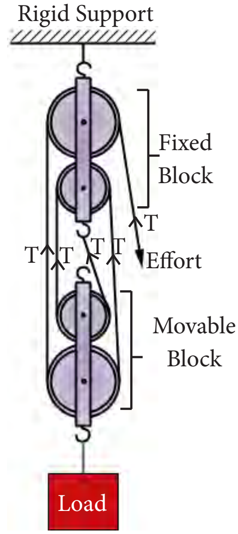


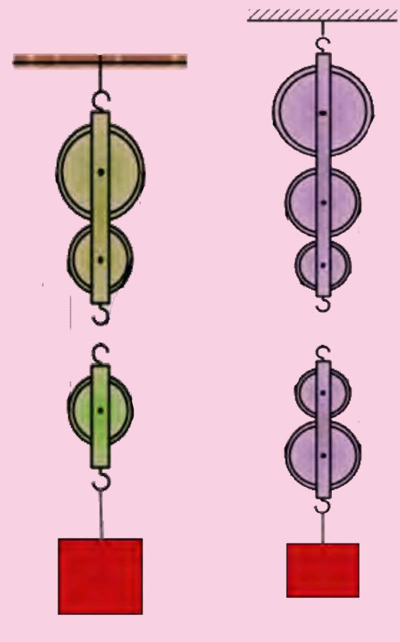
Figure 10.13. Block and tackle system.

http://www.mikids.com/SMachinesPulleys.htm

Questions

Figure 10.14 shows two systems of pulleys.

1. Copy diagram (a) and (b) in your notebook and draw a string around the pulleys such that the effort is applied downward.
2. Indicate effort, load, and tension in the diagrams.
3. Calculate the mechanical advantage, velocity ratio and efficiency percentage of each system.
4. Compare the values of MA, VR, and efficiency and predict the values of MA, VR and efficiency of block and tackle system consisting of four pulleys.



(a) (b)

Figure 10.14.

iii. Gears

We can see gears in bicycle, toys, steam engines, robots, watches, clocks, and other machines. Gears are simple machines used to control the speed and change the direction. It is also used as force multiplier. It is a circular disc with teeth around its rim capable of rotating about its axis. A **gear train** consists of two or more than two wheels with teeth interlocked into each other.

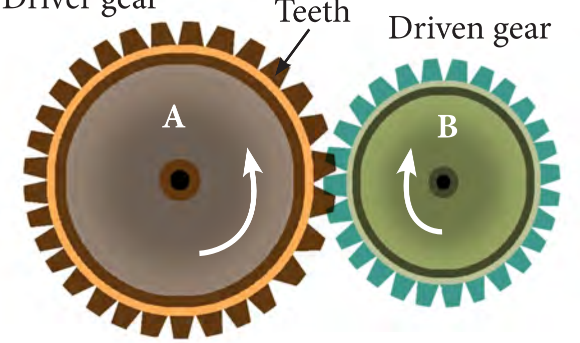


Figure 10.15. Driver and driven gear.

When one of the gears moves, it rotates all other gears. Consider a gear train as shown in Figure 10.15. The gear wheel A which receives the effort and moves first is called **driver gear**, and the gear wheel B, which bears the load and rotates due to gear wheel A is called **driven gear**. Driven gears always rotate in opposite directions of the driver gear.

Reprint 2024

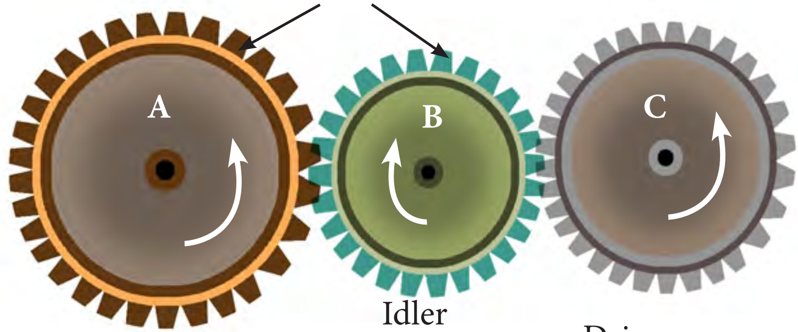


Figure 10.16. Gear train with idler.

Gear A turns in an anticlockwise direction making gear wheel C turn in an anticlockwise direction. The idler gear B is used so that the rotation of the two important gears is the same. Where there are two gears of different sizes, the smaller gear will rotate faster than the larger gear. The speed of rotation of gear is inversely proportional to the number of teeth. The comparison of these two speeds is called **velocity ratio** or **gear ratio**.

The gear ratio of a pair of gears is calculated by

$$\text{Gear ratio} = \frac{\text{Speed of rotation of driver gear}}{\text{Speed of rotation of driven gear}} = \frac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$$

Therefore, if the larger gear is set as the driver gear for the simple gear train as in Figure 10.17,

$$\text{Gear ratio} = \frac{\text{Number of teeth of driven gear}}{\text{Number of teeth of driver gear}} = \frac{30}{60} = 0.5$$

Here, we find that the amount of output force is half times the input force. However, even if force is not multiplied, the smaller gear rotates twice when larger gear rotates once. This shows the multiplication of speed, i.e., speed is gained. The gain in speed can be calculated by the following ratio.

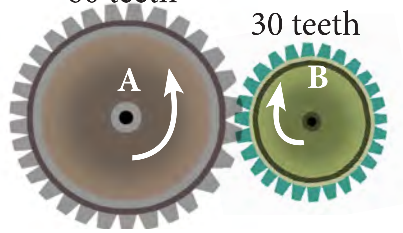


Figure 10.17. Gear ratio (I)

$$\text{Gain in speed} = \frac{\text{Number of teeth of driver gear}}{\text{Number of teeth of driven gear}}$$

$$= \frac{60}{30} = 2$$

To gain speed the smaller gear is always taken as the driven gear.

If the smaller gear is the driver gear for the simple gear train in Figure 10.17, then

Gear ratio = 60 ÷ 30 = 2

In other words, the driver gear revolves two times to make the driven gear revolve once. If 100 N force is applied to the input, then the output force obtained is 100 N x 2 = 200 N. Therefore, in this arrangement even though driven gear moves slowly, force is multiplied.

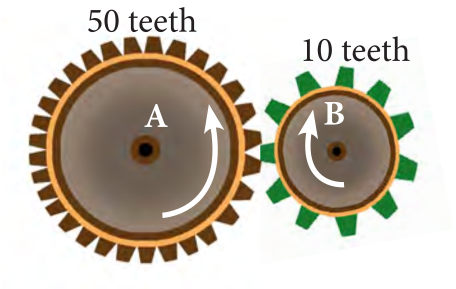


Figure 10.18. Gear ratio (II)

Similarly, in Figure 10.18, number of teeth of the driver gear = 50 and the number of teeth of the driven gear = 10

Therefore,
$$\text{Gear ratio} = \frac{\text{Number of teeth of driven gear}}{\text{Number of teeth of driver gear}} = \frac{10}{50} = 0.2$$

This means that the output is 0.2 times the input force.

Also,
$$\text{Gain in speed} = \frac{\text{Number of teeth of driver gear}}{\text{Number of teeth of driven gear}} = \frac{50}{10} = 5$$

It means, when driver gear A completes one rotation, the driven gear B completes 5 rotations. Therefore, there is an increase in the speed by 5 times. This principle of gear ratio is used in vehicles moving faster on the plain road.

If the smaller gear is the driver gear, then
$$\text{Gain in speed} = \frac{\text{Number of teeth of driven gear}}{\text{Number of teeth of driver gear}} = \frac{10}{50} = 0.2$$

$$\text{Gear ratio} = \frac{\text{Number of teeth of driven gear}}{\text{Number of teeth of driver gear}} = \frac{50}{10} = 5$$

This principle of gear ratio is used as the speed reducer and as a force multiplier.

Reprint 2024

4. Density

Learning Objectives

On completion of this topic, you should be able to:

- define density and state its unit.
- define relative density.

Every object that exists on earth is made up of small particles, and has some weight and mass of its own. Some objects sink in water and some float on water. All objects can be compared to each other based on their heaviness or lightness. These heaviness and lightness of the objects depend on the mass contained in each object. One of the unique properties of a material is the density.

a. Density

The mass of the substance is the amount of matter contained in it. The space occupied by the mass of an object is its volume. Different volume may be occupied by the same amount of mass. It depends on the type of substance. For example, one kilogram each of cotton and iron occupy different volumes. The volume of cotton is much larger than the volume of an equal mass of iron. This is because the particles of iron are closely arranged occupying less space, while the atoms and molecules in cotton are loosely arranged.

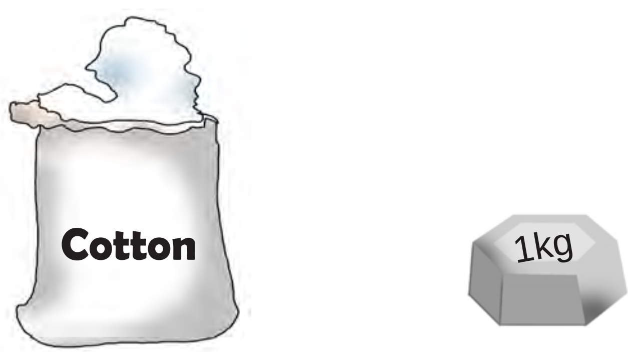


Figure 10.19. Objects with same mass.

Activity 10.6. Understanding density

Materials required

Pan balance, metre scale, transparent jar, cotton, sand, and water.

Reprint 2024

Investigation 1

Procedure

Step 1. Take two jars of equal capacity. Fill one of the jars with sand and the other with cotton.

Step 2. Measure the mass of sand and cotton using a pan balance and record them.

Answer the following questions.

i. Which quantity remained constant in the experiment?
ii. What is the volume of the sand and cotton?
iii. Which substance has more mass?
iv. Which substance is heavier? Why?
v. How are mass, volume and heaviness of a substance related?
vi. What conclusion can you draw from the experiment?

Investigation 2

Procedure

Step 1. Take one half kg each of sand and cotton. Fill sand in one of the jars, and cotton in another jar.

Step 2. Observe the space occupied by sand and cotton in the jar.

Answer the following questions.

i. What is the mass of the sand and cotton?
ii. Which quantity remained constant in the experiment?
iii. Which substance occupies more space?
iv. Which substance is of lesser volume?
v. How is mass related to volume and heaviness of sand and cotton?
vi. Draw the diagram to show the arrangement of molecules of sand and cotton in a jar.
vii. What conclusion can you draw from the experiment.

The substance is dense if the molecules are closely arranged. The amount of mass contained in a substance of unit volume is called **density**. Density is the property of a substance that differentiates heavy substance from the light ones.

Reprint 2024

From the experiments in Activity 10.6, we found that density of a substance depends on two factors.

i. Density of a substance increases with the decrease in volume for the same mass of substance.

ii. Density of a substance increases with the increase in mass in the same volume of the substance.

Therefore,

$$\text{Density} \propto \text{Mass}$$

$$\text{Density} \propto \frac{1}{\text{Volume}}$$

Mathematically,

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

If the mass is measured in gram and volume in cubic centimetre, then the unit for density is **gcm^{-3}**. The bigger unit of density is **kgm^{-3} (kilogram per cubic metre)**. Density of water is different at different temperatures. The density of water at a temperature of 4^0 C is 1 gcm^{-3} or 1000 kgm^{-3}. This means that the volume of 1cm^3 contains mass of 1 g of water, or volume of 1 m^3 contains mass of 1 kg of water. Similarly, each substance has its unique density.

Questions

1. The mass of 25 cm^3 of brass is 210 g. Calculate the density of brass.
2. Dema takes a piece of wood to find its density. She records the observation as given below:

   Length of wood piece= 5 cm

   Breadth of wood piece= 2 cm

   Height of wood piece= 2 cm

   a. Can Dema find the density from the above recording? Why?

   b. Dema places wood piece on a pan balance. Reading on the pan balance is 45 g. Will the wood float in water? Why?
3. Take any two regular shaped objects and find their densities.

Reprint 2024

b. Relative Density

Relative density is the ratio of the density of a substance to the density of a given reference material. It has no unit.

If a substance's relative density is less than one, then it is less dense than the reference; if greater than 1, then it is denser than the reference. If the relative density is exactly one, then the densities are equal; that is, equal volumes of the two substances have the same mass. If water is the reference material and the relative density of silver is 10.5. It means that silver is 10.5 times denser than water.

Mathematically,

$$\text{Relative Density} = \frac{\text{Density of substance}}{\text{Density of water (reference material)}}$$

Water is the most common reference material. The value of relative density of any substance is generally calculated with water as a reference material. Relative density is termed as **Specific gravity,** if water is used as the reference material.

A substance with a specific gravity less than one will float in water. For example, an ice cube, with a specific gravity of about 0.91, and pine wood with specific gravity about 0.5 float in water. While floating, the surface of pine wood above the level of water is greater than the surface of ice cube above water. A substance with a specific gravity greater than one, such as metals and stones, will sink in water.

Example 10.2.

If the density of copper is 8.9 gcm^{-3}, the relative density of copper is calculated as follows.

Solution:

Density of copper = 8.9 gcm^{-3}, density of water = 1 gcm^{-3}.

$$\text{Relative Density} = \frac{\text{Density of copper}}{\text{Density of water}} = \frac{8.9\ \text{gcm}^{-3}}{1\ \text{gcm}^{-3}} = 8.9$$

Activity 10.7. Investigating relative density

Materials required

A small metal cube, metre rule and pan balance.

Reprint 2024

Procedure

Step 1: Find the volume of metal cube with the help of metre rule.

Step 2: Find the mass of the metal cube.

Step 3: Find the density of metal cube.

Step 4: Calculate the relative density.

Questions

1. Calculate the relative density of substances with water as a reference and fill in Table 10.5.

Table 10.5

Sl No.	Substance	Density in gcm^{-3}	Relative Density
1	Gold	19.3	
2	Lead	11.3	
3	Alcohol	0.8	
4	Petrol	0.7	
5	Air	1.29	

2. What is the relationship between the value of density and relative density of a substance.
3. Predict the value of densities of substances in Table 10.6

Table 10.6

Sl No.	Substance	Density in gcm^{-3}	Relative Density
1	Silver		10.50
2	Copper		8.90
3	Sea water		1.10
4	Kerosene		0.80
5	Carbon dioxide		0.0019

WEBLINK

http://www.wiredchemist.com/anim-density
http://www.goalfinder.com/preview.asp?productcode=SPGPRO3&productid=86&productname=Concept%20of%20Density%20-%20Educational%20Science%20flash%20animation

Reprint 2024

Exercise

Fill in the blanks with correct word(s).

1. Mass = ... × density.
2. A lever in which the mechanical advantage is always less than 1, is a .... lever.
3. A single fixed pulley is a simple machine because it helps to change the.............. of force.
4. The pivot about which the lever rotates, is known as ....
5. To increase the speed of vehicle, ... gear should be the smallest gear.

Match the following

Column A	Column B
1. MA can be equal to 1 or lesser than 1 or greater than 1.	a) Block and Tackle
2. MA is always lesser than 1.	b) Sea saw
3. Speed	c) Knife
4. MA is always greater than 1	d) ms^{-1}
5. Density	e) kgm^{-3}

Check whether the following statements are True or False. Correct the false statements.

1. The single fixed pulley helps to multiply force.
2. Iron nail sinks in water because density of iron nail is more than the density of water.
3. Unbalanced force does not bring any change in its state of rest or of uniform motion in a straight line.
4. The gear which makes another gear to rotate is called driver gear.
5. In class III lever, the effort is applied between the fulcrum and the load.

Reprint 2024

Multiple Choice Questions

1. Table 10.7 shows the mass and volume of three objects (X, Y, and Z).

Table 10.7.

X	Y	Z
Mass = 4 g	Mass = 6 g	Mass = 8 g
Volume = 2 cm^{-3}	Volume = 6 cm^{-3}	Volume = 4 cm^{-3}

Which statement about the densities of these three objects is correct?

A. Y is denser than X.
B. X is denser than Z.
C. Y and Z have equal densities.
D. X and Z have equal densities.

2. Figure10.20 shows a person about to lift a book using a ruler and pencil.

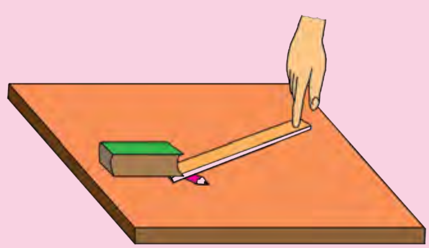


Figure 10.20

Which simple machine is illustrated in Figure 10.20?

A. Gear.
B. Lever.
C. Pulley.
D. Inclined plane.

Reprint 2024

3. Figure 10.21 shows two dogs pulling on a rope with constant but unbalanced forces.

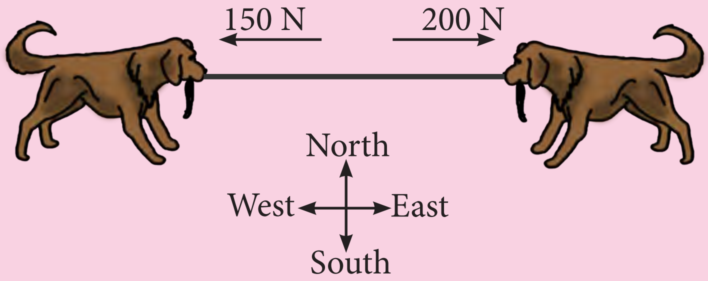


Figure 10.21.

In which compass direction will both the dogs most likely move:

D. East.

E. West.

F. North.

G. South.

4. A crane is an example of

A. inclined plane.

B. wedge.

C. pulley.

D. lever.

5. If the effort arm is longer than the load arm, then

A. MA is less than 1.

B. MA is more than 1.

C. MA is equal to 1.

D. MA is equal to 2.

Reprint 2024

Answer the following questions

1. Define density.
2. The density of mercury is 13.6 gcm^{-3}. What do you understand by this statement?
3. Define balanced force.
4. Use Figure 10.22 to answer questions a and b. The figure shows a resting cart on a frictionless surface. Two unbalanced opposing forces are applied to the cart.
   a. If the unbalanced opposing forces of 270N and 360N are applied to the cart at the same time, what will happen?
   b. Identify two types of motion when the cart is in motion .

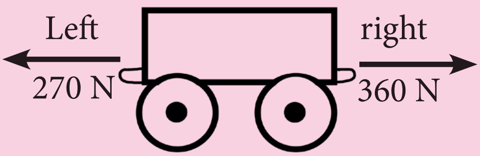


Figure 10.22

5. State three ways in which machines are useful to us.
6. Figure 10.23 shows a lever that can be used to lift a person. The fulcrum is the point on which the lever pivots.

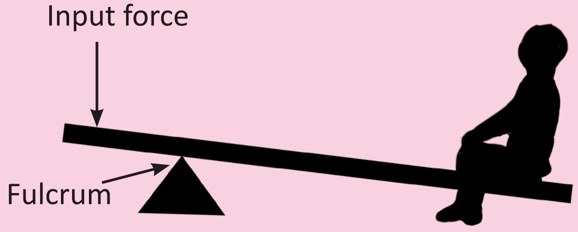


Figure 10.23

   Describe one change that could be made to the lever to decrease the input force needed to lift the person.

7. Figure 10.24 shows the tin shear. Why are the handles longer than the blade?

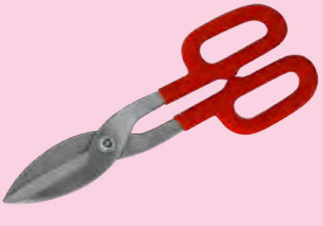


Figure 10.24

8. Figure 10.25 shows different arrangement of pulleys to lift a 100 gram load to a distance of 10 centimetres.

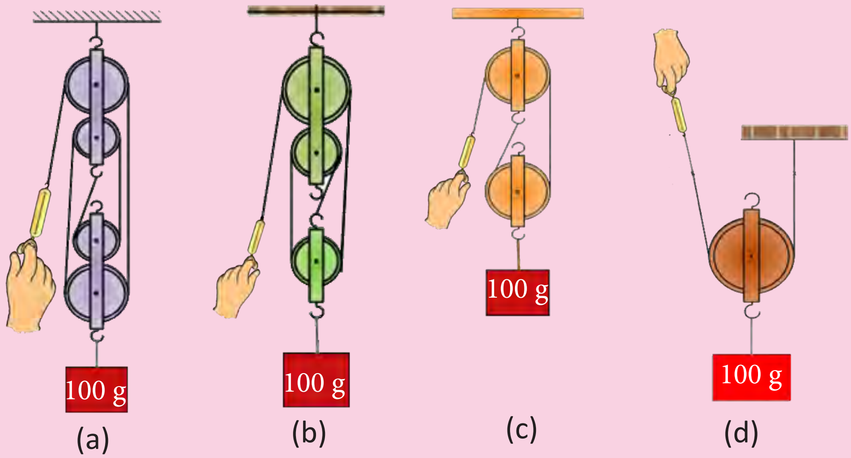


Figure 10.25

Which arrangement would require the least force to lift the load? Justify.

9. Copy Table 10.8 and compare single fixed pulley and the single movable pulley.

Table 10.8

Sl No	Parameter	Single Fixed Pulley	Single Movable Pulley
1	Rigid support		
2	MA		
3	Movement		
4	Usage		
5	Load		

10. Sonam and Dorji were using a stapler to staple their papers together. Sonam pressed down at the end of the stapler while Dorji pressed down near the middle of the stapler as shown in Figure 10.26. Sonam finished the job faster, and his fingers were less tired as compared to Dorji. Why?

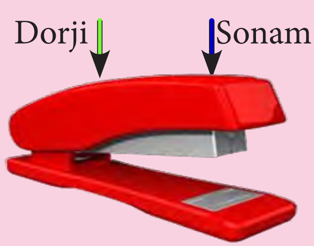


Figure 10.26

Reprint 2024

11. A ball rolling on the ground covers a distance of 200 m due South in 20 s. What is the speed of the ball?

12. Consider a football player warming up for the match. Figure 10.27 shows movement of player from A to B, B to C, and C to D at various times. What is the player's average speed?

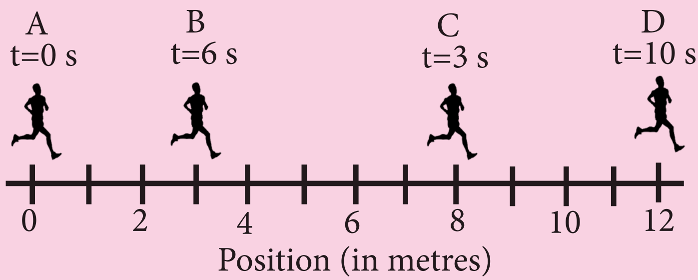


Figure 10.27

13. Calculate the mass of a body whose volume is 2 m^3 and the density is 520 gcm^{-3}.

14. An object with mass of 40 g has a volume of 80 cm^3. Will the object float or sink in water? Why?

15. Figure 10.28 shows two gear system. Which system can be used to gain maximum speed?

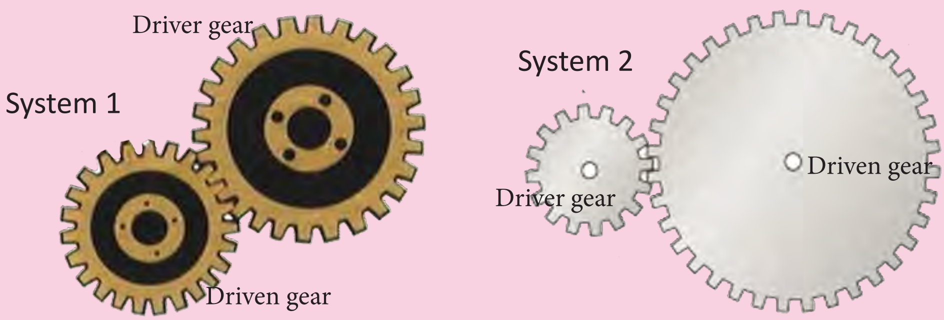


Figure 10.28

Chapter 11
Electricity and Magnetism

Electrical energy is one of the important forms of energy that people use at homes, industries, offices, and in many other places. Streak of lightning often seen across the sky is also one of the forms of electrical energy. Electrical energy is said to be clean energy but it can be dangerous if used without safety.

Electricity is brought to our homes through electrical wires and used to operate electrical devices like rice cooker, television, radio, etc. In this chapter, we will study about how electricity is used in our homes in different ways. We will also study about the static electricity, magnetism, and how they are produced and used.

1. Electric Circuits

Learning Objectives

On completion of this topic, you should be able to:

- describe electric circuits and its types.
- design and construct a circuit diagram connecting ammeter and voltmeter.
- measure current and voltage in circuits by using devices.
- explain the distribution of voltage and current in parallel and series circuit.
- explain the role of resistance in the flow of current.
- identify and track energy transformation in electrical appliances.

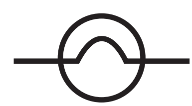
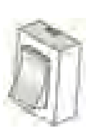
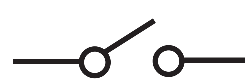
Circuits are closed paths for electricity to flow through. All the electrical appliances at home are connected to a battery or mains supply with the help of wires to form a complete circuit.

Reprint 2024

In a series circuit, electrical appliances are connected one after another in series. In this type of circuit, equal amount of current flows through all the electrical appliances, while the voltage is distributed among all the electrical appliances. In this, if one arm of circuit or an appliance is removed, the circuit becomes incomplete and the electric current will not flow through the circuit.

Generally, symbols are used to represent the electrical appliances and the wires while drawing an electric circuit. Table 11.1 shows the symbols used to represent the components of an electrical circuit.

Table 11.1 *Electrical Components and their Symbol*

Components of Electrical Circuit	**Symbol**
 Cell	
 Battery of three cells	
 Bulb	
 Conducting wire	
   Switch	
 Voltmeter	
 Ammeter	

Reprint 2024

Questions

Figure 11.1 shows two types of circuits.

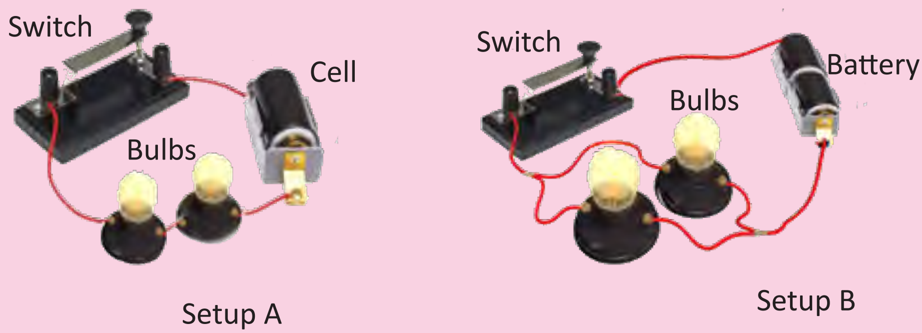


Figure 11.1.

Open URL https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc and use PhET simulation to design parallel and series circuit of Figure 11.1.

1. Name the type of circuit in Set-up A and Set-up B.
2. Will there be a difference in the brightness of the bulbs in set-up A? Explain.
3. Use image editing software to draw parallel and series circuits with appropriate symbols.

a. Electric Current and Voltage

The flow of charge in a circuit is called **electric current**. It is measured in an **ampere (A)**. Electric current flowing in a circuit is measured by using an ammeter. The electric force that produces a flow of current in a circuit is called **voltage**. It is measured in **volt (V).** Voltage across two ends of circuit is measured by connecting a voltmeter. The symbols used for ammeter and voltmeter in a circuit are given in Table 11.1.

Ammeter is an electrical device used to measure the electric current following through a circuit. Ammeter is always connected in series with the circuit.

In Figure 11.2, the amount of flow of current is shown by the deflection of the pointer.

Figure 11.2. Ammeter.

$$\text{Value of one division on the scale (least count)} = \frac{\text{Range}}{\text{Total division}}$$

$$= \frac{3\ \text{A}}{30} = 0.1\ \text{A}$$

Number of divisions shown by deflection = 3

Observed ammeter reading = least count × number of divisions

$$= 0.1\ \text{A} \times 3 = 0.3\ \text{A}$$

Voltmeter is an electrical device used to measure the voltage across a circuit. Voltmeter is always connected in parallel to the circuit.

In Figure 11.3, the voltage across a circuit is shown by the deflection of the pointer.

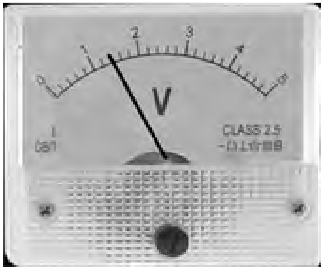


Figure 11.3. Voltmeter.

$$\text{Value of one division on the scale (least count)} = \frac{\text{Range}}{\text{Total division}}$$

$$= \frac{5\ \text{V}}{25} = 0.2\ \text{V}$$

Number of divisions shown by deflection = 7

Observed voltmeter reading = least count × number of divisions

$$= 0.2\ \text{V} \times 7 = 1.4\ \text{V}$$

Activity 11.1. Measuring current and voltage

Materials required

Battery, connecting wire, ammeter, voltmeter, and switch

Reprint 2024

Procedure

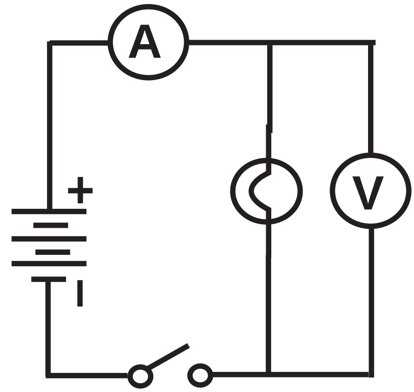


Figure 11.4. Simple circuit.

Step 1. Remove the insulation at the ends of the wires.

Step 2. Set up the circuit as shown in Figure 11.4.

Step 3. Close the switch and observe the pointer in the ammeter and voltmeter. (If the pointer deflects towards the left, change the direction of the cell). Note the readings.

Step 4. With the same set-up, repeat step 3 with two cells and then with three cells.

Step 5. Copy Table 11.2 and record your observations.

Table 11.2 *Measurement of Current and Voltage*

No of cell	Ammeter Reading			Voltmeter Reading		
	Least Count (A)	Number of Divisions Dhown by Deflection	Observed Reading (A)	Least count (V)	Number of Divisions Shown by Deflection	Observed Reading (V)
1						
2						
3						

Answer the following questions.

i. What quantities are measured in Step 3?

ii. How does the value of voltage and current change with increase in the number of cells?

iii. What will be the change in voltage if you change the voltmeter with a different least count?

Reprint 2024

Activity 11.2. Measuring current and voltage in series circuit

Materials required

Connecting wire, ammeter, voltmeter, switch, bulb with holder, and battery.

Procedure

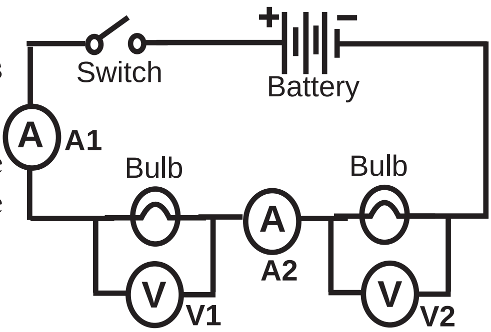


Figure 11.5. Series circuit.

Step 1. Remove the insulation at the ends of the wires.

Step 2. Setup the circuit as shown in Figure 11.5 without the ammeter and the voltmeter.

Step 3. Connect the ammeter in A1 position and the voltmeter in V1 position.

Step 4. Copy Table 11.3 and record the readings.

Step 5. Remove the ammeter from A1 and voltmeter from V1 and place them in A2 and V2. Record the readings.

Table 11.3 *Measurement of Current and Voltmeter in Series Circuit*

Ammeter Reading (current in amperes)	**Voltmeter Reading (voltage in volts)**
A1 =	V1 =
A2 =	V2 =

Answer the following questions.

i. What difference did you observe in ammeter readings?
ii. What difference did you observe in voltmeter readings?
iii. What can you conclude from the readings of ammeter?
iv. What can you conclude from the readings of voltmeter?

Reprint 2024

In a series circuit, current flows through a single path. Let us look at Figure 11.6, where water is pumped through water mill 1 and 2. The water mill 1 experiences full force of water from the water pump, while water mill 2 receives less force of water as water mill 1 obstructs the flow of water. Similarly, when the current flows in a series circuit, the first electrical appliance receives more voltage than the succeeding appliance. For example, the bulbs are connected in series, then the first bulb glows brighter than the succeeding bulbs. Greater the amount of voltage the bulb receives, brighter it glows.

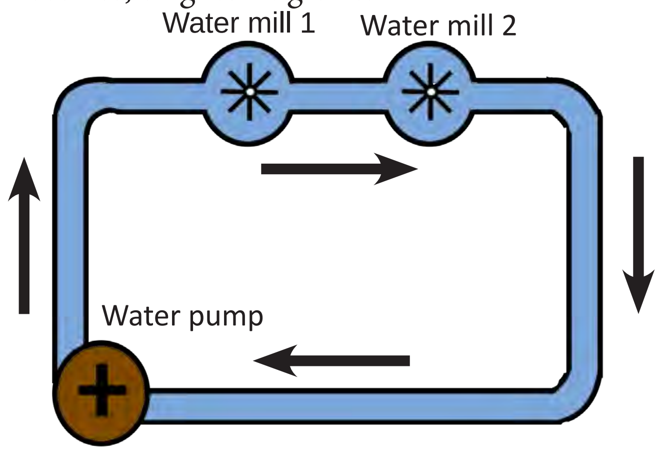


Figure 11.6. Analogy of series circuit

Activity 11.3. Measuring current and voltage in parallel circuit

Materials required

Connecting wire, voltmeter, ammeter, bulb with holder, switch, and battery.

Procedure

Step 1. Remove the insulation at the ends of the wires.

Step 2. Set-up the circuit as shown in Figure 11.7 without the ammeter and the voltmeter.

Step 3. Connect ammeters in position A1 and A2 and then voltmeter in position V2.

Step 4. Copy Table 11.4 and record the readings.

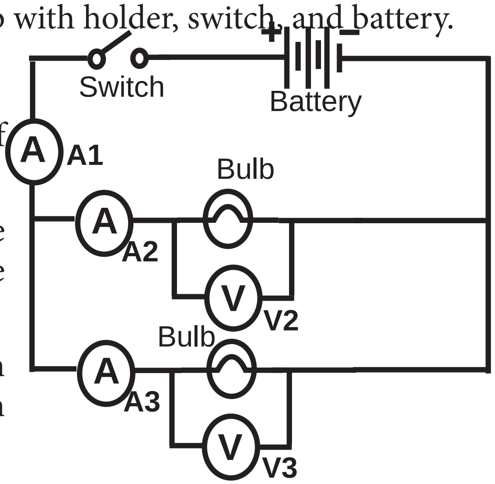


Figure 11.7. Parallel circuit

Reprint 2024

Step 5. Remove the ammeter from A2 and voltmeter from V2 and place them in A3 and V3. Record the readings.

Table 11.4 *Measurement of Current and Voltage in Parallel Circuit*

Ammeter Reading (current in amperes)	**Voltmeter Reading (voltage in volts)**
A1 =	V2 =
A2 =	V3 =
A3 =	

Answer the following questions.

i. What difference did you observe in ammeter readings?

ii. What difference did you observe in voltmeter readings?

iii. What can you conclude from the readings of ammeter?

iv. What can you conclude form the readings of voltmeter?

In a parallel circuit, the current flowing through each components of the circuit will be different while the voltage will be equal.

Let us look at Figure 11.8, where the water is pumped by the water pump through water mill 1 and water mill 2. Both water mill 1 and water mill 2 experience the same force of water from the water pump. Similarly, current has more than one path to flow in the parallel circuit. When the current flows in a parallel circuit, all the appliances receive equal amount of voltage. For example, if bulbs are connected in parallel, all the bulbs will glow with equal brightness as they receive the equal amount of voltage.

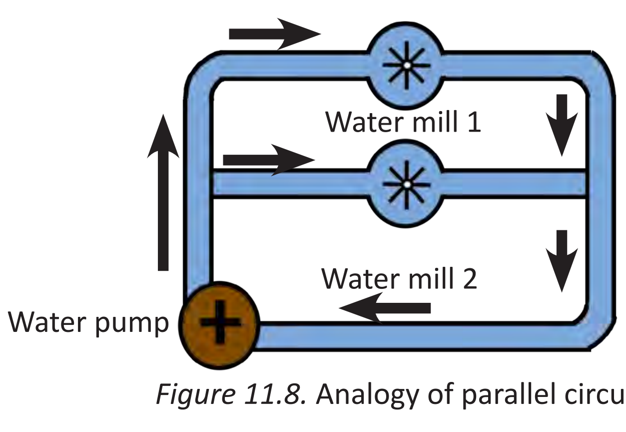


Figure 11.8. Analogy of parallel circuit.

Home appliances are usually connected in parallel circuits so that they receive equal voltage. If one of the appliances is damaged in the circuit, others can still function.

b. Role of Resistance in the Flow of Current

As the current flows through a wire, the wire resists the flow of current in much the same way as those nails resisting the rolling table tennis ball as shown in Figure 11.9.

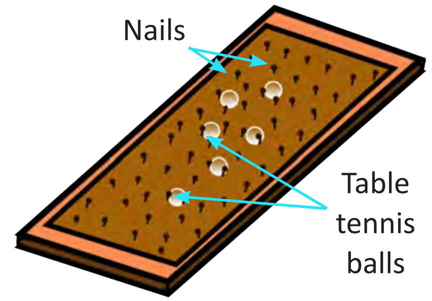


Figure 11.9. Analogy of resistance

The obstruction offered by the wire to the flow of current is called **resistance**. All the electrical components in a circuit will offer some amount of resistance. Different electrical appliances or wires offer different resistance. The flow of current depends upon the resistance in a circuit. Conducting material with high resistance reduces the flow of current.

If the nails in Figure 11.9 were a little closer to each other, what effect would they have on the rolling ball?

Activity 11.4. Investigating resistance of different materials

Materials required

Connecting wires, ammeter, battery, coil resistor, rusted iron nail and steel spoon.

Procedure

Step 1. Setup the circuit as shown in Figure 11.10.

Step 2. Complete the circuit by joining terminals X and Y with the coil resistor.

Step 3. Copy Table 11.5 and record the ammeter reading.

Step 4. Repeat Step 2 and 3 by connecting X and Y with rusted iron nail and then the steel spoon.

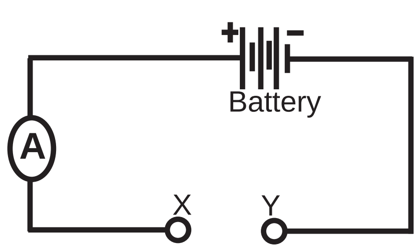


Figure 11.10. Circuit to test resistance.

Reprint 2024

Table 11.5 *Measuring Resistance of Conducting Material*

Conducting Material	Ammeter Reading (A)
1. Coil resistor	
2. Rusted iron nail	
3. Steel spoon	

Answer the following questions.

i. What happens to the ammeter reading with the change in conducting material?
ii. Why do different materials conduct different amount of current?
iii. What would be the ammeter reading if the spoon is replaced by a glass rod?

WEBLINK

http://saburchill.com/physics/chapters/0036.html
http://saburchill.com/physics/chapters/0038.html
http://saburchill.com/physics/chapters/0040.html

Activity 11.5 Investigating the role of resistance

Materials required

Copper wire, nichrome wire, switch, and battery.

Procedure

Step 1. Setup the circuit as shown in Figure 11.11.

Step 2. Close the circuit for one minute.

Step 3. Open the switch to break the circuit.

Step 4. Touch the nichrome coil.

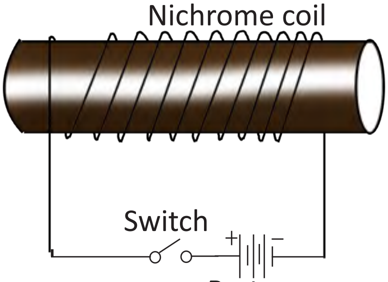


Figure 11.11. Heating effect of current.

Answer the following questions.

i. What did you observe when you touch the nichrome wire?
ii. Why was there a change in the temperature of the wire?
iii. What energy changes is taking place in the nichrome wire?
iv. What difference will you observe if the nichrome wire is replaced by a wire having high resistance?
v. Name some appliances on which this application is used.

c. Transformation of Electrical Energy

The use of electricity is convenient because electrical energy can be transformed from one form to another. For example, an electric fan changes the electrical energy to mechanical energy, an electric heater changes electrical energy to heat and light energy, and an electric bulb changes electrical energy to light and heat energy.

Copy and fill up Table 11.6 to show the transformation of electrical energy into other forms of energy.

Table 11.6 *Transformation of Electrical Energy*

Sl No.	Activity	Form of Energy Changed
1.	Switching on lights	
2.	Cooking in a rice cooker	
3.	Watching a television	
4.	Putting on a room heater	
5.	Using a bread toaster	
6.	Charging a mobile phone	
7.	Using an electric blender	
8.	Using a loud speaker	

Reprint 2024

Questions

Study Figure 11.12 carefully and answer the following questions:

Figure 11.12.

1. Trace the energy transformation in Figure 11.12.
2. What type of electrical circuit is this?
3. If you replace the existing wire with a longer wire, what change do you expect to see in the brightness of the bulbs?

WEBLINK

http://www.bbc.co.uk/schools/gcsebitesize/science/add_edexcel/static_elec/staticrev1.shtml

Reprint 2024

2. Static Electricity

Learning Objectives

On completion of this topic, you should be able to:

- explain common electrostatic phenomena.
- explain the applications of static electricity.
- explain the effects of static electricity.

If a comb is brought near small pieces of paper after combing dry hair, it attracts the paper pieces. Some people experience mild shocks when they touch the car door right after driving. Why does these happen?

When different insulating materials are rubbed against each other, they become electrically charged by friction. These charges remain static on the objects on which they are developed. This is called static electricity.

An atom contains equal number of protons (positive charge) and electrons (negative charge). Hence, the body is electrically neutral. But when two bodies are rubbed together, electrons move from one body to another. The body which receives the electrons become negatively charged, while the other body which loses the electrons become positively charged. The separation of charges between the two bodies after being rubbed produces static electricity.

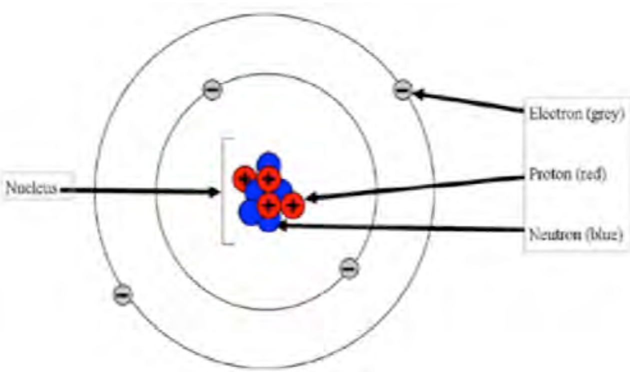


Figure 11.13. Structure of an atom.

For example, as in Figure 11.14, when a piece of silk cloth is rubbed with a glass rod, electrons move from glass rod to silk as electrons are loosely packed in glass compared to silk. The glass rod loses electrons and becomes positively charged. The silk gains electrons and becomes negatively charged. These charges remain on the surface of these two objects giving rise to static electricity. Since they acquire equal and opposite charges, they attract each other..

Similarly, figure 11.15 illustrates the static electricity developed in ebonite rod and fur.

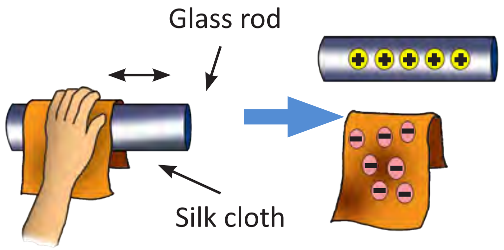


Figure 11.14. Static electricity in silk cloth and glass rod.

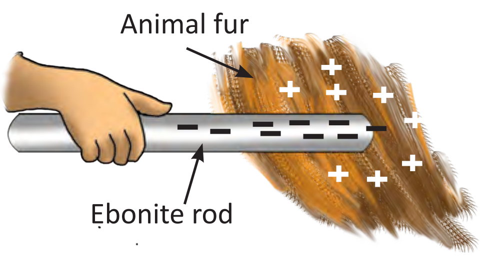


Figure 11.15. Static electricity in animal fur and ebonite rod.

a. Attraction and Repulsion of Charged Body

If two bodies have different charges, they attract or pull towards each other. If two bodies have the same charge, they repel or push away from each other.

The electrically charged body also attracts neutral body. For example, negatively charged rubber comb attracts uncharged body like small pieces of paper, animal fur and human hair.

b. Lightning

Do you know that even atmosphere has static electricity? The most known and powerful display of electrostatics in nature is the lightning.

In a cloud, water, air, and dust particles collide with each other as they move. An electrical charge is built up just like the one that builds up in rubbing two different objects. After a while, the whole cloud fills up with electrical charges. The lower portion of the cloud carries negative charges, and the upper portion carries positive charges. They cannot flow from one cloud to another or to the ground because the air between them acts as an insulator.

Figure 11.16. Cause of lightning.

When a huge amount of charge builds up, the insulating property of the air breaks down. As a result, electrons are suddenly released. The release of electrons is called an electric discharge. An electric discharge takes place between two oppositely charged clouds, or between a charged cloud and the surface of the earth. This causes a flash of lightning.

The lightning is dangerous due to high electric discharge (more than a thousand volts). Therefore, we must know how to protect ourselves during lightning.

- Stay away from tall trees.
- Avoid touching metallic objects like TV antenna.
- Disconnect your computer, TV, telephones, etc.
- Use umbrella with wooden or plastic handle.
- If you are in the middle of an open field, the best thing is to lie down flat on the ground.
- If you are travelling by vehicle, stay inside.

c. Effects of Electrostatic Phenomena

- The sparks produced during the discharged of electrons are dangerous in the presence of highly flammable materials. A special earth clamp between fuel tank and ground is connected during filling the fuel tank to drain the charges safely to the earth.
- Static charges can also destroy sensitive electronic components. This is why workers in electronic plants wear special anti-static shoes and earthed wristbands.
- Lightning can cause forest fire and cracks in buildings. Lightning can severely burn or kill living beings.

d. Application of Electrostatic Phenomena

i. Pollution Control

Smoke is made of tiny solid particles. For example, carbon. To remove these particles, an electrostatic precipitator is used as shown in Figure 11.17.

When waste gases containing smoke particles are made to pass through negatively charged metal grid, the smoke becomes negatively charged. These negatively charged smoke particles are attracted to the positively charged collecting plate. Once the negatively charged particles touch the positive plate, they get neutralised and drop down into the collecting chamber. Therefore, smoke escapes into the atmosphere through the chimney without toxic waste particles.

This type of precipitator is installed in industries like Penden Cement Authority Limited, Gomtu.

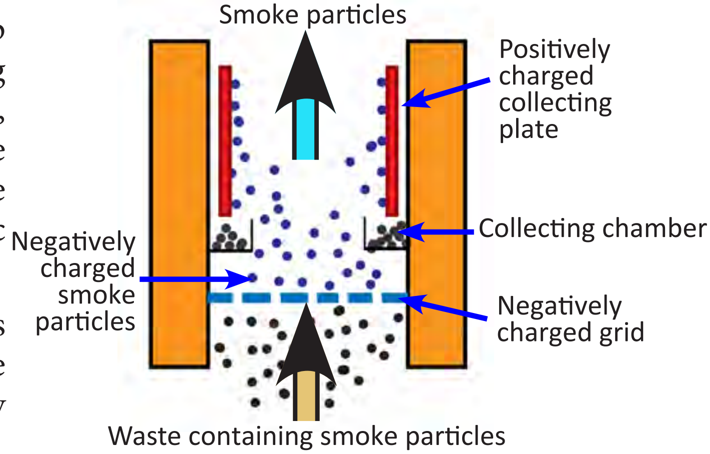


Figure 11.17. Mechanism of electrostatic precipitator.

Activity 11.6. Making your own electrostatic precipitator

Materials required

Cardboard tube (30 cm long and 2.5 cm diameter), aluminium foil, induction coil, incense, copper wire, a thick wire, matches, battery, switch, a pair of scissors, a small pet (Polyethylene terephthalate) bottle and masking tape.

Procedure

Step 1. Cut the pet bottle 5 cm above base. Use the upper part of the bottle and make it as shown in Figure 11.18.

Step 2. Wrap the aluminium foil round the cardboard chimney just below the upper end and place it on the mouth of the pet bottle.

Step 3. Hang a thick metal wire down the centre of the tube so that it does not touch

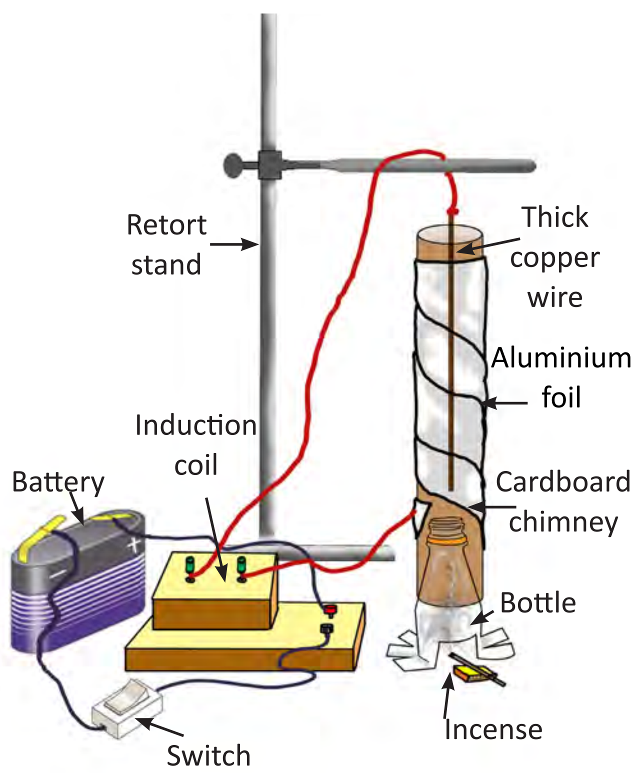


Figure of 11.18. Experimental setup for precipitator.

Reprint 2024

the walls of the tube.

Step 4. Connect the foil with the high voltage terminal of an induction coil through a switch and the hanging wire to the other terminal of the induction coil.

Step 5. Your arrangement should look as shown in Figure 11.18.

Step 6. Place a lit incense through the hole. What comes out of cardboard chimney?

Step 7. Put on the induction coil in the circuit. What do you observe?

ii. Painting Cars

The spray gun is charged positively, which causes every paint particle to become positively charged. When the paint is sprayed from the spray gun, the paint particles spread due to the repulsion among the particles because like charges repel. The object to be painted is negatively charged to attract the paint particles. In this way the paint forms an even layer on the car body.

Figure 11.19. Painting vehicles.

Can you find more information about application of electrostatic phenomen.

3. Magnetism

Learning Objectives

On completion of this topic, you should be able to:

- explain magnetic field.
- explain how a magnet attracts a magnetic substance.
- differentiate between temporary and permanent magnets.
- explain how electromagnet works.

In lower classes, you learnt that the force acting in the region surrounding a magnet is called magnetic field. The entire magnetic field of any magnet is represented by the imaginary lines of force that travel in a curved path around

Reprint 2024

the magnet. They represent the strength and direction of the magnetic force. The points of a magnet where the magnetic force is the strongest are called poles. Substances which are attracted by a magnet are called magnetic substances, while those which are not attracted by a magnet are non-magnetic substances. In this topic, you will learn more about the properties of a magnet and the types of magnet.

a. Molecular Theory of Magnetism

Magnetic substances like iron and steel are composed of many small magnets called molecular magnets.

Activity 11.7. Investigating the particle arrangement in a magnet

Materials required:

Test tube with a cork stopper, iron filings or pins, bar magnet

Procedure

Step 1. Fill one-fifth of the test tube with pins and put a cork stopper.

Step 2. Place it flat on the table.

Step 3. Observe and draw how the pins are arranged.

Step 4. Bring a bar magnet near the end of the test tube (opposite to the end that has the stopper).

Step 5. Observe and draw, how the pins are arranged.

Answer the following questions.

i. What does the test tube filled with pins represent?

ii. What differences do you observe in the two situations? Why?

iii. What can you conclude about the arrangement of the iron pieces from the two situations?

In an ordinary magnetic substance, these molecular magnets are arranged randomly. Since the molecular magnets point in different directions, there is no net magnetism in the substance.

When a piece of magnetic substance is brought near a magnet, the molecular magnets start arranging themselves in an ordered way with their north poles pointing one way and their south poles pointing the opposite way. When all

Reprint 2024

the molecular magnets get arranged and point in the same direction, they reinforce one another and make the magnetic substance behave like a magnet. As the ordering process of molecular magnets is increased by an external magnetic field produced by the magnet, more and more molecular magnets are arranged in orderly manner, making strong concentration of north poles at one end and south poles at the other end of the substance. This increases the strength of the magnet.

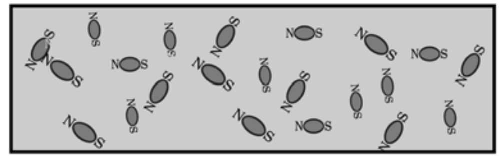


Figure 11.20. Molecular magnets in a magnetic substance.

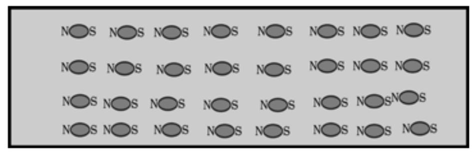


Figure 11.21. Molecular magnets in a magnet.

Process like heating, dropping, hammering, etc. disrupt the order of arrangement of molecular magnets. These processes can demagnetise a magnet.

b. Magnetisation

When a magnet is brought near a magnetic substance, the substance is magnetised and it behaves like a magnet. This phenomenon is known as **magnetic induction.** For example, when north pole of a bar magnet is brought near the iron piece, the latter becomes a magnet. This is because the north pole of the bar magnet induces south pole in the near end of the iron piece, while the far end becomes the north pole. As a result, the near end of iron piece is attracted to the north pole of the magnet.

Materials like soft iron lose their magnetic behaviour when the magnet is removed. These types of materials undergo temporary magnetisation. However materials like steel, nickel and cobalt retain their magnetic behaviour even after the removal of the magnet. These substances undergo permanent magnetisation. Hence, temporary and permanent magnets depend on the nature of the substances used in making a magnet.

Magnets can be also made by passing electric current through a coil over a magnetic substance. When an electric current is passed through a coil over a soft iron, it temporarily behaves like a magnet. Such types of magnets are called temporary magnets. However, when electric current is passed through a coil over a steel bar, it retains magnetic behaviour for a long period even after the removal of the electric current. Such types of magnets are called **permanent magnets**. The magnets made with the help of electricity are called electromagnets.

Exercise

Fill in the blanks with correct word(s).

1. Voltmeter is used to measure voltage and it is connected in ________ to the circuit.
2. Conducting material with high _________ reduces the flow of current.
3. Electric charges developed due to friction when two bodies are rubbed together is called _________ electricity.
4. A lightning discharge is a heavy flow of _________ between two oppositely charged clouds.
5. A magnet has ____________________ field surrounding it.

Match the following

Column A	Column A
1. Sound energy changes to electrical energy.	a. An electric fan
2. Electrical energy changes to magnetic energy.	b. A DVD Music System
3. Electrical energy changes to heat energy.	c. Microphone
4. Electrical energy changes to mechanical energy.	d. A curry cooker
5. Electrical energy changes to sound energy.	e. Temporary magnet

Check whether the following statements are True or False. Correct the false statements.

1. In a parallel circuit, the current flowing through each of the components will be same.
2. If two different objects are rubbed together, they acquire equal and opposite charges.

Reprint 2024

3. The production of heat increases as the current in a wire increases.
4. When electrons are added to a body, it is said to be positively charged.
5. The south pole of a bar magnet when brought near one end of an unmagnetized iron bar, induces a south pole at that end.

Multiple Choice Questions

1. Which circuit diagram in Figure 11.22 shows the correct connection of ammeter and voltmeter?

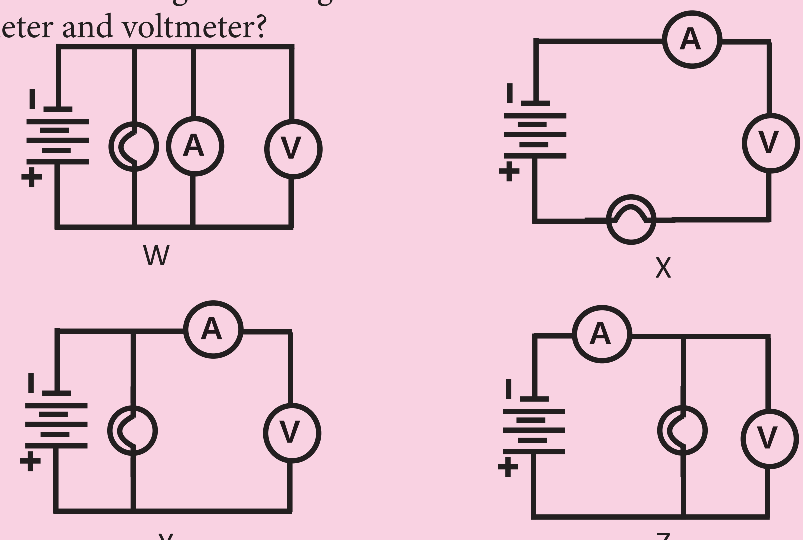


Figure 11.22.

   A. W
   B. X
   C. Y
   D. Z

2. Which sequence of energy transformations occurs when a torch is turned on?

   A. chemical → light → electrical
   B. chemical → electrical → light
   C. electrical → light → chemical
   D. electrical → chemical → light

Reprint 2024

3. Figure 11.23 shows three neutral metal spheres x, y, and z in contact and on insulating stands.

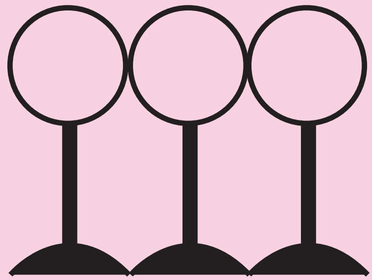


Figure 11.23.

Which diagram in Figure 11.24 best represents the charge distribution on the spheres when a positively charged rod is brought near the sphere, but does not touch it?

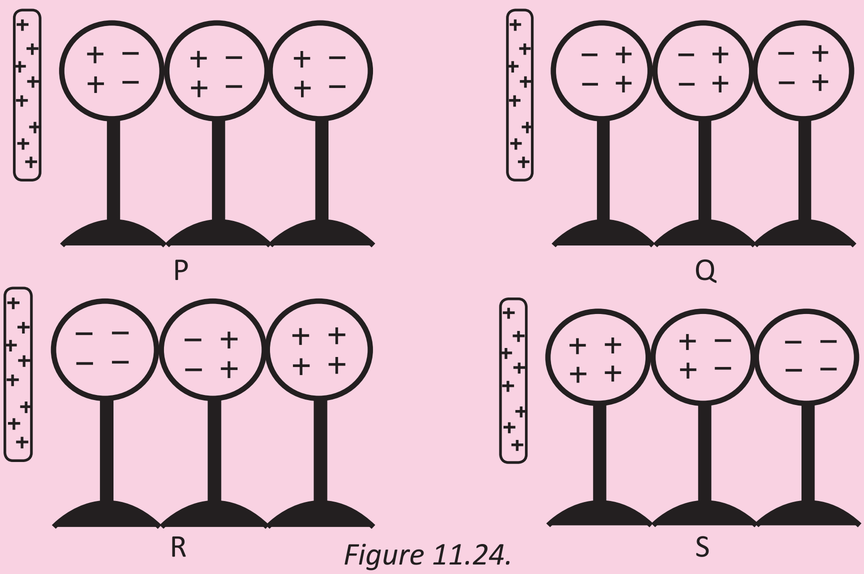


Figure 11.24.

A. P
B. Q
C. R
D. S

Reprint 2024

4. A girl pulls off sweater over the head. Her hair gets attracted to the sweater due to
   A. a magnetic force.
   B. a heat transfer.
   C. an electrical charge.
   D. a chemical change.
5. A magnetic compass is used for finding direction. A trekker's compass is made of
   A. iron.
   B. aluminium.
   C. copper.
   D. steel.
6. A student is making an electric bell which did not work when tested. His friend advises him to modify his model by increasing the strength of the magnet. He followed the advice by
   A. increasing the number of turns of coil.
   B. decreasing the number of coil.
   C. keeping the number of turns same.
   D. decreasing the number of cells.

Answer the following questions

1. What is meant by an electric current? What is its unit?
2. In the electric circuit shown in Figure 11.25, label the parts A, B, C, D, and E. State the function of C and E.

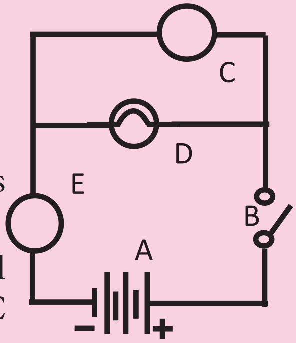


Figure 11.25.

3. A student attached two balloons to equal lengths of string and tied them to the same point. The student observed that the balloons repelled each other, as shown in Figure 11.26.

Reprint 2024

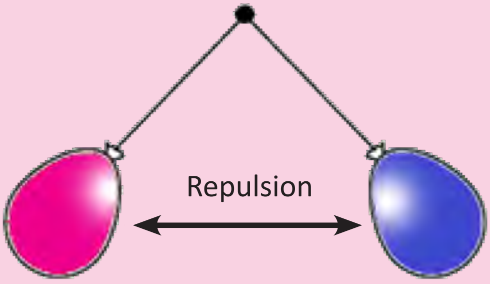


Figure 11.26.

In terms of electrical charges, explain why the balloons repelled each other.

5. A person travelling from Paro to Thimphu stops on the way to buy some vegetables. As he got down from his car, he gets a mild shock from the knob of the car door. Why do you think so?

6. During lightning it is advisable not to stay under tall trees. Explain.

7. Why do we hear a crackling noise while removing a nylon shirt or stockings in winter?

8. Magnets are used in an electric doorbell as well as in a magnetic compass. State three differences between the two magnets.

9. A teacher in the science laboratory notices a student dropping a bar magnet. The teacher advises the student to handle the magnet carefully. How does rough handling of a magnet affect its quality?

WEBLINK

http://www.pa.uky.edu/sciworks/qem.htm

Reprint 2024

Chapter 12
Light and Sound

Light is a form of energy that is available from many sources. It travels in straight lines in all directions at a different speed in different medium including vacuum. Objects become visible in the presence of light. When light falls on different surfaces it may be scattered at the same angle, or into different directions depending on the nature of the surface. It may be absorbed by a surface fully or partially. The property of reflection of light from different types of surfaces has many applications in our everyday life.

We hear different kinds of sound every day. These sounds may be produced by the school bell, automobiles, barking dogs, musical instruments, and many other objects. A sound is a form of energy that is produced by a vibrating body. Unlike light, sound requires a material medium for transmission. It is propagated through a medium in the form of waves. The range of hearing for different animals is different. While sounds can help to communicate and provide enjoyable experiences for people, loud sounds can have a negative impact on living things and the environment.

1. Propagation of Light

Learning Objectives

On completion of this topic, you should be able to:

- distinguish between luminous and non-luminous objects.
- explain that light travels in a straight line in all directions.
- explain that light travels with finite speed in a uniform medium.

Any object that emits light is a source of light. The emitted light travels in straight lines in all directions.

Reprint 2024

Objects are visible when the light emitted by them or the light scattered by them enters the eyes. These visible objects are classified into two categories: luminous objects and non-luminous objects.

An object, which emits light of its own, is called **luminous** object. The Sun, star, a burning candle, glowing electric bulb, lighted torch, and fire are examples of luminous objects. Luminous objects are visible because the light emitted by them enters the eyes.

An object, which does not emit light of its own, is called **non-luminous** object. A chair, house, tree, table, book, and the Moon are examples of non-luminous objects. Non-luminous objects become visible when light reflected from their surface enters the eyes.

Light travels at a very high speed. It can cover about three hundred thousand kilometres in one second in air. For example, a bus takes about two days to cover 544 kilometres from Trashigang to Thimphu, while light can cover the same distance in less than one second.

The speed of light is constant in a uniform medium. It changes with the change in density of a medium. Higher the density of the medium, lesser will be the speed of light.

Table 12.1 *Speed of Light in Different Medium*

Medium	Speed of Light
Air	3×10^8 m/s
Water	2.25×10^8 m/s
Glass	2×10^8 m/s

WEBLINK
http://www.salsburg.com/light.html

Reprint 2024

Activity 12.1. Investigating speed of light

Observe the pictures in Figure 12.1 and answer the questions that follow.

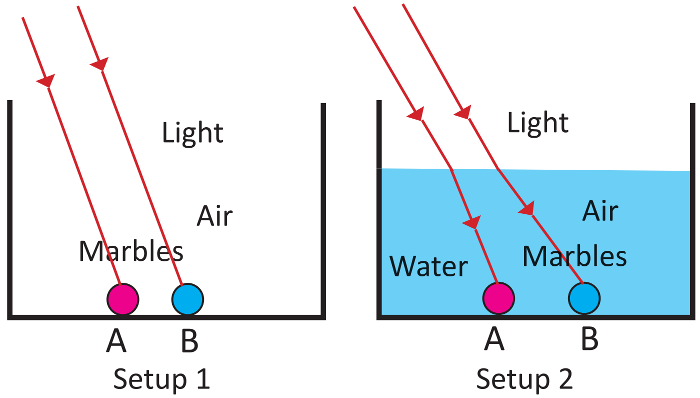


Figure 12.1. Speed of light in air and water.

i. In which setup will the light reach the marbles first? Why?
ii. In setup 2, which marble, A or B receives the light first? Why?

WEBLINK

http://www.virneth.co.uk/apps/transparent.htm
http://www.learnerstv.com/animation/animation.php?ani=102&cat=physics

Reprint 2024

2. Reflection of Light

Learning Objectives

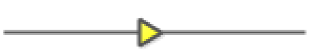
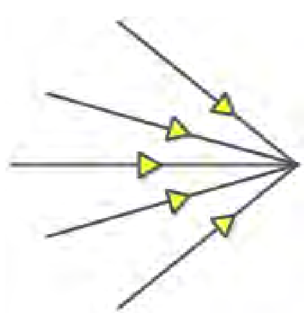
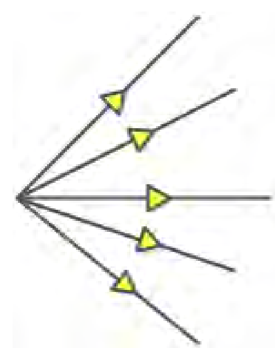
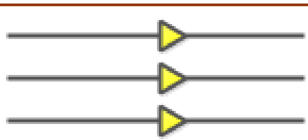
On completion of this topic, you should be able to:

- describe the reflection of light at a plane surface.
- investigate laws of reflection of light.

When light falls on the surface of an object, some of it returns to the same medium, some of it passes through the object and the rest of it is absorbed. The bouncing back of light into the same medium after striking a surface is called a **reflection** of light. Reflection of light depends on the nature of a surface.

Light can be represented diagrammatically in the form of rays and beams as shown in Table 12.2.

Table 12.2 *Diagrammatic Illustration of Light*

 A ray	 Convergent beam	 Divergent beam
 Parallel beam		

a. Regular Reflection and Irregular Reflection

Regular reflection is a phenomenon in which rays of light are reflected parallel to each other after striking a surface.

Irregular reflection is a phenomenon in which rays of light are scattered in different directions after striking a surface.

Reprint 2024

An objects become visible when the scattered light enters the eyes. Irregular reflection is shown in Figure 12.3.

b. Terms Used in the Reflection of Light

Watch the downloaded video or open the link https://www.youtube.com/watch?v=dwxaq4c9K6k and answer the questions.

Differentiate regular and irregular reflection.

Explain the following terms:

a. Normal
b. Incident ray
c. Reflected ray
d. Angle of incidence
e. Angle of reflection

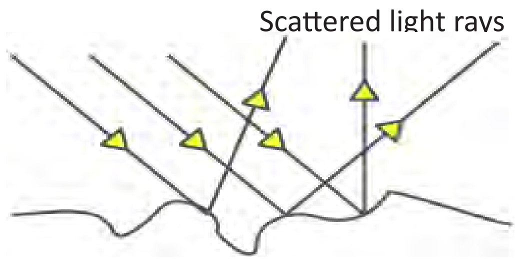


Figure 12.2. Regular reflection.

Copy Figure 12.4 and label the following:

i. incident ray
ii. reflected ray
iii. normal
iv. angle of incidence
v. angle of reflection

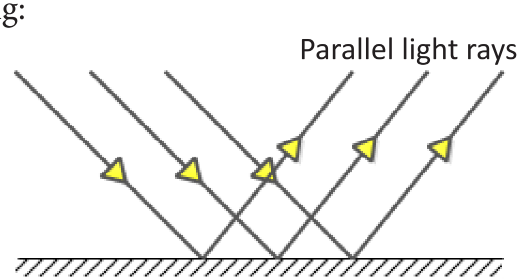


Figure 12.3. Irregular reflection.

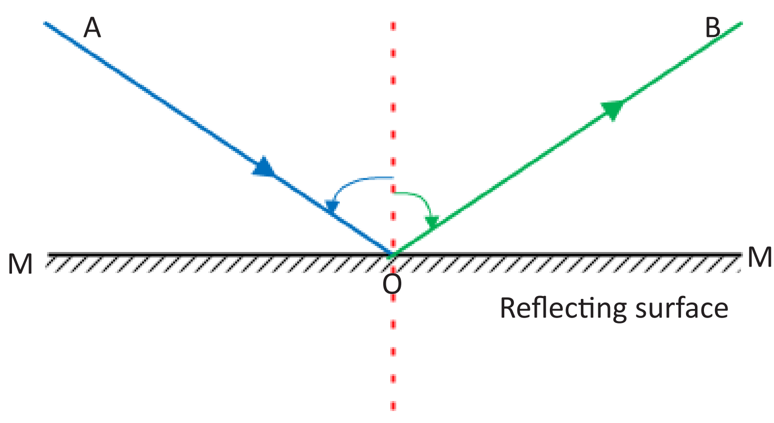


Figure 12.4. Reflection of light.

Reprint 2024

c. Laws of Reflection

Activity 12.2. Investigating the laws of reflection

Materials required

Plane mirror with stand, thumb pins, drawing pins, white paper, drawing board, and geometry box.

Procedure

Step 1. Take a white sheet of paper and fix it firmly on the drawing board with thumb pins.

Step 2. In the middle of the paper, draw a straight line XY. Select a point of incidence O and draw a normal ON.

Step 3. With the help of protractor, draw an incident ray such that the angle of incidence is $30^{0.}$

Step 4. Place the plane mirror along the line XY.

Step 5. Fix two pins A and B in front of the mirror on the incident ray.

Step 6. Now look at the images of the two pins from the other side and fix two more pins at C and D in line with the images on the mirror.

Step 7. Join the points C and D and extend them up to the mirror line XY at O.

Step 8. Measure the $\angle$ NOD with the help of a protractor.

Step 9. Repeat the procedure from Step 3 to Step 8 for angles of incidence 45^0 and 60^0 .

Step 10. Record your observation and complete Table12.3.

Reprint 2024

Table 12.3 *Observation of Angle of Reflection*

Sl No	Angle of Incidence	Angle of Reflection
1	30^0	
2	45^0	
3	60^0	

Answer the following questions.

i. What relation do you find between the angle of incidence and the angle of reflection?

ii. The ________________ray, reflected ray and the_______________, at the point of incidence lie on the same plane.

iii. State two laws of reflection based on the answer from question i and ii.

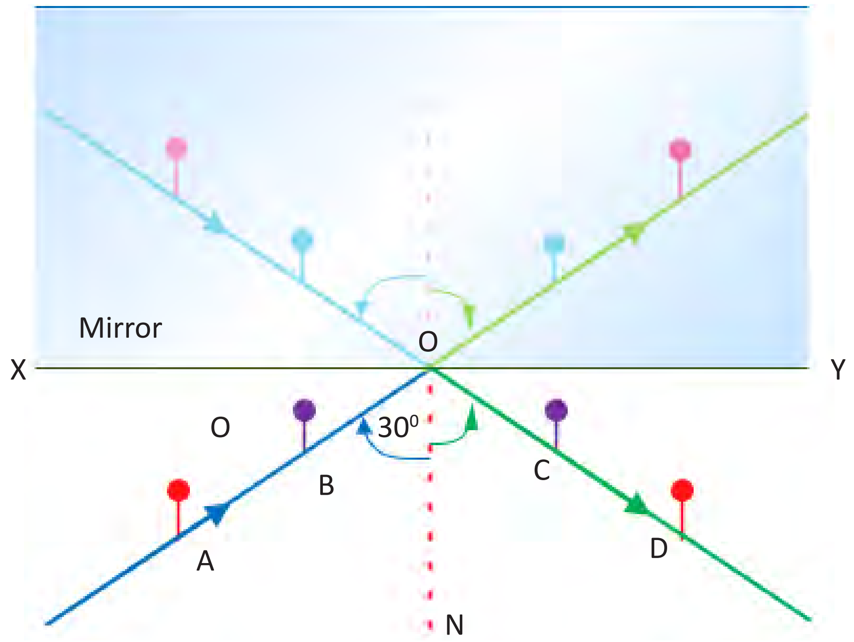


Figure 12.5. Demonstration of laws of reflection

Reprint 2024

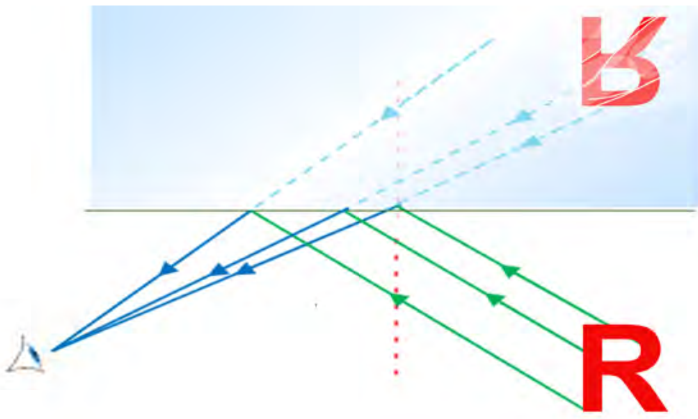


Figure 12.6. Reflection by plane mirror

d. Reflection through Plane Mirror

The image formed by plane mirror is upright, same size as the object, formed into the mirror, and laterally inverted. This is illustrated in Figure 12.6

The image formed by a plane mirror can be represented using ray diagram.

Steps to construct a ray diagram to locate the image of an object.

a. Draw a straight line MM' and shade it on one side to represent a plane mirror.

b. Draw a dot to represent a point object O.

c. Draw an eye to show the line of sight through which the image will be seen. The line of sight is an imaginary line from the position of the eye to the image.

d. Take two incident rays starting from the object and reflect them from the mirror obeying the laws of reflection.

e. Extend the rays behind the mirror to get the point of intersection. This is the image point I.

f. This diagram shows that the distance of the object from the mirror is equal to the distance of the image from the mirror.

Questions

1. Complete the ray diagram given in Figure 12.7 to show the image formation of the extended object OO' in the mirror MM'
2. How would the letters of the word SCIENCE be reflected if placed in front of a mirror?
3. Complete the ray diagram given in Figure 12.8 to determine the positions from which the complete image be seen at the point.

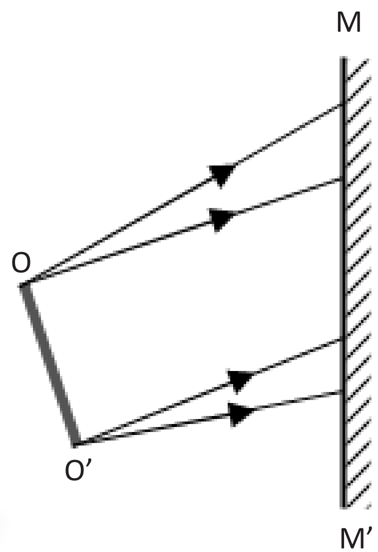


Figure 12.7.

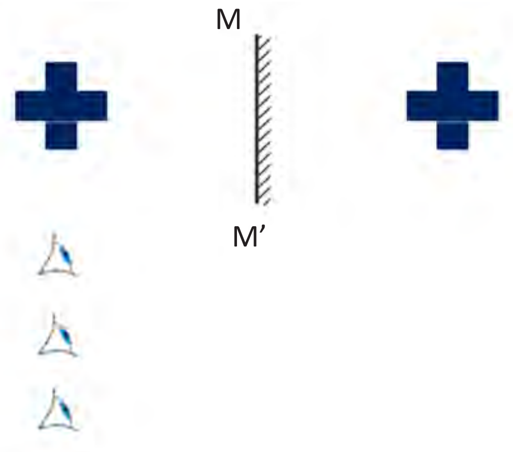


Figure 12.8.

Do it Yourself

Design a device that works using a plane mirror.

3. Spherical Mirrors

Learning Objectives

On completion of this topic, you should be able to:

- draw ray diagrams to show how spherical mirror forms image of an object placed at different positions.
- state applications of spherical mirrors.

A mirror in which the reflecting surface is a part of a sphere is called a **spherical mirror**. If the inner surface is the reflecting surface, it is called a **concave mirror**. If the outer surface is reflecting surface, it is called a **convex mirror**. These types of mirror obey the laws of reflection exactly the same way as the plane mirror.

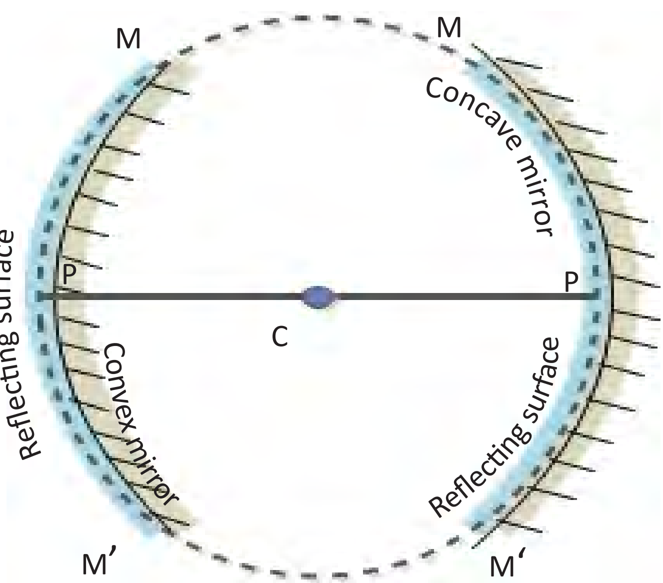


Figure 12.9. Spherical mirror.

Reprint 2024

Activity 12.3. Identifying the terms used in spherical mirrors

i. Draw a circle of radius 5 cm. Mark the centre with C. The centre of the circle is the **centre of curvature**.

ii. Cut an arc approximately one-fourth of circumference and locate the geometric centre of the spherical surface in the arc. This is a **pole**. Mark with P.

iii. Join C and P and extend beyond it. This line is the **principal axis**.

iv. The distance between C and P is the **radius of curvature**. It is denoted by R.

v. Shade the arc on the caving side. This gives a convex mirror.

vi. Shade the arc on the bulging side. This gives a concave mirror.

vii. The part of the mirror which is exposed to the light is called **aperture**.

Activity 12.4. Identifying the types of spherical mirror

Materials required

Convex mirror and concave mirror.

Procedure

Step 1. Observe the nature of the reflecting surfaces of the given mirrors.

Step 2. Observe the image of your face formed by moving each mirror back and forth.

i. How are the reflecting surfaces of the two mirrors different?

ii. Complete Table 12.4 to describe the images formed.

Table 12.4 *Characteristics of Image Formed by Spherical Mirror*

Type of Mirror	Characteristics of Image	
	Upright or Inverted	**Magnified or Diminished**
Convex mirror		
Concave mirror		

Reprint 2024

Principal Focus of a Concave Mirror

It is a point on the principal axis at which the rays of light, incident parallel to the principal axis actually meet after reflection. It is represented by the symbol 'F' as shown in Figure 12.10. Since the light rays actually meet or converge after reflection, concave mirrors have a real focus. These types of mirrors are also called **converging mirrors**.

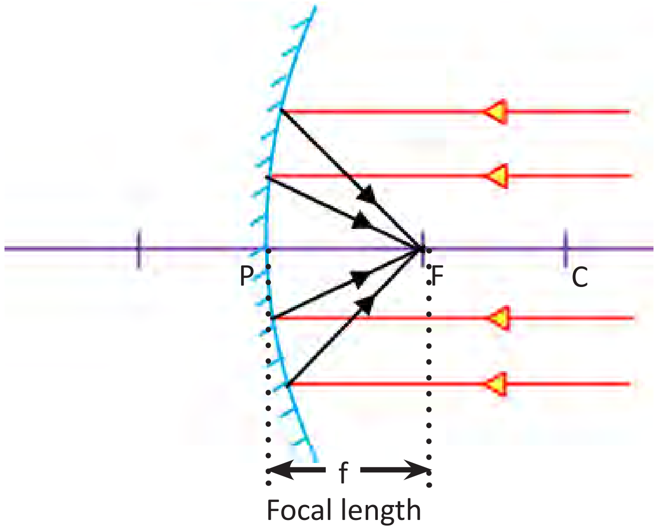


Figure 12.10. Converging mirror.

Principal Focus of a Convex Mirror

It is a point on the principal axis at which the rays of light, incident parallel to the principal axis appear to diverge after reflection. It is represented by the symbol 'F' as shown in Figure 12.11.

Since the light rays appear to diverge from a point after reflection, convex mirrors have virtual focus. These types of mirrors are also called **diverging mirrors**.

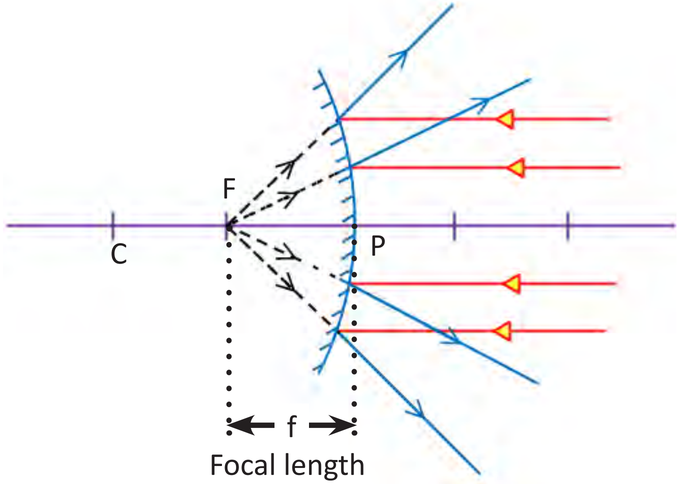


Figure 12.11. Diverging mirror.

Focal Length

It is the distance between the principal focus and the pole of the mirror. It is represented by symbol **f**. In Figure 12.10 and Figure 12.11, the distance PF represents the focal length.

For a spherical mirror (concave or convex), the focal length is half of its radius of curvature.

$$f = \frac{R}{2} \text{ or } R = 2f$$

Example 12..1

The radius of curvature of a rear view mirror of a car is 30 cm. What is its focal length?

Solution:
Focal length,

$$f = \frac{R}{2}$$

$$f = \frac{30}{2} = 15 \text{ cm}$$

Formation of Image by Spherical Mirrors

Ray diagrams are usually used to show the formation of images by mirrors.

To construct a ray diagram, we need at least two rays whose paths after reflection from the mirror are known.

Real image is formed on the screen like photographic plates because the rays after reflection actually meet in front of the mirror.

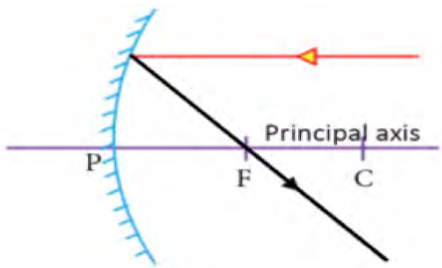
Virtual image is not formed on the screen because the rays after reflection do not actually meet but appear to meet behind the mirror.

Reprint 2024

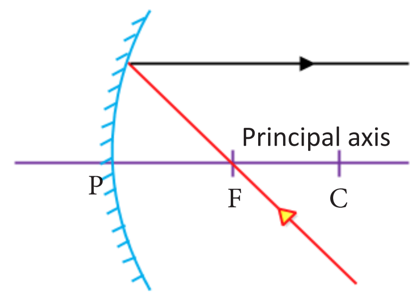
Concave Mirror

Any two ray diagrams of the following can be considered to obtain the image by a concave mirror.

1. Rays of light travelling parallel to the principal axis after reflection will pass through the focus.
2. Rays of light travelling through focus will reflect parallel to the principal axis.

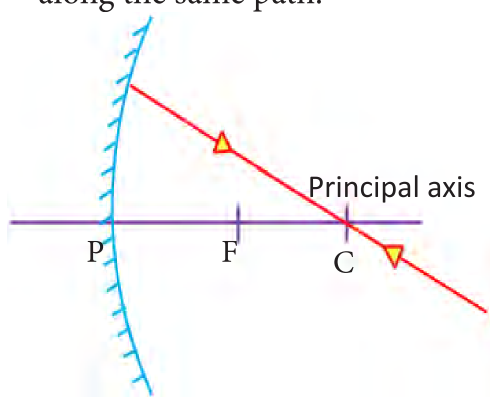


(a)

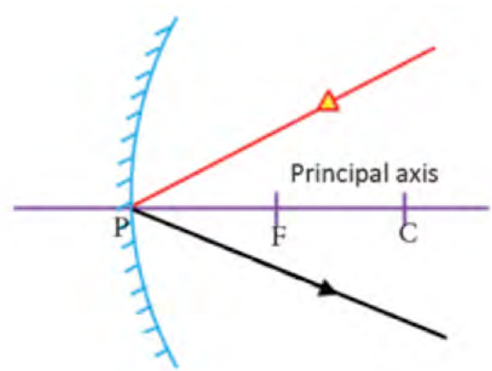


(b)

3. Rays of light passing through the centre of curvature will reflect along the same path.
4. Rays of light incident on the pole of the mirror will reflect, following the laws of reflection.



(c)



(d)

Figure 11.12. Construction of drawing ray diagrams for concave mirror.

WEBLINK http://www.pa.uky.edu/sciworks/qem.htm

Reprint 2024

Formation of Image

1. When an object is at infinity, as in Figure 12.13, the characteristics of the image formed are:
   - real
   - inverted
   - highly diminished
   - at focus

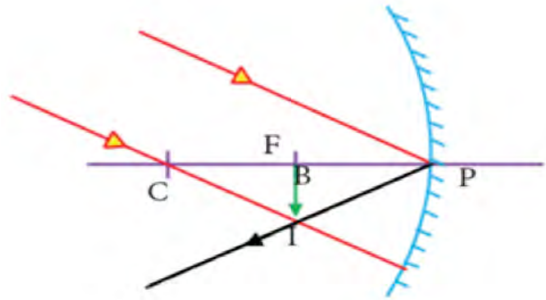


Figure 12.13.

2. When an object is placed beyond the centre of curvature, as in Figure 12.14, the characteristics of the image formed are:
   - real
   - inverted
   - diminished
   - between centre of curvature and focus

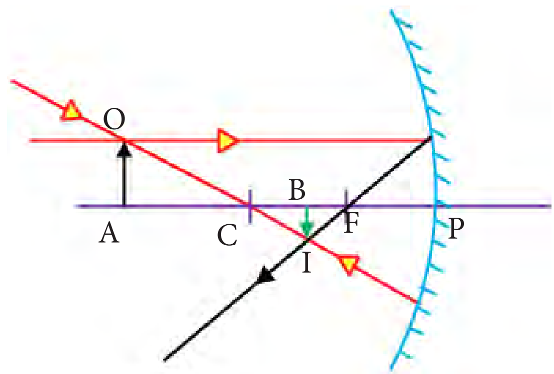


Figure 12.14.

3. When an object is placed at centre of curvature, as in Figure 12.15, the characteristics of the image formed are:
   - real
   - inverted
   - same size as object.
   - at the centre of curvature

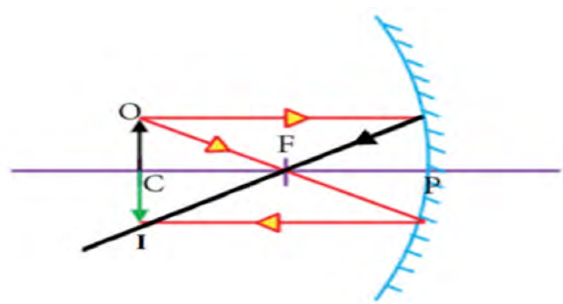


Figure 12.15.

4. When an object is between focus and centre of curvature, as in Figure 12.16, the characteristics of the image formed are:
   - real
   - inverted

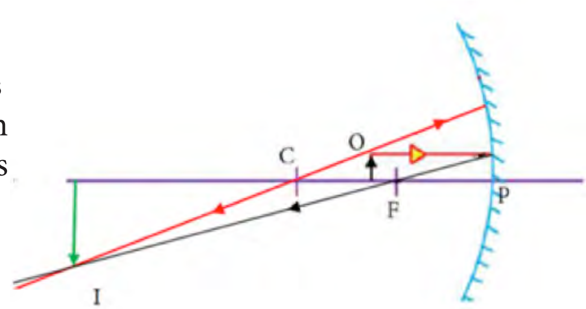


Figure 12.16.

Reprint 2024

- enlarged
- beyond centre of curvature.

Explore the formation of image with the help of ray diagram and write down the characteristics of the image formed.

a. when an object is at the principal focus.

b. when an object is in between the pole and the focus.

Uses of Concave Mirror

Concave mirror is used

- as shaving mirror
- as make-up mirror
- as dentist's mirror
- in searchlights
- in floodlights
- in headlights of vehicles and
- in solar heating devices.

Question

Construct a ray diagram to show how a concave mirror is used in search light.

WEBLINK

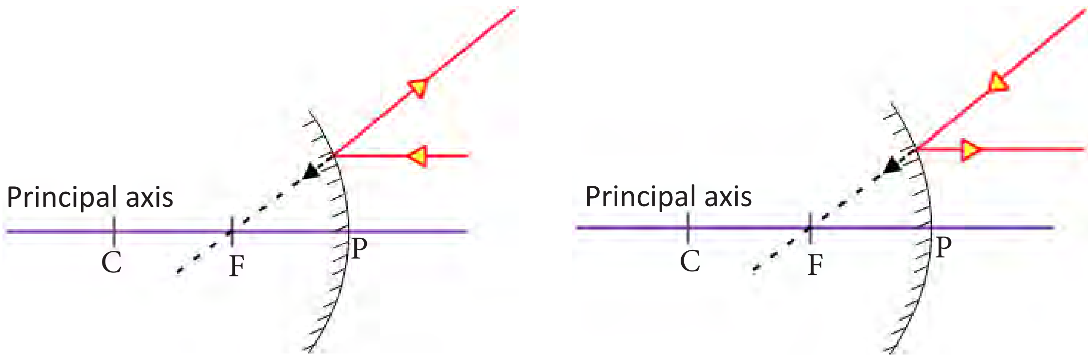
http://www.physicsclassroom.com/mmedia/optics/rdcmd.cfm

http://www.physicsclassroom.com/Class/refln/u13l3d.cfm

Reprint 2024

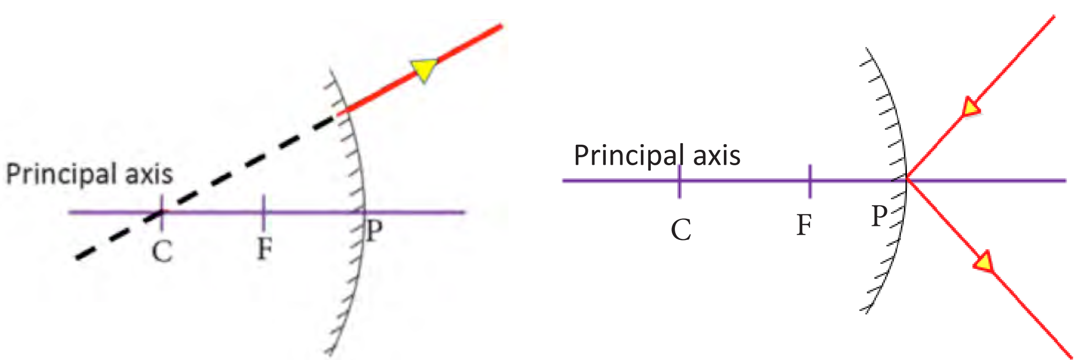
Convex Mirror

1. Ray of light travelling parallel to principal axis after reflection appears to diverge from the focus.
2. When a light ray appears to pass through focus, it will reflect parallel to the principal axis.



(a) (b)

3. Ray of light appearing to pass through the centre of curvature will reflect in the same path.
4. Ray of light incident on the pole of the mirror will reflect, following the laws of reflection.



(c) (d)

Figure 11.12. Construction of ray diagram for convex mirror.

WEBLINK
http://www.physicsclassroom.com/class/refln/u13l4b.cfm

Reprint 2024

Formation of Image

When an object is placed in front of a mirror, as in Figure 12.18, the characteristics of the image formed are:

- always virtual
- upright
- diminished
- between pole and focus

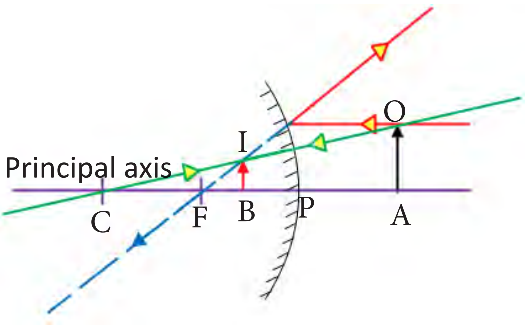


Figure 12.18.

Explore the formation of image with the help of ray diagram and write down the characteristics of image formed when an object is at infinity.

Uses of Convex Mirror

Convex mirror is used

- as rear view mirror in vehicles.
- as reflector in street light.
- in shops to detect shoplifters.
- at sharp bends to give a view of incoming traffic.

Question

Copy and complete Table 12.5.

Table 12.5 *Characteristics of Lenses*

Characteristic	Concave Mirror	Convex Mirror
Reflecting surface		
Path of rays		
Type of focus		
Type of image formed		

Reprint 2024

4. Production and Propagation of Sound

Learning Objectives

On completion of this topic, you should be able to:

- explain how sound is produced.
- explain that sound requires medium for propagation.
- compare the speed of light and sound.
- identify different sounds based on their wave patterns.
- explain the audible range of sound for different animals.

Sound is produced due to the vibration of a body. For example, vocal cord, the air in a flute, string in **yangchen** and **chiwang** and leather membrane in a drum vibrates to produce sound. Some sounds are loud and shrill, while some are flat and dull. In lower classes, you have investigated how sound is produced. In this chapter, you will further investigate how sound is produced and propagated.

Everyday many sounds are produced in outer space due to collision of space bodies and other cosmic activities. We cannot hear these sounds because the space is vacuum and sound requires a medium for propagation. Sound can propagate not only through gases but also through solids and liquids. Some materials like air, water, and iron can easily transmit sound energy from one place to another. On the other hand, materials like a blanket and thick curtains absorb most of the sound energy, therefore, they do not transmit sound energy easily.

Reprint 2024

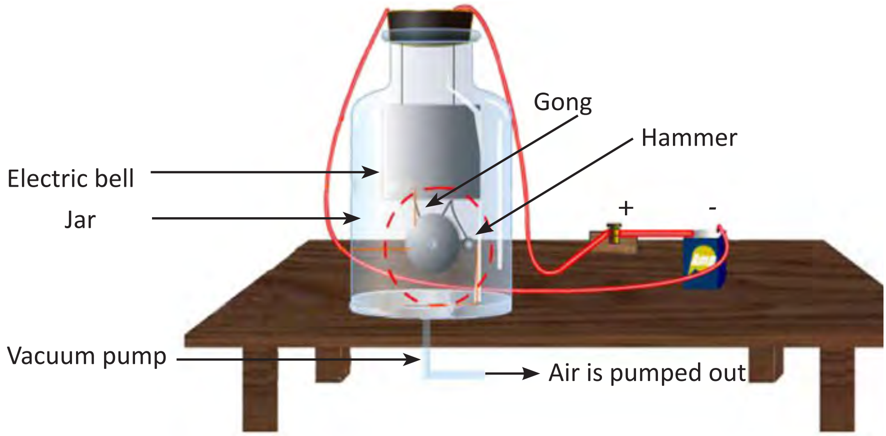


Figure 12.19. Demonstration of sound propagation.

In an experiment, as shown in Figure 12.19, an electric bell is kept hanging inside an airtight transparent jar which is connected to a vacuum pump. When the bell is switched on, the hammer is seen striking the gong and the sound is also heard.

However, when the air inside the jar is slowly pumped out by the means of a vacuum pump, the loudness of sound gradually decreases. Finally, no sound is heard when all the air is drawn out of the jar although the hammer is seen striking the gong. This experiment shows that sound cannot travel through a vacuum. A Material medium is necessary for sound propagation.

Answer the following questions based on the above experiment

i. What causes the decrease in loudness of sound produced by the bell?

ii. How do we make the bell jar air tight in the above experiment?

iii. Sound does not propagate through vacuum. Why?

Do You Know?

Astronauts on the surface of the Moon talk to each other over the radio phones. There is no air on the surface of the the Moon through which sound can travel.

WEBLINK

http://www.tutorvista.com/content/physics/physics-iii/waves/sound-propagation.php
http://www.physchem.co.za/OB11-wav/sound1.htm

a. Sound Wave

During thunderstorm, lightning is seen first and the sound of thunder is heard later. Why?

The speed of the light in air is 3×10^8 m/s and the speed of sound is 330 m/s. This shows that light travels about one million times faster than the sound in the air. The sound travels in the form of waves. **Wave** is a disturbance that moves through a medium.

Activity 12.5. Investigating sound wave

Materials required:

Computer.

Use the PhET simulation from the given URL and answer the following questions.
https://phet.colorado.edu/sims/html/waves-intro/latest/waves-intro_en.html

i. How is the wave of faint sound different from the wave of loud sound?

ii. What happens to the loudness of sound when the amplitude is increased?

iii. What happens to the loudness of sound when the frequency is increased?

iv. Draw a graph that illustrate the sound wave of a man and a woman produce in the same medium.

b. Wave Patterns

Different sounds are produced from different sources and these result in different wave patterns. Since sound is a wave, we can relate the characteristics of sound to the patterns of a wave.

Figure 12.21, Figure 12.22, and Figure 12.23 show wave patterns of different sounds.

Reprint 2024

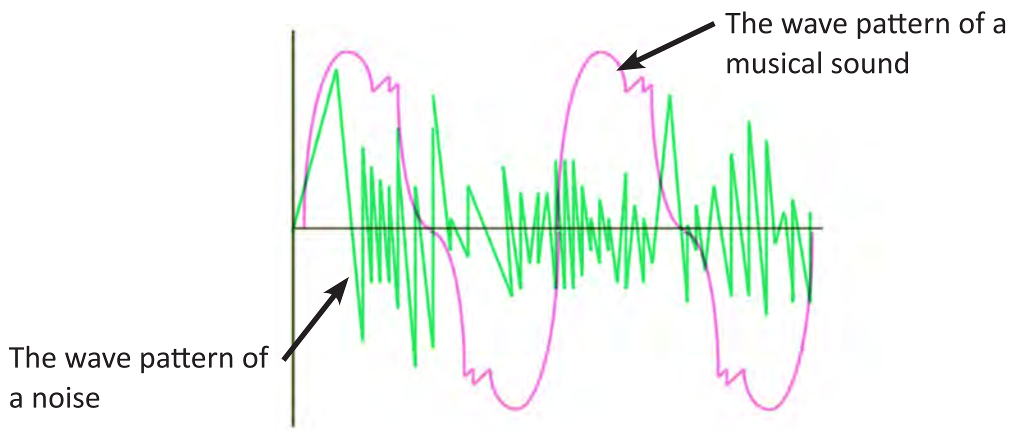


Figure 12.21. Wave pattern of musical sound and noise.

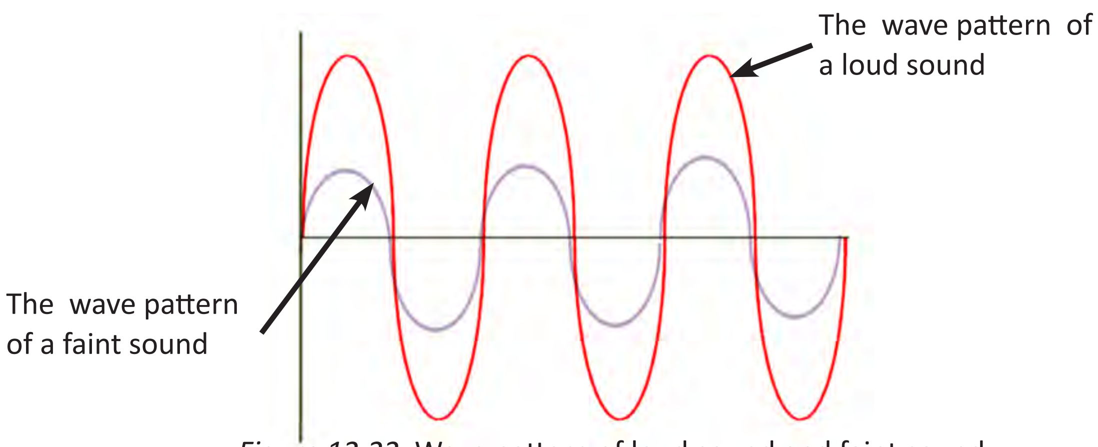


Figure 12.22. Wave pattern of loud sound and faint sound.

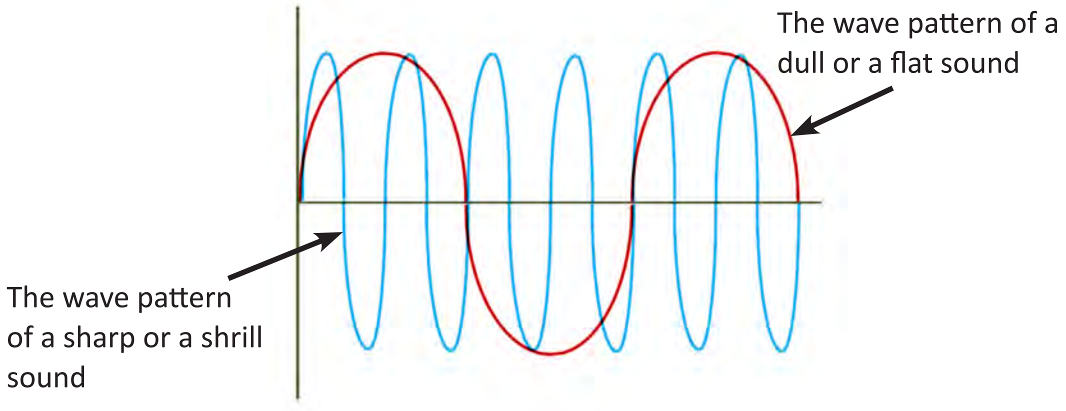


Figure 12.23. Wave pattern of flat sound and shrill sound.

Reprint 2024

Question

Draw wave pattern formed for the sounds produced by the following activities.

Table 12.6

Activity	Type of Sound	Wave Form
Roaring of a lion	Loud	
Blowing whistle	Shrill	
Sound from a flute	Musical	
Clattering of tin	Noise	
Humming of a bee	Dull	

c. Range of Audibility

The number of vibrations made by a body in one second is called **frequency**. It is measured in hertz (Hz). One Hertz (Hz) is equal to one vibration per second.

The vibration which has frequency between 20Hz to 20,000Hz is called audible range for humans.

The vibration which has frequency less than 20Hz is called infrasonic sound.

The vibration which has frequency more than 20,000Hz is called ultrasonic sound.

Uses of Ultrasonic Sound

1. Dogs can hear sounds of frequency up to 45,000Hz. Special whistle which produces ultrasonic sound are used by police to pass instructions to their trained dogs.
2. The bats usually produce ultrasonic vibrations when they fly at night. When these vibrations strike the objects, they are reflected back. On receiving the reflected sound, bats can locate the prey or avoid obstacles. Dolphins use ultrasonic sound to locate their prey in a similar ways as the bats. The same technique is also used while fishing at seas.
3. Ultrasonic vibration is used in medical science to diagnose problems of

Reprint 2024

internal organs such as liver, gallbladder, heart, etc.

Uses of Infrasonic Sound

1. Infrasonic sound is used by animals like whales, giraffe, elephants and birds to communicate amongst themselves.
2. Infrasonic sound is used to monitor earthquake, tsunami, volcano, avalanche, thunderstorm, and severe weather.
3. Infrasonic sound is use to monitor the stability of old buildings and structures.

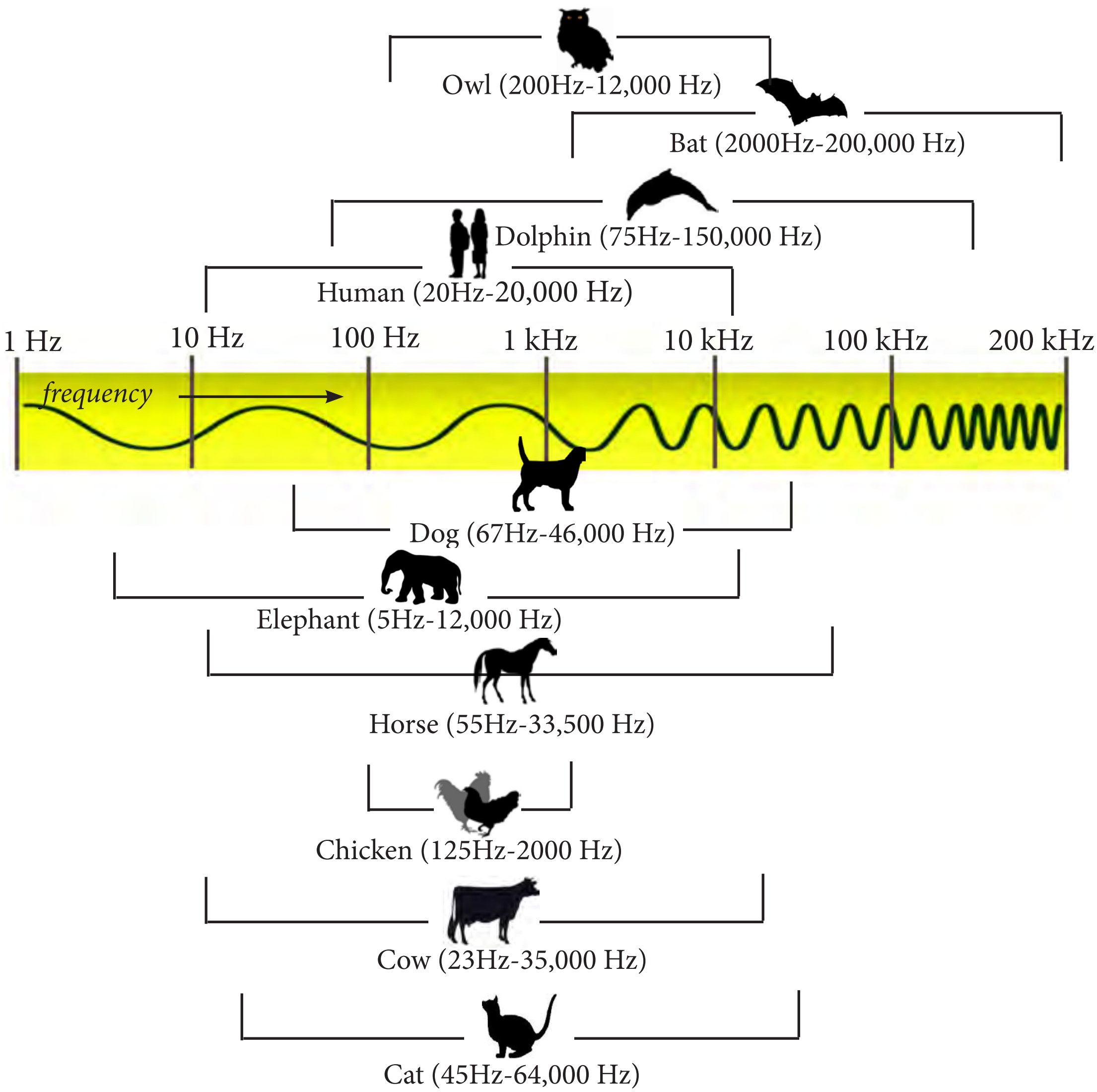


Figure 12.24. Audibility range.

Do You Know?

Animals were reported to have fled the area hours before the actual tsunami hit the shores of Asia in 2004. It is because animals have been known to perceive the infrasonic waves going through the earth hours before the natural disaster. Therefore, we can use these as an early warning sign.

5. Sound and Environment

Learning Objectives

On completion of this topic, you should be able to:

- explain the negative effects of noise on human and our environment.
- explain the devastating effect of abnormally loud sounds.

With lots of human activities around us, many different types of sounds are produced. Some sounds are undesirable to hear. Such sounds come from automobiles, use of fire-crackers, and explosives, loud music, aeroplanes, and many other sources. These sounds are called noise.

Activity 12.7. Identifying sounds in the surrounding

In groups, list the different types of sound that you hear in your surrounding and fill Table 12.7.

Table 12.7 *Sound and its Effect*

Sound	Effect

Noise is a sound which is unpleasant to hear. Too much noise leads to noise pollution. Noise pollution is excessively unpleasant sound created by humans, animals or machines that disrupt the activity of normal life. Noise causes fatigue, nervousness, headache, mental disturbances, and hypertension and can even

Reprint 2024

lead to hearing impairment. The noise pollution can adversely affect marine lives too.

Questions

1. Identify and list the sounds that cause noise pollution:
   i. at home
   ii. in the neighbourhood
   iii. transportation
2. In a group, discuss and list the ways to reduce noise pollution. Design posters with appropriate slogans using Paint.NET. Share posters in Google Classroom.

Effects of Loud Sound

There are many effects of loud sounds such as triggering an avalanche, hearing impairment, cracking of building interfering with telecommunication, etc.

Activity 12.8: Case study

Are dam site blasts cracking the Dzongs?

Recent artificial tremors and subsequent cracks on some of the landmarks of Trongsa, residents and authorities of the dzongkhag attribute to activities being carried out at the Mangdechu hydropower construction site.

Authorities have reported of extension on existing cracks on the walls of Trongsa dzong that overlooks the gorge of the

Reprint 2024

Mangde river, and fresh cracks appearing on the walls of the renovated Ta-dzong (watchtower) above the dzong.

Trongsa residents said, ever since work on the Mangdechu project began, heavy sounds and echoes of explosion from the dam construction site, a few kilometres below the dzong, have been regular.

Over the months, the loud explosions began showing their impact, dzongkhag authorities said, on the landmarks of the dzongkhag.

Ta-dzong's officiating curator Loday said the three-storey block of the watchtower, which serves as meditation centre and security room, have developed new cracks since a few months ago.

He said, a few days ago, some Indian experts that Jaypee association hired to conduct studies on the relationship between explosions at the dam site and damage to the dzongs, said there was none.

"They said the cracks weren't new and that they weren't caused by the blasting at the dam site," he said, insisting there were no crack on the walls of the structure before. "These cracks are a few metres long."

Others staying inside the Ta-dzong said, whenever there was blasting at the dam site, they felt vibrations and heard their windowpanes quivering.

To find out if cracks on the walls of the two dzongs were really caused by the blasting occurring at intervals at the dam site, the experts have glued rectangular glass slabs, the size of a data card, on some of the cracked walls of the two dzongs.

"The glass is supposed to determine if the cracks were indeed caused by the blasting," the junior engineer said. "It's supposed to break in the event of another blast."

An engineer with the project said the issue of cracks on the walls of the dzong was reported before the project began.

A site engineer at the dam construction said at least three to four blasts were being carried out in a day, although officials claimed not to know how much blasting was done so far since the project began.

"All blasting is done in a way that ensures minimal affect in the area," he said. "For less damage and less vibration, a detonator was used for blasting."

Jaypee official were unable to comment on the issue, saying the two scientists they hired were studying the case.

"Such problems can't be solved through discussion but through scientific methods," he said, adding the actual causes of the cracks on the dzongs would be known only after they received the survey data from the experts, who are leaving the country in a few days.

(Source: *Kuensel, dated 26th January, 2013*)

Reprint 2024

Questions

Answer the following questions based on the case study.

1. What was the hypothesis stated in the above case?
ii. What experiment was conducted to test the hypothesis?
iii. What conclusion can you draw from the case study?

WEBLINK
http://www.lcse.umn.edu/specs/labs/waves/apps_to_everday.html

Reprint 2024

Exercise

Fill in the blanks

1. The ray of light that bounces back from the surface of shiny steel plate is known as _______________.
2. The speed of light in air is about _______________.
3. When the rays of light do not actually meet, ____________ image is formed
4. We usually see _______________ objects due to reflection.
5. A dentist detects the dental problem of a patient by using a _______________mirror.
6. The number of vibrations made by a body in one second is called its _____________.
7. An object can act as a source of sound when it is in a state of _________.
8. Sound requires medium for ______________.
9. Animals like bat and dolphin make use of _____________ sound to catch their prey.
10. In residential areas, automobile drivers are advised not to blow horns to reduce __________ pollution.

Check whether the following statements are True or False. Correct the false statements.

1. Light rays passing through the focus of a spherical mirror will be reflected parallel to principal axis.
2. The image formed in a dress up mirror is a magnified image .
3. A mirror used in search light produces real image.
4. Virtual images can be seen with our eyes.
5. A magnified and clear image can be seen when the face is at the focus of a spherical mirror.
6. Some animals like elephants, cats and dogs hear infrasonic sounds.
7. Multipurpose halls are usually fitted with cardboards with holes in the ceiling to reduce noise.
8. Music is produced by irregular vibration.

Reprint 2024

9. Sounds produced by different whistles differ from one another.
10. Human eardrums can be damaged by sound of low frequency.

Match the following

Column A	Column B
1. A body emitting its own light	a. concave mirror
2. Image of face seen in clean water.	b. noise
3. Frequency is more than 20,000 Hz	c. $3 \times 10^8 ms^{-1}$
4. Cannot travel through vacuum.	d. convex mirror
5. Speed of light in water	e. Avalanche
6. Caused by very large sound.	f. Light
7. Mirror used for shaving.	g. Sun
8. Travel faster than sound.	h. sound
9. Rear view mirror in vehicles.	i. untrasonic sound
10. Cause headache, hypertension and fatigue.	j. regular reflection
	k. moon
	l. $320 ms^{-1}$

Multiple Choice Questions

1. Which of the following is the only characteristic of image formed by convex mirror?
   a. Real
   b. Virtual
   c. Inverted
   d. Same size

2. A point on the principal axis of a mirror through which the parallel rays of light converge after reflection is
   a. pole.
   b. principal focus.
   c. principal axis.
   d. radius of curvature.
3. An object is placed at a distance of 2 cm from a plane mirror. If the object is moved 1 cm towards the mirror, the new distance between the object and its image is
   a. 4 cm.
   b. 2 cm.
   c. 1 cm.
   d. 3 cm.
4. The mirror used by doctors to examine eye, throat, nose, and ear is
   a. concave mirror.
   b. convex mirror.
   c. plane mirror.
   d. make up mirror.
5. We get a magnified, erect and virtual image when an object is placed
   a. between the pole and focus of the concave mirror.
   b. beyond the centre of curvature of the concave mirror.
   c. in front of the convex mirror.
   d. between the centre of curvature and focus of the concave mirror.
6. Human can hear the sound which have frequency of vibration from
   a. 20 Hz to 200 Hz.
   b. 20 Hz to 2000 Hz.
   c. 20 Hz to 20,000 Hz.
   d. 20 Hz to 200,000 Hz.

7. Which one of the waves in Figure 12.25 shows the highest frequency?

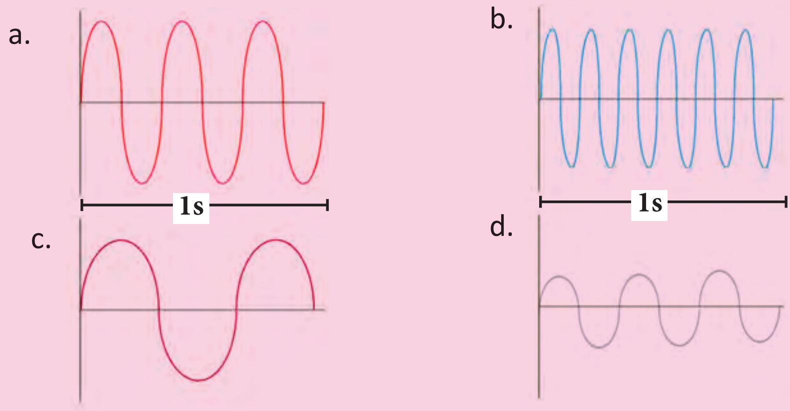


Figure 12.25.

8. Sounds produced by girls are usually regarded shrill because they have
   a. low frequency.
   b. high frequency.
   c. regular vibration.
   d. irregular vibration.

Answer the following questions

1. The speed of light is different in different medium. Justify.
2. Copy and complete the diagram in Figure 12.26 to show the formation of an image by a concave mirror of object O placed between the centre of curvature C and the focus F of the mirror.

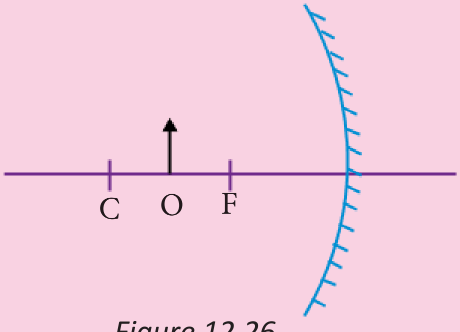


Figure 12.26.

3. Name the mirror that always produces upright and virtual images. Draw a diagram to support your answer. Write down the characteristics of the image formed.

4. During visits to hydro power plants, visitors are advised to use ear plugs. What could be the reason?
5. A concave mirror can produce a real or a virtual image. Give one difference between a real image and a virtual image.
6. Mention the kind of mirror used in the following:
   a. Reflector in a torch.
   b. Reflector in a street lamp.
   c. Cosmetic mirror.
   d. In a solar cooker.
7. Is there a possibility of making non-luminous object luminous? Explain?
8. Sound cannot travel in a vacuum. Give reason.
9. Why are the Moon and the planets non-luminous objects?
10. Differentiate between regular and irregular reflection.
11. Why do we see lightning first and then hear thunder only after some time, though they occur simultaneously?
12. The angle between the incident ray and the reflected ray is 160^0. Calculate the angle of reflection.
13. A ray AB is incident on a plane mirror as shown in Figure 12.27. Draw the reflected ray and calculate the values of angle of incidence and angle of reflection?

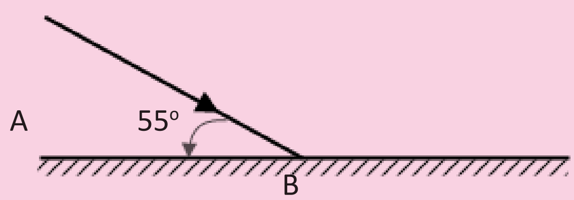


Figure 12.27.

14. Find the radius of curvature of a concave mirror of focal length 10 cm.
15. An astronaut on the Moon saw two huge asteroids collide with great force in the space but did not hear the sound. Explain.
16. In our country, we have problems of forest fire. Many of these fires start from unknown sources where people do not visit. Is there possibility of fire being started without actually igniting it? Justify.

Reprint 2024

17. A person looks at the mirror of half the size of his body as shown in Figure 12.28.

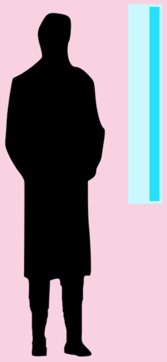


Figure 12.28.

   a. Will the person be able to see his feet in the mirror? Make a prediction.
   b. Was your prediction correct? If not, explain any errors in your reasoning.
   c. Which property of light is illustrated when you are able to see your image?

18. Snakes do not have ears but they can respond to the sound. Explain.

WEBLINK
http://www.pa.uky.edu/sciworks/qem.htm

Reprint 2024

Chapter 13

The Earth and Beyond

The sky has drawn the attention of the people for a long time making them wonder about what is out there, and how they affect the lives on the Earth. We see billions of stars shining in the sky at night. The Sun is a star like the billions of other stars in the sky. Other stars are very far away, so they look tiny. There are planets which move round these stars forming solar systems. We live in one of the planets called Earth, which moves round the Sun. There are seven other planets and a lot of other heavenly bodies moving around the Sun. All these heavenly bodies together with the Sun is called the Solar System. The Sun is at the centre of the Solar System.

The Sun is important to us because it gives us heat and light energy, due to which life exists on the Earth. Life cannot exist on the Earth without the Sun.

Learning Objectives

On completion of this topic, you should be able to:

- describe solar system.
- explain the movements of planets around the Sun.
- explain the causes of solar eclipse and lunar eclipse.
- explain the significance of phenomena of solar system on life on the Earth.

1. Formation of the Solar System

According to the Big Bang theory, throughout the Milky Way and the other galaxies, there were swirling clouds of dust and gas known as a **nebula**. An explosion inside the nebula started a gravitational collapse of the clouds, causing the hydrogen atoms to attach to one another through mutual gravity. Such events led to the formation of the stars, the planets, and other heavenly bodies including the Sun. Our solar system was formed around 4.6 billion years ago from a massive cloud of hydrogen gas and a huge swirling cloud of dust leftover from the Big Bang. See figure 13.1.

Reprint 2024

The Sun contains most of the material weight of the Solar System making it the largest in the Solar System. Therefore, the Sun exerts the maximum gravitational force on the other heavenly bodies of the Solar System. The powerful gravity of the Sun attracts all the other heavenly bodies in the Solar System towards it. At the same time, these rapidly moving heavenly bodies try to fly away from the Sun, outward into the emptiness of the outer space. The result of this process keeps these heavenly bodies in their orbits between the Sun and the outer space.

The Solar System is mostly an empty space. The planets are very small compared to the space between them.

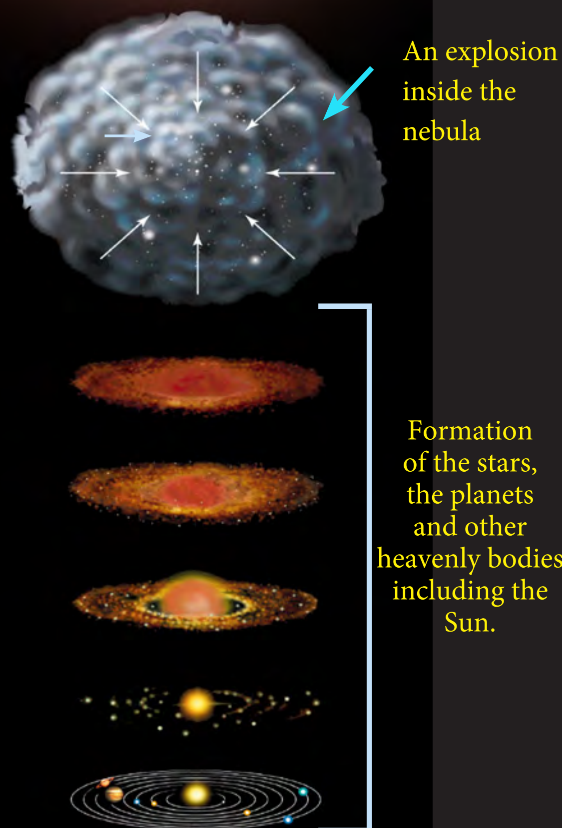


Figure 13.1. Formation of the Solar System.

Figure 13.2. The Solar System.

Reprint 2024

a. The Sun

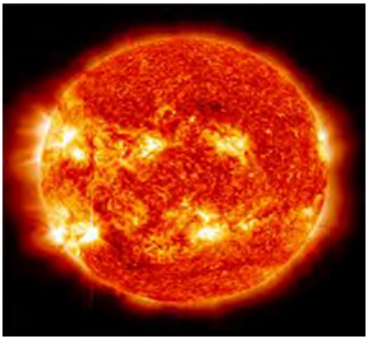


Figure 13.3. The Sun.

The Sun is the biggest star at the centre of the Solar System. It is almost spherical in shape and consists of hot plasma interwoven with a magnetic field. It is the closest star to the Earth. Its distance from the Earth is about 150 million kilometres. It has a diameter of about 1,392,684 km, about 109 times greater than that of the Earth, and its mass is about 2×10^{30} kg, about 330,000 times heavier than the Earth. The Sun exerts a huge force of attraction to everything within 600 million kilometres. This is the reason why planets, moons, and other celestial bodies orbit the Sun. The Sun is the mother star around which the Earth revolves once a year. It is the source of heat, light and life itself on the Earth.

b. Satellites

Figure 13.4. Artificial satellite.

A satellite is an object that revolves around a planet in a circular or elliptical path. The Moon is the Earth's natural satellite and there are many human-made satellites, usually closer to the Earth. Artificial satellites are devices launched into space using powerful rockets. Artificial satellites are equipped with a large number of scientific devices to collect information about the heavenly bodies, or for communication.

Artificial satellites are used for scientific researches, weather forecasting, remote sensing, communication, navigation, and for military purposes. Russia was the first country to launch world's first artificial satellite, Sputnik, in October 1957.

c. Asteroids

In addition to the planets, moons and satellites, the Solar System contains millions of smaller bodies such as asteroids, comets, meteoroids, etc. **Asteroids** are leftover materials from the formation of the Solar System. Asteroids revolve round the Sun in a belt between the orbits of the Mars and the Jupiter. This belt is known as the asteroid belt. These asteroids were believed to be large planets,

Reprint 2024

which broke away due to the gravitational force of the Jupiter. At present, they exist in rock form of different sizes. Ceres is the first and the largest asteroid discovered, which is classified as the dwarf planet.

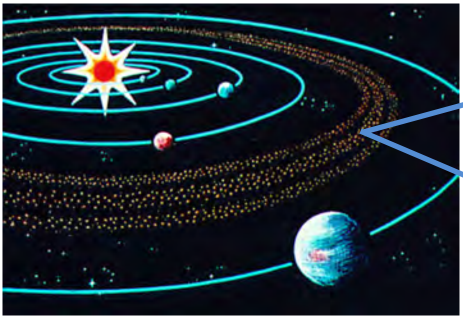


Figure 13.5. Asteroid belt.

Figure 13.6. Asteroids.

d. Comets

Comets are made out of dust and ice, like a dirty snowball. They revolve round the Sun in elliptical orbits. Sometimes, one comet may crash with others making the comets change the direction and follow a new path, bringing them near the Sun, or to the inner part of the Solar System. When the comet comes close to the Sun, it begins to melt, emitting gas and dust which forms the glowing tail of comets.

Figure 13.7. Halley's Comet.

Halley's Comet is one of the well known comets, which appear once in 76 years. It was last seen in 1986. When do you think it would be seen again?

e. Meteoroids

You would have probably heard of a shooting star or a falling star. Have you ever seen one? Their names are a little misleading and this causes some people to think that these fast moving trails of light are stars that have fallen out of the sky. This is not true. These shooting stars are called **meteoroids**. Meteoroids are very small pieces of debris flung out of comets and asteroids. When they come close to the Earth, they are pulled towards the Earth by the gravitational force. As they enter into the atmosphere, they get heated up due to friction with the air and start burning and are known as shooting stars. Some large pieces produce spectacular fireballs that are very bright and may even explode.

Sometimes, meteoroids do not burn up completely and strike the Earth's surface. Such remains of meteoroids are called **meteorites**.

Figure 13.8. Meteoroid Crater.

Figure 13.9. Meteoroids.

Figure 13.8 shows the crater near the Grand Canyon in Arizona. It was formed about 50,000 years ago when a meteorite about 30 metres wide, weighing 100,000 tons struck the Arizona desert at an estimated speed of 20 kilometres per second.

f. Planets

During the night, if we observe the sky carefully, we will see points of light appearing to move among the stars. These moving points of light are called planets, meaning wanderers. A planet is actually a large object which reflects the light of a star. Our solar system has eight planets. In the order of their distance from the Sun, they are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. They revolve round the Sun in an imaginary paths called orbits.

Mercury, Venus, Earth, and Mars are four planets closest to the Sun, and they are called **inner** or **terrestrial planets**. They are mostly made up of rocks. The other four planets namely Jupiter, Saturn, Uranus, and Neptune are called the outer or **Jovian** or **giant planets**. They are large balls of gases with rings around them. These giant planets are much colder than terrestrial planets since they are far away from the Sun.

Until 2006, Pluto was considered as the ninth planet but, in the view of recent discoveries and the change in understanding of the planetary system, the International Astronomical Union (IAU) has placed Pluto into a category of other planets called **dwarf planet**.

Reprint 2024

Any celestial body qualifies as a dwarf planet if,

i. it is in orbit around the Sun.

ii. it is nearly spherical in shape.

iii. its orbit round the Sun overlaps with that of any other heavenly body.

Since the orbit of Pluto overlaps with that of Neptune, it is classified as a dwarf planet. Some other dwarf planets are Eris, Ceres, Haumea, and Makemake.

Table 13.1. Distance of Planets from the Sun

Name of the Planet	**Size of the Diameter**	**Minimum Distance from the Sun**	**Maximum Distance from the Sun**	**Mean Distance from the Sun**
Mercury	4878 km	46.0 million km	69.8 million km	58 million km
Venus	12102 km	108 million km	109 million km	108.5 million km
Earth	12756 km	146 million km	152 million km	149.6 million km
Mars	6794 km	205 million km	249 million km	228 million km
Jupiter	142984 km	741 million km	817 million km	778.5 million km
Saturn	120536 km	1.35 billion km	1.5 billion km	1.43 billion km
Uranus	51118 km	2.7 billion km	3 billion km	2.88 billion km
Neptune	49528 km	4.46 billion km	4.54 billion km	4.5 billion km

Questions

Study Table 13.1 and answer the following questions.

1. Name the largest and the smallest planets in the solar system? What are their radii?
2. How many times is the largest planet bigger than the smallest planet?
3. Which planet is the coldest planet? Why?
4. Comparatively, which two planets are closest in their sizes?
5. Which two planets have the maximum space between them?

Reprint 2024

g. Eclipses

The Moon moves around the Earth. The Earth and the Moon are illuminated by the Sun. At a single point of time, the Earth, the Moon and the Sun lie in a straight line. During that time, either the shadow of the moon would fall on the Earth, or the shadow of the Earth would fall on the Moon. This phenomenon causes an eclipse. The eclipses are classified into two types:

- Lunar eclipse
- Solar eclipse

i. The Lunar Eclipse

An eclipse of the Moon can only occur on a full moon night, but not during every full moon night. This is because the orbits of the Earth and the Moon do not always come to lie in the same plane. During the course of revolution and rotation of the Earth, the Sun, the Earth and the Moon come to lie in a straight line with the Earth in between the Sun and the Moon. This causes the shadow of the Earth to fall on the moon. This phenomenon is called lunar eclipse. Lunar eclipse is safe to observe with naked eyes. However, a pair of binoculars will help to magnify the view.

When the whole of the Moon is in umbra region, total lunar eclipse occurs. A partial lunar eclipse occurs when the Moon is partly in umbra region and partly in penumbra region.

During the lunar eclipse, the Moon is closer to the Earth and exerts more gravitational force on the Earth's surface. This causes moderately high tides. The

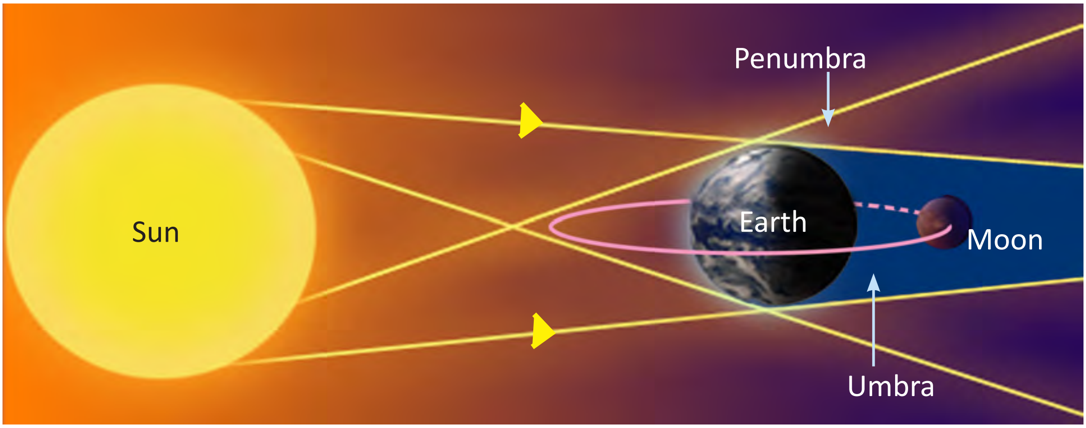


Figure 13.12. Lunar eclipse.

Reprint 2024

shape of the shadow of the Earth cast on the Moon during the lunar eclipse also confirms the shape of the Earth.

ii. Solar Eclipse

A solar eclipse can only occur at new Moon, but not in every new Moon. This is because the orbits of the Moon and the Earth do not come to lie in the same plane during every new Moon. A solar eclipse is caused when the Moon comes in between the Sun and the Earth in a straight line during the course of their revolutions. The Moon blocks the Sun fully or partially and casts its shadow on the Earth. People in the region of umbra will see a total solar eclipse, whereas those in the penumbra region will see a partial solar eclipse.

It is not advisable to look directly at the solar eclipse with naked eyes. Protective eye glasses and X-ray papers may be used. During solar eclipse, the Earth receives a very large amount of ultraviolet radiations. These radiations can burn the retina of our eyes, which can cause permanent blindness.

During the solar eclipse, the Moon, the Earth and the Sun are aligned in a straight line, and the Sun exerts the maximum gravitational force on the Earth's surface. This causes high tides. The dark disc that covers the Sun during the eclipse also confirms the shape of the Moon.

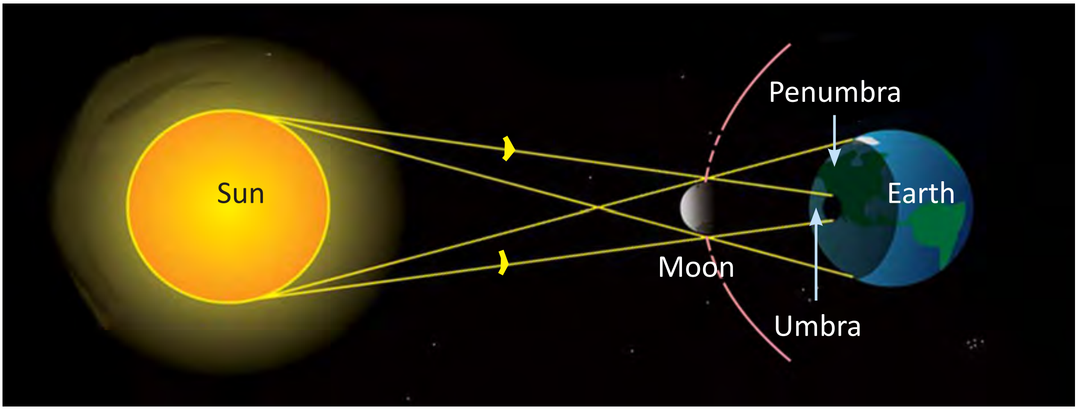


Figure 13.13. Solar eclipse.

WEBLINK

http://www.kidsastronomy.com/solar_system.htm
http://www.kidsastronomy.com/astroskymap/solar-eclipse.html
http://shadowandsubstance.com/

Reprint 2024

Exercise

Fill in the blanks with correct word (s).

1. When the meteoroids travel all the way through the atmosphere and land on the earth, we call them ________________.
2. During the solar eclipse ________________ casts its shadow on the ________________.
3. Pluto was once considered as planet but it has been recently reclassified as a ___________.
4. The Jovian planet closest to Saturn is ____________.
5. The biggest star in the solar system is the ________________.

Match the items of Column A with correct answers of Column B.

Column A	Column B
1. The planet with the ring of gas.	A. Star
2. A heavenly body which has light of its own.	B. Artificial Satellites
3. The hottest planet in the solar system	C. Saturn
4. Provides useful information for the study of climate change.	D. Rotation of the Earth
5. The phenomenon that leads to the formation of day and night.	E. Mercury
	F. Venus

Check whether the following statements are True or False. Correct the false statements.

1. Asteroids are left over materials from the formation of the Solar System.
2. Comets glow because they have long tails. .
3. The umbra of the Moon's shadow is the region from which no part of the rays is visible.

Reprint 2024

4. Ceres is the first and the largest asteroids discovered, which is now classified as real planet.
5. There is life in the planet Venus.

Multiple choice questions

1. An object revolving around a planet is called
   A. star.
   B. comet.
   C. Sun.
   D. Moon.
2. The heavenly body is made up of ice and dust, and when it comes near the Sun, melts forming a glowing tail. This heavenly body is called
   A. asteroid.
   B. meteoroid.
   C. comet.
   D. meteorite.
3. When the Earth, the Moon, and the Sun come to lie in a straight line and the Moon is not visible, the phenomenon is lunar eclipse. This occurs at the time of:
   A. new Moon.
   B. full Moon.
   C. solstice.
   D. waning Moon.
4. The Sun being the largest body has the highest gravitational pull on all planets. However, planets do not collapse into the Sun. This is because of
   A. gravitational pull of the Earth.
   B. gravitational pull among the planets.
   C. gravitational pull of Moon.
   D. the balancing force.

Reprint 2024

5. The lunar eclipse can be observed with naked eyes, but it is advisable to observe the solar eclipse with some protection. This is because the rays from the Sun can damage

   A. retina.
   B. brain.
   C. kidney.
   D. heart.

6. The Earth gets most of its light from

   A. the stars.
   B. the Sun.
   C. the Moon.
   D. other planets.

7. Figure 13.14 shows the Moon orbiting the Earth, and the Earth orbiting the Sun.

   Which force is responsible for these orbiting motions?

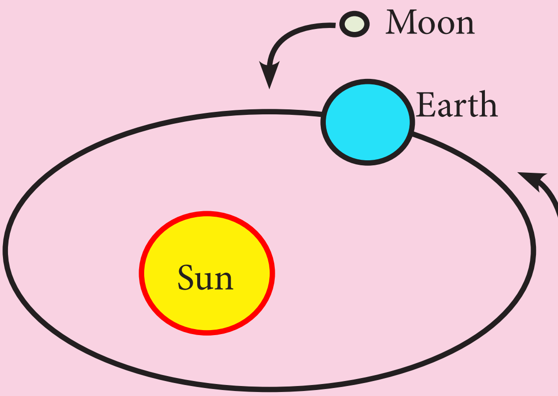


Figure 13.14.

   A. friction.
   B. magnetism.
   C. electricity.
   D. gravity.

8. The Moon is visible to observers on the Earth because of

   A. reflected sunlight.
   B. absorbed light from the Earth's atmosphere.
   C. gases in the Moon's interior.
   D. volcanic eruptions on the Moon's surface .

Reprint 2024

9. The Moon has the greatest effect on the Earth's

   A. year.
   B. ocean tides.
   C. seasons.
   D. daylight hours.

Answer the following questions.

1. List the correct order of the planets in the Solar System, starting closest to the Sun?
2. The Earth's atmosphere is primarily nitrogen and oxygen. Venus has a thick atmosphere of carbon dioxide, with traces of poisonous gases such as sulphur dioxide. Atmosphere of Mars is extremely thin, containing carbon dioxide. Jupiter, Saturn, Uranus, and Neptune primarily have hydrogen and helium. When Pluto is near the sun, it has a thin atmosphere, but when Pluto travels to the outer regions of its orbit, the atmosphere freezes and collapses to the planet's surface. In that way, Pluto acts like a comet.
   i. What is the factor that allows the life to exist on the Earth?
   ii. How different is the atmosphere of Venus from that of Neptune?
   iii. Describe the two characteristic features of Pluto.
3. Why do the stars appear like point objects?
4. Why are the first four planets called the terrestrial planets?
5. What are dwarf planets? Name one that was earlier classified as a planet.
6. What are artificial satellites? Give some uses.
7. Lunar eclipse does not occur every month. Why?
8. Explain how solar and lunar eclipses occur with the help of a labelled diagram.

Reprint 2024

Annexture - A

Assessment

Assessment in science involves testing of scientific knowledge, skills, values and attitudes. The assessment should be able to diagnose the learning progress or gap of the learner in terms of expected core competencies and learning outcomes. Consequently, it is imperative to use appropriate assessment techniques and tools to provide relevant feedback to the learners and to assess the impact of teaching learning processes.

Holistic assessment entails assessing all the three domains of learning: cognitive, psychomotor and affective. Thus, the assessment practice in science assesses Scientific Knowledge (SK), Working Scientifically (WS), Scientific Values and Attitudes (SV) of the learners.

Purpose of Assessment

Assessment is used to:

i. inform and guide the teaching and learning process.

ii. gauge the efficacy of the teaching and learning process.

iii. assess the relevance of curriculum materials.

iv. help learner's set learning goals.

v. monitor learner's progress in achieving learning outcomes.

vi. generate reports on learner's performance.

Areas of Assessment

The assessment in science focuses on the three domains of learning reflected as scientific knowledge (cognitive), working scientifically (psychomotor) and scientific values and attitudes (affective) as detailed below:

i. **Scientific Knowledge (SK):** The learner meets the requirement reflected in the learning objectives and expected learning outcomes under each unit, chapter, and topic. The learner is able to provide expected scientific information through various ways as asked.

ii. **Working Scientifically (WS):** The learner demonstrates scientific skills such as observing, predicting, inquiring, questioning, investigating, experimenting, measuring, classifying, recording, analyzing, inferring, communicating, etc. and explain how science works.

iii. **Scientific Values and Attitudes (SV):** The learner exhibits interest, curiosity, intellectual drive, creativity, exploring possibilities, inquisitiveness, finding facts, coherent presentation of ideas, reasoning

Reprint 2024

skills, collaborative skills, respect and concern for all, etc.

Assessment Modalities

The assessment focuses on diagnosing the learning gap through Continuous Formative Assessment (CFA), Continuous Summative Assessment (CSA) and Summative Assessment (SA) using appropriate assessment tools.

Specifically, the assessment is carried out in the following ways:

i. **Home work:** The extended activities given to students encourages independent learning and responsibility to complete the task. The task is assigned only on important topics that require extra time and energy, and to be assessed using appropriate assessment tools such as rubrics, rating scale, and checklist.

ii. **Class work:** The learning activities such as group discussion, presentation, individual work, etc. are assessed using appropriate assessment tools.

iii. **Journal:** A journal is an informal written record of personal thoughts, experiences, and observations. The students are free to express their ideas related to science and the entries can be simple and short, written or sketched based on their observation. You have to observe carefully and write down your observations. Therefore, the science journal probes students to document their observations about the scientific concepts, events and phenomenon that they observe and experience in their daily lives.

This activity shall be carried out throughout the academic session with periodical assessments. An exercise book can be maintained by each student to make a minimum of 15 entries in their science journal. While maintaining journal, students are expected to explain the concept with the use of appropriate scientific language and scientific processes. The journal must be well organised and have the reflection of the learner. Teacher must assess each entry and may use the sample rubrics to assess the students' work.

iv. **Project work:** It is an opportunity for the learner to learn and explore the basics of science through the scientific process of observation, investigation, analysis, and synthesis to generate scientific knowledge and understanding. The project work is given based on the topic of the learner's choice and assigned at the beginning of the academic session. It is mandatory to assess both process and product of the project work. The learner must choose the topic based on their interest in the beginning of class VII and complete the project work by the end of class VIII. Therefore, teacher shall assess some components in class VII and remaining in class VIII as reflected in rubrics

Reprint 2024

of project work. The product of the project work must be inclusive of write ups, illustrations, models or collection of real objects.

The format for the project work write-up must include observation, questioning, hypothesis, background information, design, data collection, analysis, conclusion and sharing as explained in the scientific processes.

The teacher may use the given sample rubrics to assess the students' project work.

v. **Practical work**: It is a hands-on experience given to the learner to test, develop, and apply the scientific theories learnt in the class. It enhances the deeper understanding of scientific ideas which culminates in the development of scientific skills, temper and positive attitudes and values. A practical work is conducted based on the requirement of the topic and concept.

vi. **Test and Examination**: It is a procedure intended to establish the quality, performance, or reliability of learner's learning. It is used to test the conceptual understanding and competencies of students in subject matters. Tests are generally administered at the end of every chapter while the examinations are conducted at the end of each term.

Assessment Matrix

Assessment Matrix									
		CFA	**CSA**					**SA**	**Grand Total**
		Domains	**Domains**						
		SK WS SV	**SK WS SV**	**SK**	**WS**	**SV**	**Total**	Examination	**CSA+Exam**
Areas of Assessment	Term I	Home Work	Home Work	1	1	1	3	25	40
		Class work	Class Work	1	1.5	1.5	4		
		Practical work	Test	1		1	2		
		Journal	Journal	0.5	1	1.5	3		
		Project work	Project work	0.5	1	1.5	3		
	Term II	Home Work	Home Work	1	1	1	3	45	60
		Class work	Class Work	1	1.5	1.5	4		
		Practical work	Test	2		1	3		
		Journal	Journal	0.5	1	1	2.5		
		Project work	Project work	0.5	1	1	2.5		
			Grand Total	9	9	12	**30**	70	**100**

Topic-wise time allocation and weighting

Chapter Number	Chapter	Maximum time required (mins)	Weighting
1	Cell	450	6%
2	Human as Organism	750	10%
3	Green Plant	705	9%
4	Living Things and their Environment	475	6%
5	Classifying Material	520	7%
6	Patterns in Chemistry	710	10%
7	Material and Change	650	9%
8	Mixture	525	7%
9	Work and Energy	450	6%
10	Force and Motion	540	7%
11	Electricity and Magnetism	650	9%
12	Light and Sound	710	10%
13	The Earth and Beyond	290	4%
Total		7425	100.00%

The total time required to complete the topics is 7425 minutes or 165 periods of 45 minutes in a period

Reprint 2024

Assessment Tool

It is important to use appropriate assessment criteria and tools to obtain the right information on the progress of the learners. This is because the quality of information acquired through assessment is determined by the tools and descriptors chosen for assessment. The assessment tools and samples are given below:

i. **Checklist:** It offers 'yes' or 'no' format in relation to the achievement of specific criteria by a learner. It can be used for recording observation of an individual, a group, or the whole class.

ii. **Rating scale:** It allows teachers to indicate the degree or frequency of the behaviours, skills, and strategies displayed by the learner. It has scale-based criteria to describe the quality or frequency of the work with precise and reliable descriptive words. The teachers can use it to record observations and the learners can use it for self-assessment.

iii. **Rubric:** It presents a set of criteria with a fixed measurement scale and a detailed description of each level of performance. It helps to increase the consistency and reliability of scoring.

iv. **Anecdotal Record:** It helps to record specific observations of a learner based on behaviour, skills, and attitudes in relation to the expected learning outcome. It provides cumulative information and direction for further instruction. It can be used for the ongoing observations.

Reprint 2024

Sample Assessment Tools

i. Checklist

	Domains														**Teachers feedback**	**Remedial Actions**
	SK				**WS**						**SV**					
Name	Name everyday materials	Name some transparent and opaque materials	Categorize things into degradable and non-degradable things.	Classify things in our surroundings into natural and man-made things.	Observation	Experimentation	Recording	Analysis	Conclusion	Communication	Curiosity	Respect	Inquiry	Collaboration		
Dorji	✓	✓	✓	X	X	X	✓	✓	✓	X	✓	X	X	X	**SK**: 3 ticks **WS**: 3 ticks **SV**: 1 tick	

Reprint 2024

ii. Rating Scale

Domains	Key Areas	Performance Rating					
		Exceeding	Meeting	Approaching	Beginning	Feedback	Remedial Action
SK	Define living things						
	Define non – living things						
	Mention the characteristics of living things						
	Mention the characteristics of non-living things						
	Define habitat						
	State the importance of habitat						
	Define adaptation						
	Give example of the technique used by living things to adapt						
	State the importance of camouflage						
	Explain food chain						
WS	Observation						
	Experimentation						
	Recording						
	Analysis						
	Conclusion						
	Communication						
SV	Curiosity						
	Respect						
	Inquiry						
	Collaboration						

Reprint 2024

iii. Rubric

Domains	Key Areas	Performance Rating				Remarks/ Feedback
		Exceeding	Meeting	Approaching	Beginning	
Scientific Knowledge	Sources of light	Identify four or more sources of light	Identify three sources of light	Identify two sources of light	Identify only one source of light	
	Properties of light	Explain two properties of light in their own words	Explain one property of light in their own words but one as given in the book	Explain two properties of light as given in the book	Explain any property of light as given in the book	
	Properties of sound	Explain two properties of sound in their own words	Explain one property of sound in their own words but one as given in the book	Explain two properties of sound as given in the book	Explain any property of sound as given in the book	
Work Scientifically	Scientific skills	Demonstrate observation, experimentation, recording, and communication skills	Demonstrate any three skills	Demonstrate any two skills	Demonstrate any one skill	
Scientific values and attitudes	Scientific attitude and scientific inquiry	Demonstrate curiosity, respect, inquiry and collaboration	Demonstrate any three	Demonstrate any two	Demonstrate any one	

Reprint 2024

iv. Anecdotal Record

Anecdotal Records are detailed, narrative descriptions of an incident involving one or several learners. They are focused narrative accounts of a specific event. They are used to document unique behaviors and skills of a learner or a small group of learners. Anecdotal Records may be written as behavior occurs or at a later time and comprise of following components:

Anecdotal Record

Developmental Domain: ……………….

Learner's Name:……………………….. *Learner's Age:*…………..

Time: …………………………
Observer:…………………

Setting:……………………….

Anecdotal:

(Describe exactly what you see and hear; do not summarize behavior. Use words conveying exactly what a learner said and did. Record what the learner did when playing or solving a problem. Use specific language to describe what the learner said and did including facial expression and tone of voice; avoid interpretations of the learner's behavior).

Interpretation:

(What specific inferences can you make from this anecdotal record? What does it tell you about this learner's growth and development? The inferences must be directly related to the domain designated in the anecdote and refer to a specific aspect of the domain.)

Implication for Planning:

(Give a specific activity that you would incorporate into curriculum planning as a result of what you learned about this learner. Make sure that the plan is directly related to the area of development described in the anecdote and the activity is different from the one in the anecdote. Include a brief explanation of why you would create this specific activity.)

Reprint 2024

Rubric for Presentation

Domain	Key Areas	Criteria				Remarks
		Exceeding	Meeting	Approaching	Beginning	
SK	Preparedness	Demonstrate clear and logical flow of ideas supported by relevant visual aids.	Contains any three components.	Contains any two components.	Contains any one component.	
	Content	Present variety of ideas that are relevant to the topic.	Presents some ideas that are relevant to the topic.	Presents limited ideas that are relevant to the topics.	Presents ideas that are not relevant to the topic.	
WS	Presentation skills	Communicate the ideas, attains to all the audiences, uses proper gestures and completes within time.	Contains any three components.	Contains any two components.	Contains any one component.	
SV	Collaboration	Seek suggestions, responses to the queries and shows a positive learning attitude.	Contains any three components.	Contains any two components.	Contains any one component.	

Reprint 2024

Rubric for Homework

Domains	Criteria	Performance Rating			
		Exceeding	Meeting	Approaching	Beginning
SV	Completion	All of the assigned work is complete.	Most of the assigned work is complete.	Some of the assigned work is complete.	Little or a few of the assigned tasks are complete.
SK	Accuracy	All of the answers are correct.	Most of the answers are correct.	Some of the answers are correct.	Little or a few of the answers are correct.
WS	Presentation	Work is neat, error free and legible with relevant illustrations.	One component is missing.	Two components are missing.	Three or more components are missing.
WS	Originality	Display of original and creative ideas.	Partial display of original and creative ideas.	Little display of original and creative ideas.	No display of original and creative ideas.
SV	Submission date	Submitted on due date	Submitted one day after the due date	Submitted two days after the due date.	Submitted three days after the due date.

Reprint 2024

Rubrics for Journal

Domains	Key Areas	Performance Rating			
		Exceeding (4)	**Meeting (3)**	**Approaching (2)**	**Beginning (1)**
SK	Knowledge of Concepts	Contains relevant and accurate information and demonstrates clear and sequential conceptual understanding.	Contains relevant information that is accurate and demonstrates conceptual understanding.	Contains minimum relevant information with fair conceptual understanding.	Contains less information without conceptual understanding.
WS	Scientific Process	Exhibits specific evidence of questions, predictions and results supported with appropriate illustrations and pictures.	Exhibits evidence of questions, predictions and results supported with appropriate illustrations and pictures.	Exhibits demonstrates evidence of only questions or predictions and the results are supported with illustrations or pictures.	Exhibits ideas with illustrations and pictures.
SK	Scientific Language	Uses appropriate scientific language, conceptual and mathematical information, throughout the journal to communicate ideas and personal expression.	Uses scientific language, conceptual and mathematical information to communicate ideas and personal expression.	Uses scientific language, either conceptual or mathematical information to communicate ideas and personal expression. .	Uses scientific language used is not clear and coherent.
SV	Neatness and Organization	Contains original, creative ideas and has diverse entries that are legible with title and date.	Contains creative ideas and has diverse entries that are legible with title and date.	Contains diverse entries that are legible with title and date.	Contains some entries that are legible with or without title and date.
SV	Reflection	Demonstrates full understanding of scientific concepts that are insightful with relevant connections to personal life and the wider world.	Demonstrates some understanding of scientific concepts with relevant connections to personal life and the wider world.	Demonstrates fair understanding of scientific concepts and relates to personal life and the wider world.	Demonstrates fair understanding of scientific concepts and lacks connection with the real life.

Source: Adapted from https://www.cbsd.org

Rubric for Project work

	Domains	Key Areas	Performance Rating			
			Exceeding (4)	Meeting (3)	Approaching (2)	Beginning (1)
Class VII	SV	Observe	Phenomena observed is systematic, objective and verifiable.	Phenomena observed is systematic, objective but not verifiable.	Phenomena observed is objective but not systematic and not verifiable.	Phenomenon observed is subjective and not verifiable.
	SV	Question	Clearly stated, focused, and relates to variables	Loosely stated, focused, and relates to variables	Loosely stated and relates to variables	Loosely stated and does not relates to variables
	SK	Hypothesize	Feature variables and predict the relationship between variables	Predict the relationship between variables	Feature the variables	Makes no sense
	SK	Background Information	Relevant, has adequate information, unbiased and concise.	Relevant, has adequate information, unbiased but not concise.	Relevant, has adequate information that is bi-ased and not concise.	Relevant but lack ade-quate information.
	WS	Design	Procedure is detailed and sequential.	Procedure is not detailed and sequential.	Lack detailed and sequential procedure	Procedure is not shown
	SV	Collect data	Appropriate method, relevant and sufficient data	Appropriate method, relevant but not sufficient data	Inappropriate method, sufficient but irrelevant data	Inappropriate method, insufficient and irrelevant data
Class VIII	WS	Analyse	Appropriate mathematical procedures or appropriate charts with clear interpretation	Appropriate mathematical procedures or appropriate charts but no clarity in interpretation	Inappropriate mathematical producers or charts but no clarity in interpretation	Inappropriate mathematical producers or charts and unclear no interpretation
		Conclusion	Restate the hypothesis, supports or refutes it, and explain the role of the test in making the decision.	Restate the hypothesis, supports or refutes it,	Supports or refutes the hypothesis	Restate the hypothesis
		Communication	Focus on communicating the central idea, using evidences in the logical format	Focus on communicating central idea with evidences	Focus on central idea	No focus on central idea

Reprint 2024

Annexture - B

Model Question Paper

Subject: Science **Full Marks: 100**

Class: VII **Time: 2 Hrs**

Question 1

Direction: Each question is followed by four possible answers. Choose the correct answer and write it down in your answer sheet. [25x1 Marks]

1. Karma bought some common salt from the market which was contaminated with ammonium chloride and sand. The procedure he should adopt to obtain pure common salt is:
   a. mixing the sample in water and then evaporating the solution.
   b. heating the mixture in a china dish.
   c. mixing the sample in alcohol and then evaporating the decanted solution.
   d. heating the sample, tdissolving it in water, and then evaporating the decanted solution.
2. Figure 1.1 shows a life process taking place within a cell.
   Which life process is shown in Figure 1.1?
   a. Reproduction.
   b. Respiration.
   c. Digestion.
   d. Photosynthesis.

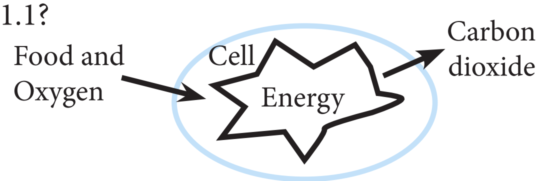


Figure 1.1.

3. The type of change shown in Figure 1.2 is
   a. physical change.
   b. chemical change.
   c. both physical and chemical change.
   d. reversible change.

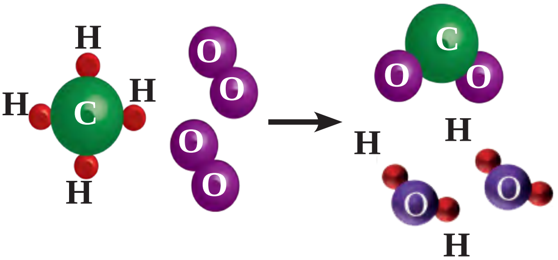
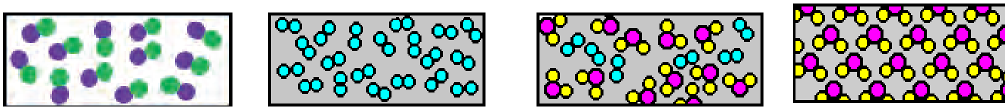


Figure 1.2.

4. A student peeled off a green leaf and observed it under a microscope. What shape would be seen?
   a. Oval .
   b. Conical.
   c. Cylindrical.
   d. Rectangular.

Reprint 2024

5. Figure 1.3 represents a model of a product formed by mixing different substances. Atom of each substance is represented by different colours.



a b c d

Figure 1.3.

Which diagram correctly models a chemical mixture?

a. Figure 1.3 a
b. Figure 1.3 b
c. Figure 1.3 c
d. Figure 1.3 d

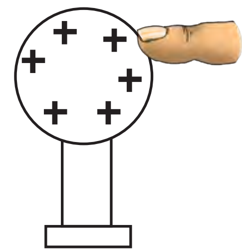


Figure 1.4.

6. In Figure 1.4, when the positively charged sphere is touched ,________move from the __________to the ___________.

a. electrons. sphere, finger
b. protons, sphere, finger
c. electrons, finger, sphere
d. sphere, finger, electrons

7. Which is the correct set of properties of an acid?

a. Sour , corrosive, change litmus paper from red to blue.
b. Sour , slippery, change litmus paper from blue to red.
c. Bitter, slippery, change blue litmus from blue to red.
d. Sour , corrosive, changes litmus paper from blue to red.

8. Table below shows three levers (A, B, and C).

A	B	C
Effort Arm = 5 cm	Effort Arm = 10 cm	Effort Arm = 2 cm
Load Arm = 5 cm	Load Arm = 5 cm	Load Arm = 1 cm

Which statement about the mechanical advantage (M.A.) of these three levers is correct?

a. A has greater M.A. than B.
b. B has greater M.A. than C.
c. A and C have equal M.A.
d. B and C have equal M.A.

9. What can be the consequence(s) of not having skeleton in our body?

a. The body will not be able to support and protect internal organs.
b. The body will not be able to digest food.

Reprint 2024

c. The body will not be able to breath.
d. The body will not be able to produce new individual.

10. The movement of particles from the region of higher concentration to the region of lower concentration is called
a. osmosis .
b. diffusion.
c. pressure.
d. expansion.

11. The flowchart in Figure 1.5 represents the process of photosynthesis. Which activity occurs at Q?
a. Animals eat plants as food.
b. Plants release water into the soil.
c. Carbon dioxide and water are used to make sugar.
d. Animals breathe out carbon dioxide.

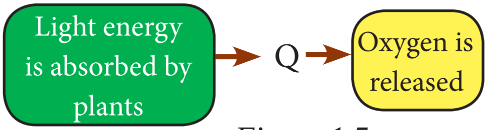


Figure 1.5.

12. The diagram below represents a germinated seed which is cut open. Which Which labeled part store the food for the growth and development of new plant?
a. Embryo.
b. Epicotyl.
c. Seed coat.
d. Cotyledons.

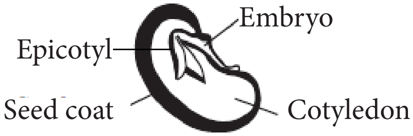


Figure 1.6.

13. Density of pure iron is 7.86 g/cm^3 . Density of pure iron is 7.86 g/cm3. When a teacher immerses it in water; it sinks, because its relative density is more than 1. The teacher then asks a student to make it float in water. What should the student do to make the iron float in water?
a. Increase the mass of the iron.
b. Increase the volume of the iron.
c. Decrease the mass of the iron.
d. Decrease the volume of the iron.

14. Which of the following is a highly concentrated solution?
a. 5 grams per 100 mL.
b. 37 grams per 100 mL.
c. 17 grams per 100 mL.
d. 36 grams per 100 mL.

15. Distance and displacement are equal to each other if the body moves along
a. a circular path.

Reprint 2024

b. an elliptical path.
c. a straight line path.
d. a curved path.

16. Which body in our solar system is a star?
    a. Earth.
    b. Venus.
    c. Mars.
    d. Sun.

17. Directly Observed Therapy Short course (DOTS) is a common strategy used by the trained health workers to provide the prescribed drugs to a patient suffering from
    a. cholera.
    b. TB.
    c. malaria.
    d. AIDS.

18. Which diagram best represents light being reflected after striking the flat surface of a mirror?

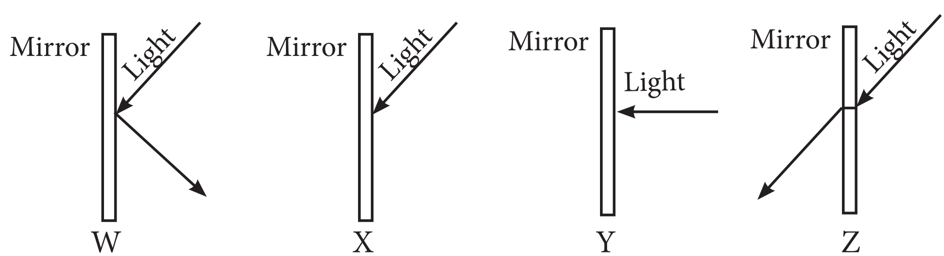


Figure 1.7.

    a. W.
    b. X.
    c. Y.
    d. Z.

19. In an air-conditioned bus, water is slowly collected on the glass window panes. This process is best described by :
    a. melting .
    b. boiling.
    c. evaporation.
    d. condensation.

20. The Moon is visible to observers on the Earth because of the
    a. reflected sunlight.

b. absorbed light from Earth's atmosphere.
c. gases in the Moon's interior.
d. volcanic eruptions on the Moon's surface.

21. The beak of the humming bird is long and slender. This allows the bird to feed on nectar from the inner depth of the flowers. This is an example of
    a. extinction.
    b. competition.
    c. adaptation.
    d. variation.
22. When an atom loses its electron(s) to another atom, it acquires
    a. neutral.
    b. negative charge.
    c. positive charge.
    d. no change in charge.
23. The gaps were left in the table for the undiscovered elements and their properties were predicted with the help of the neighbouring elements. This is the peculiar feature of
    a. Dobereiner's triads.
    b. Newlands' table.
    c. Mendeleev's periodic table.
    d. Modern periodic table.
24. Bats detect the obstacles in their path using
    a. audible sound waves.
    b. infrasonic sound waves.
    c. radio sound waves.
    d. ultrasonic sound waves.
25. A person suffering from anemia due to the lack of iron in diet can be recommended to eat
    a. liver, red meat, bean, green vegetable.
    b. milk , dairy product, vegetable.
    c. water, milk, tooth-paste.
    d. sea food, iodised salt.

Reprint 2024

Question 2

Fill in the blanks. *[10x1 Marks]*

1. Vitamins are essential to keep the body healthy. Lack of vitamin A in a diet leads to…………..........
2. The disease that can be prevented by immunization of dogs and pets against rabies is ....
3. Clean air is a mixture of gases such as oxygen, nitrogen, hydrogen, carbon dioxide, water vapour, and inert gases. Clean air is ………………mixture.
4. When sodium hydroxide is added to ferric chloride solution, a reddish brown precipitate is formed. The precipitate is separated from the mixture by the process of …………..
5. Electrons are found revolving around the nucleus of an atom in a fixed path called ………………
6. A ray of light appearing to pass through the centre of curvature of a convex mirror will reflect in the ……………………………..path.
7. ....is the part of the seed that grows into the shoot system of a plant.
8. Many people visit the hot spring in Gelephu every year. The type of energy derived from hot spring is an example of …………………………..
9. In a chemistry laboratory, Sonam heated a test tube containing white zinc oxide (ZnO), which turns yellow on heating and white on cooling. This is an example of .... change.
10. An important part of a cell that holds many cell organelles is…………...

Question 3

Direction: *Write TRUE or FALSE against the given statements. Correct the false statements.* *[10x 1Marks]*

1. When alkali dissolves in water, it produces hydroxyl ion.
2. It is normal to have more than one nucleus in a cell.
3. Athlete's foot is a fungal infection that affects skin between the toes and the sole of a foot. It can spread from infected person through direct skin contact and indirectly through towels, socks, shoes and floors.
4. To gain speed the smaller gear is always taken as the driven gear.
5. Respiration does not take place in human sperm.
6. Calcium nitrate is a mixture of calcium, nitrogen and oxygen.
7. Photosynthesis is the process where cells use oxygen to release stored energy.
8. Fermentation is an example of aerobic respiration.
9. When you get stung by a honey bee, you need to apply vinegar.

Reprint 2024

10. A charged object and a neutral object will attract.

Question 4

Direction: *Match the items of Column I with the answers of Column II [10 Marks]*

Column I	Column II
1. Scabies	A. Object within focus
2. A non-metallic element that is good conductor of electricity	B. Lime water
3. A boy completing a 200 m race in a A boy completed the race in a 200 m circular track	C. Artificial satellites
4. Bacteria	D. Smoke
5. A solution of iodine in ethanol	E. Decomposer
6. The image formed by a concave mirror is seen to be virtual, erect and enlarged	F. Itch mites
7. Root system	G. Zero displacement
8. CO_2 test	H. Non-aqueous solution
9. A solid – gas mixture	I. Plumule
10. Provides useful information for the study of climate change	J. Radicle
	K. Iodine
	L. Graphite

Question 5

(a) An experiment was conducted to observe the effects of acid on chalk, a form of calcium carbonate as shown in Figure 1.8. Three pieces of chalk were carved with the same pattern and placed in test tubes *A*, *B*, and *C*. Equal volumes of water were added to test tubes *A* and *B*. The student blew through a straw into test tube *B* for five minutes, producing bubbles. An equal volume of vinegar (acetic acid) was added to test tube *C* and bubbles were produced.

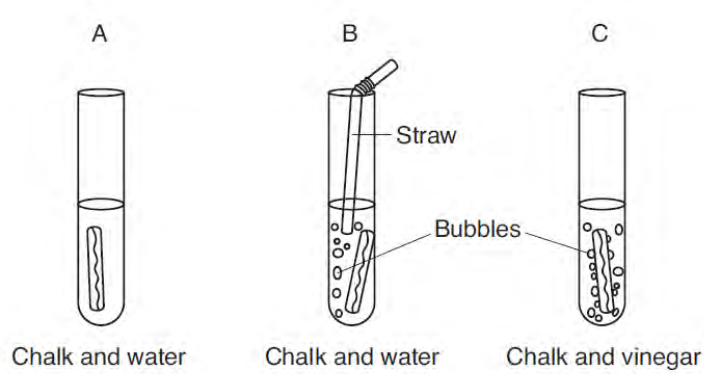


Figure 1.8.

Observations of chalk in test tubes A, B, and C

Test Tube	Observation
A	No change observed.
B	Decrease in the size and the carvings of the chalk.
C	Decrease in the size of the chalk and carvings on the chalk no longer visible.

i. Which property of vinegar is shown in test tube C? [1]

ii. Why are bubbles seen in test tube B and C? [1]

iii. What is the purpose of test tube *A* in this experiment? [1]

(b) The table below shows the densities of the four solid materials.

Density of Solid Materials

Solid Material	Density (gcm^{-3})
copper	8.90
plastic	1.17
rubber	1.34
wood	0.71

The beaker shown in Figure 1.9. contains four liquids of different densities. The blocks shown in the beaker represent four different solid materials. Indicate where each of the four solid materials would be located. [2]

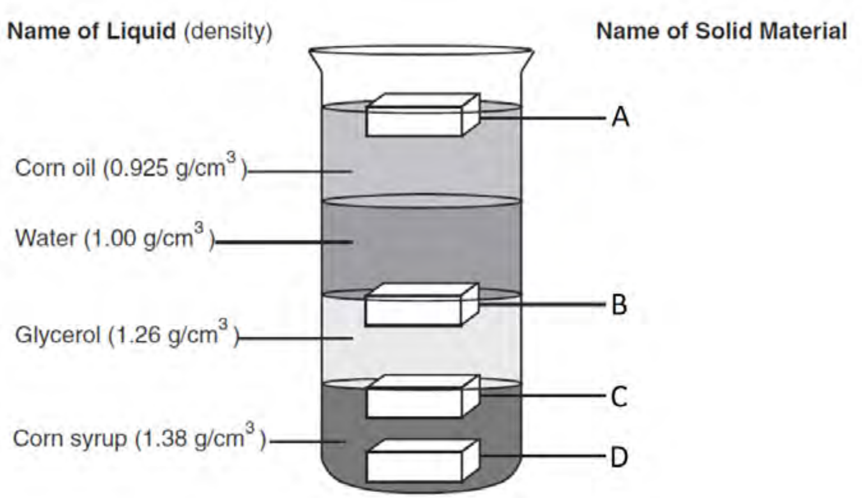


Figure 1.9.

(c) There were two colourless liquids A and B in two different conical flasks as shown in Figure 1.10. To each of the conical flasks, a few drops of methyl orange were added. Study Figure 1.10. and answer the questions that follow.

Reprint 2024

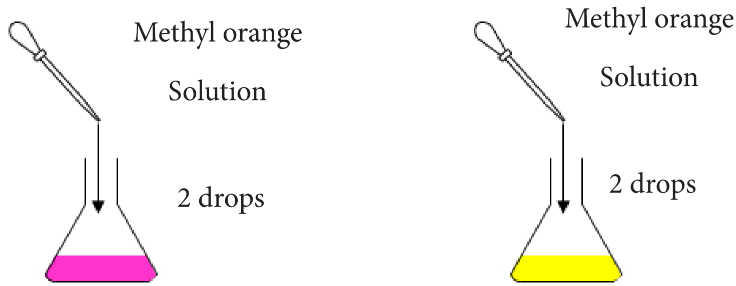


Figure 1.10.

i. What is the nature of liquid A and liquid B. [2]

ii. If equal amount of liquid A and B are added to methyl orange, what will happen to the colour of methyl orange? [1]

iii. Name and define the process that undergoes when liquid A and B are mixed.. [1]

Question 6

(a) Study the food web given in Figure 1.11. and answer the questions that follows.

(a)

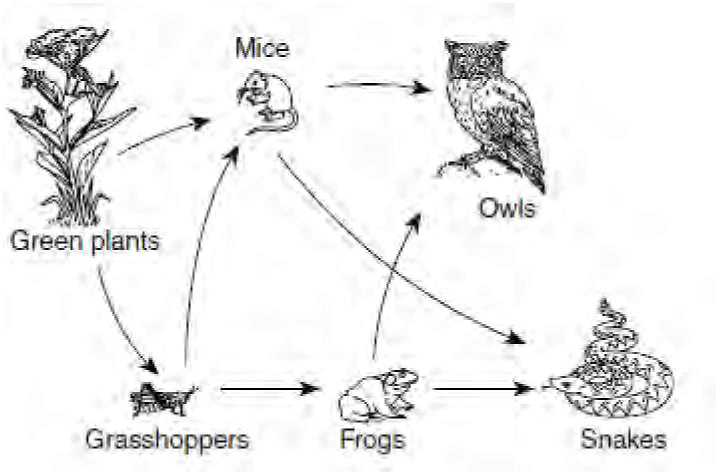


Figure 1.11.

i. How is the feeding relationship of the mouse different from the feeding relationship of the other organism in the given food web? [2]

ii. How many organisms in the given food web feed on the mouse? [2]

iii. Which group of organism is missing in the given good web [2]

(b) Unchecked growth on human population will cause imbalance in our ecosystem. Justify. [2]

(c) What is global warming? [1]

Question 7

(a) Figure 1.12 shows three conditions at which sugar dissolves in water.

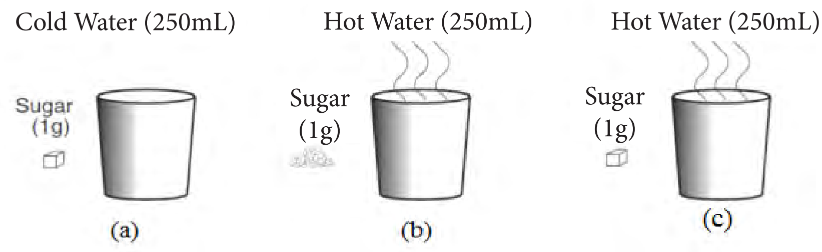


Figure 1.12.

i. In which of these glasses will sugar dissolves the fastest? [1]

ii. Identify *two* variables that affect the rate at which the sugar dissolves in glass (b). [2]

(a) Study Figure 1.13 and answer the questions that follow.

i. Draw an electric circuit using the symbol. [2]

ii. If you add another bulb in parallel to the circuit. Will the bulb glow brighter, dimmer or stays the same? Explain. [2]

(b) The pictures in Figure 1.12 show two different materials.

i. Identify items as metal and non-metal. [1]

ii. Give one similarity and difference between the two. [1]

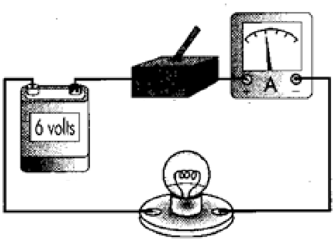


Figure 1.13.

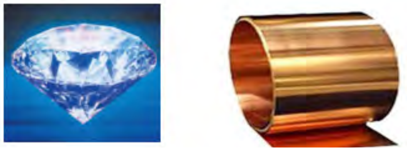
Question 8

(a) How is static electricity created? [1]

(b) What are dwarf planets? Name one that was earlier classified as a planet. [2]

(c) Define range of audibility . [1]

(d) Differentiate infrasonic and ultrasonic sounds. Give one use of each kind of sound. [2]



Diamond Copper

Figure 1.14

(e) Sunlight is absorbed by the leaves. What two substances are also taken in by the plant for photosynthesis to occur? [1]

(f) Complete the ray diagrams (a) and (b) in Figure 1.15 to show the path of reflected rays. [2]

Reprint 2024

(a) (b)

Figure 1.15.

Question 9

(a) Calculate the mass of a body whose volume is 5 and density is 520 . What is the relative density of the body? [2]

(b) “All the alkalis are bases but all the bases are not alkali”. Justify your answer with examples. [2]

(c) Figure 1.16 shows a gear system. How much speed can be gained using this system? [2]

(d) Figure 1.17 shows a human organ system.

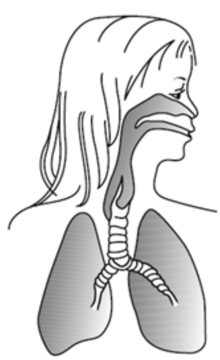


Figure 1.17.

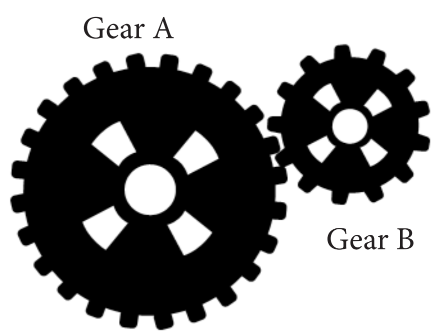


Figure 1.16.

i. Identify the human organ system given in Figure 1.17 and briefly describe its function. [2]

ii. What would happen if the size of the lung is the size of a finger nail? [1]

****

Writers

Sl No	Writer	Qualification	Agency
1	Wangpo Tenzin	M.SC	REC
2	Surjey Lepcha	M.SC	REC
3	Mr. Chetnath Dhungyal	PGDE	Rangjung HSS
4	Mr. Adip Rai	B.Ed Phy	Damphu HSS
5	Mr Kishore Mongar	M.Sc. Botany	Samtse Col. of Education
6	Ms. Kesang Choden	M.Sc. Chem	Samtse Col. of Education
7	Mr. Jigme Tshering	PGDE, M Sc. Bio	Bayling HSS
8	Mr. Kezang Tshering	PGCE.	Trashigang MSS
9	Mr. Prem Prasad Timsina	B.Sc. Bio	Nangkhor HSS
10	Mr. Tshewang Namgyel	B.Ed Sec. Bio	Trashiyangtse LSS
11	Mr. Bhim Kumar Sharma	PGDE, Chem	Damphu HSS
12	Mr. Basant Pradhan	PGDE, MSc. Chem	College of Sc. & Technology
13	Mr. Choeda Phuntsho	B.Ed. Chem	Tshebar LSS
14	Mr. Sonam Dorji	B.Ed. Sec. Chem	Nanglam HSS
15	Mr. Shankar Lal Dahal	PGCE, Phy	Bajo HSS
16	Mr. Kinley Gyeltshen	M.Ed	Dashiding HSS
17	Ms. Sital Thapa	B.Ed Sec	Lango LSS
18	Mr Deepak Raj Chhetri	B.Ed Sec Phy	Meldregang MSS
19	Ms. Sonam Choden	B.Ed. Sec	Drujeygang HSS

Reprint 2024

Reviewers (Second Edition)

Sl No	Reviewer	Agency/School	Remarks
1	Wangpo Tenzin	REC	Writer
2	Bhoj Raj Rai	REC	Writer
3	Wangchuk	REC	Writer
4	Karma Dorji	REC	Writer
5	Phuntsho Norbu	REC	Writer
6	Khem Prasad Thapa	Minjiwoong CS	Writer
7	Tashi yangzom	Khasadrapchu MSS	Writer
8	Susma Pradhan	Kuzhugchen MSS	Writer
9	Singye Thinley	Phuntshothang MSS	Writer
10	Tahi Zangpo	Darla MSS	Writer
11	Pema Tshering	Katsho LS	Writer
12	Tsheltrim Pelzang	Trashigang MSS	Writer
13	Tashi Lhamo	Yangchengyatshel MSS	Writer
14	Kinga Chedup	Wangbama CS	Writer
15	Bal Bdr. Gurung	Loselling MSS	Writer
16	Tobgay	Wangbama CS	Writer
17	Tshering Zangmo	Shari HSS	Writer
18	Namgay Dorji	Shari HSS	Writer
19	Thinley Wangchuk	Taju PS	Writer
20	OM Tshering Lepcha	Norbuling CS	ICT and Art Work
21	Ugyen Tshomo	NECS	Writer
22	Krishna	Consultant, NECS	Writer
23	Chencho Thinley	Lungtenzampa MSS	Language Editor
24	Pratima Rai	Khangkhu MSS	Language Editor
25	Karma Wangmo	REC	Layout and Typesetting
26	Kinzang Peldon	REC	Layout and Typesetting

Reprint 2024