Science and Technology

Grade 8

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Preface

School education is the foundation for preparing the citizen who are loyal to the nation and nationality, committed to the norms and values of federal democratic republic, self-reliant and respecting the social and cultural diversity. It is also remarkable for developing a good moral character with the practical know-how of the use of ICT along with the application of scientific concept and positive thinking. It is also expected to prepare the citizens who are moral and ethical, disciplined, social and human value sensitive with the consciousness about the environmental conversation and sustainable development. Moreover, it should be helpful for developing the skills for solving the real life problems. This textbook 'Science and Technology, Grade 8' is fully aligned with the intent carried out by the National Curriculum Framework for School Education, 2076 and is developed fully in accordance with the new Basic Level Science and Technology Curriculum, 2077.

This textbook is initially written by Mr. Dambaru Prasad Pokhrel, Mrs. Rabina Maharjan, Mr Ram Sharan Regmi, Mr. Yubaraj Adhikari and Mr. Lav Dev Bhatta. It has been translated by Mr. Surendra Jung Karki, Mr. Mukti Subedi and Mr. Subash Kharel. The contribution made by Director General Mr. Baikuntha Prasad Aryal, Prof. Dr. Krishna Bhakta Maharjan, Dr. Kamal Prasad Acharya, Mrs. Pramila Bhakati, Mr. Uma Nath Lamsal, Mr. Heramba Raj Kandel, Mr. Keshar Bahadur Khulal, Mr. Shailesh Bahadur Pradhan and Mrs. Mina Shrestha is remarkable in bringing the book in this form. The language of the book has been edited by Mr. Arjun Prakash Bhusal. Art editing of this book was done by Mr. Shreehari Shrestha by making it four colour. The Curriculum Development Centre extends sincere gratitude to all of them.

The textbook is a primary resource for classroom teaching. Considerable efforts have been made to make the book helpful in achieving the expected competencies of the curriculum. Curriculum Development Centre always welcomes constructive feedback for further betterment of its publications.

2080 BS

Curriculum Development Centre
Sanothimi, Bhaktapur

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1 Scientific Learning

Scientific Learning

Activities like observation, testing, survey, project work and model building are done for scientific learning. Such activities are done inside or outside the laboratory.Fact, theories and rules of science are discovered based on these activities. Safety precautions should be taken in laboratory work to avoid accidents. Such precautions also help to obtain correct results from scientific experiments, observations or research.

1.1 Precautions to be taken while Performing Experimental work in the Science Laboratory

A notice with the signs shown in the figure is pasted in the science lab. What precautions do these signals indicate? Discuss with your friends in the class.

A science laboratory is a special room for conducting various scientific studies and experimental activities. Necessary equipment and chemicals for scientific studies and research are available there. Various facts, theories, objects and substances related to science are studied, observed, tested and used in the school's science laboratory. We should pay attention to safety while doing such work. In the science lab, we must follow safety rules.

Fig: 1.1

Random scientific work without following safety measures may cause accidents as well as affect the results of observations, tests and experiments.

Figure: 1.2 Observation of Mushroom Cultivation and Experimental work in the laboratory

The following safetyrules must be followed while doing experimental work in a science laboratory:

(a) The materials should not be handled haphazardly.

(b) Masks, gloves and goggles should be worn while using harmful chemicals.

(c) An apron or a lab coat must be put on while working in the laboratory.

(d) Everyone should be aware of the emergency exit.

(e) Hands should be washed thoroughly with soap after the experimental work.

(f) Eating and drinking should not be done in the laboratory.

(g) Chemicals must not be tasted or smelled in the lab.

(h) No playing and teasing in the laboratory.

(i) The prescribed method should be used while performing experimental work in the laboratory.

(j) Special care should be taken while using a burner or touching hot objects in the laboratory.

(k) Hot equipment should not be placed directly on the table during the experimental works.

1.2 Experimental works in Science

Fig: 1.3 Experimental works in the laboratory

Observe the pictures and discuss

i. What are the students doing in the picture?

ii. Which experiment have you done in the science laboratory?

iii. What should you pay attention to when you are in the science laboratory?

iv. Why is science laboratory important?

Experimentation is an act of drawing conclusions by using science process skills like observations, research, tests and model making in order to verify different theories and principles. If the desired results are not obtained through experiments in science, other alternatives are appliedto achieve it. Experimental work may be done in the laboratory or outside but the safety measures listed above should be followed at any time.

Observation

Mamta was walking in the garden. She saw different kinds of colourful flowers in the garden. Since she has already learned about different parts of a flower in class, she picked a flower and looked at it. She slowly took out each part of the flower carefully to see the four parts of the flower one by one. In the beginning, she took out a calyx, corolla, androecium and gynoecium. Then she became clear about what was taught in class.

In a meantime, she noticed a caterpillar (Jhusilkira)sitting on a leaf of the same plant and eating it. Mamta was amused.She had studied in the previous classes that a caterpillar turns into a pupa and then to a butterfly. Therefore, she thought of keeping the caterpillar in a glass jar to observe if it turns into a butterfly. She slowly plucked the leaf along with the caterpillar, took it home and kept it safely in a jar without closing the lid. She gave soft leaves for food everyday and continuedobserving the changes. The caterpillar developed into a pupa after 15 to16 days.The caterpillar did not eat leaves after this. Thirteen to 14 days later, a yellow butterfly with black spots on the wings emerged. Mamta shared all these observations with her friends and the science teacher. The teacher explained that observations like that of Mamta play an important role while studying science.

The process of experiencing an object, event or process very carefully using the sense organs is called observation. Sense organs are used in observation. In cases where observation with our sense organs is difficult, various tools such as hand lenses, microscopes etc. are used. Observe the given experiment for instance;

Fig 1.4 Observation of the experimental work

Activity 1.1

Title : Observation of Fungi

Objective: To study the structure of fungi

Material required: Bread, water, forceps or tongs, a glass slide, a coverslip and a microscope

Method:

i. Take a piece of bread.

ii. Sprinkle some water on it and keep it covered in a moist place

iii. Sprinkle a little water every day.

iv. You will see fungi growing after a few days. Place a drop of methylene blue on the glass slide and put one of the mycelia in the drop with the help of forceps or tongs, cover it with the cover slip and observe it under the microscope.

v. Observe the structure of fungi and draw its figure in your practical file and list the characteristics of fungi based on it.

Any object is observed and experienced by seeing with the eyes, hearing with the ears, smelling with the nose, touching with the skin and tasting with the tongue. Observation is not limited to the laboratory. The rules, principles and characteristics of science can be studied by observing various natural and artificial objects, processes and events around the school and home. Apart from that, some laws and principles related to science can be observed even by visiting zoos, botanical gardens, pharmaceutical companies and information communication companies. When observing, it should be clear which object, process or event is to be observed. Accordingly, the purpose of observation should be determined. Similarly, it should be clear about what to observe and how to present the information obtained. In general, the report should be written after the observation work. There can be different formats for writing a report. For example, the report for activity 1.1 can be written as follows:

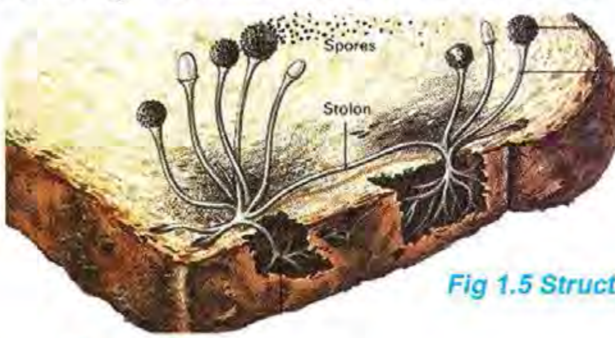


Fig 1.5 Structure of fungi

Title **Observation of Fungi**

Objective: To study the structure of fungi

Material required: Bread, water, forceps or tongs, glass slide, microscope

Method:

(i) The bread was taken.

(ii) Every day a little water was sprinkled on it and kept covered in a moist place.

(iii) Fungi appeared on the bread after a few days.

The fungus was placed on a slide of glass with the help of forceps or tongs and was observed under a microscope to study the structure of a fungus.

Result of the Observation

The following characteristics were identified while observing the fungi:

i. No green pigments were seen in them.

ii. Root-like mycelia were seen.

iii. Stem-like hyphae were observed.

iv. Sporangia were observed on the tips of long branches growing from hyphae.

Precautions

i. Be careful when using forceps as they are sharp.

ii. Avoid the fungus getting into your mouth and eyes.

Activity 1.2

Prepare a report based on observation of permanent slides of single-celled organisms like an amoeba, paramecium and euglena with the help of a microscope in a science lab.

Scientific test

It is not possible to get all the information about a subject matter, process or event only by observation. We make various assumptions based on observations. A certain scientific procedure is followed in or outside the laboratory to check whether the assumption is correct or not. The scientific investigation performed in this way is called a test. For example, perform the test given below.

Activity 1.3

Title: Test of Acids, Bases and Salts

Objective:To identify the given substances whether they are acids, bases or salts with the help of indicators.

Materials required: Lemon juice, soap water, salt water, red litmus paper, blue litmus paper, and test tubes.

Method

i. Keep lemon juice, soap water and salt water in separate test tubes.

ii. Dip a red and blue litmus paper respectively in a test tube containing lemon juice and observe the change in the litmus paper.

iii. Similarly, repeat the same process for soap water and salty water.

Observation:

Record the results of the reaction on the Practical file:

Indicators	Lemon juice	Soap water	Saltwater
Red litmus paper			
Blue litmus paper			

Conclusion:

Red litmus with lemon juice shows ....colour and blue litmus shows ....colour. Red litmus with soap water shows ... colour and blue litmus shows ....colour. Red litmus with salt water shows....... colour and blue litmus show ...... colour. Hence, ... is an acid, ... a base and .... is salt.

Determining whether the substances given in activity 1.3 are acids, bases or salts are not possible by observation only. One can only guess from the observation of the given activity. In the scientific learning process, inference or assumption is also called a hypothesis. Testing is the act of checking whether a hypothesis is true or not. Testing in science is also a kind of experimental work. It should be clear what is going to be tested and what is our assumption before any test. It should be clear about the purpose and process of testing with necessary materials, and the format to present the information obtained after testing.

A report should be written after the test work. There may be different formats for writing the reports. A sample format of the report writing is given below.

Title: Test of acids, bases and salts.

Objective: To separate the given substances as acids, bases and salts with the help of indicators.

Materials Required: Lemon juice, soap water, salt water, indicators (red and blue litmus paper) and test tubes.

Method

(i) The given substance was placed in three separate test tubes.

(ii) Changes in the colour of red and blue litmus paper were observed by dipping in lemon juice, soapy water and salt water one by one.

Observations

Indicators	Lemon juice	Soap water	Salt water
Red litmus paper	No change in colour	Blue	No change in colour
Blue litmus paper	Red	No change in colour	No change in colour

Conclusion:

..........is acid as it turns blue litmus paper to red colour.,

.... is a base as it turns red litmus paper into blue colour, and

.... should be neutral because no colour change was observed.

Activity: 1.4

Write a report with the help of a teacher, after testing the fact that salt and water are formed by the chemical reaction of acid and base.

Activity 1.5

Two new students from class 8 are going to the science lab to do experimental work. What suggestions would you give them about the precaution they should take while working in the laboratory? Prepare a chart about the suggestions given and demonstrate it in class.

1.3 Research work

Any research begins with a question or a curiosity. Generally, research is a study in depth or to find an answer to a question or curiosity. All the discoveries made are the achievements of such studies and research. While researching, the researcher has to patiently study a subject by completing a certain procedure. Even if you fail many times, you should try again by finding the weaknesses and improving on them. You have to follow different scientific methods while conducting research work.

Phases of the Research Work

The following steps are generally followed in carrying out research work:

a. Goal setting.

b) Making inferences or hypotheses.

a. Choice of the data collection method.

c) Preparation of required materials.

d) Data collection

e) Analysis of data

f) Conclusion

Read the given dialogue

Rusa	:	What are you thinking about, Samprit?
Samprit	:	Yesterday, the teacher said that the manure used in the fields causes water pollution. I did not understand that. Manure is applied to the fields for the plants and how does it pollute water?
Rusa	:	Can plants take all the fertilizers applied in the fields?
Samprit	:	Perhaps not.
Rusa	:	Where does the manure that is not absorbed by the plants go?
Samprit	:	Rainwater, perhaps will wash it away.
Rusa	:	Where will the rainwater take it away?
Samprit	:	They may bring it to the rivers, lakes and ponds.
Rusa	:	In this way, excess fertilizer on the plant is washed away with rainwater into rivers, lakes, and ponds, and

it causes the growth of algae there. The increased algae take up dissolved oxygen in the water and oxygen will be deficient for aquatic animals.

Samprit : What you said may be correct, but I am still not convinced how algae develops due to the manure swept away by rainwater.

Rusa : So let's have an inquiry or conduct research work.

Activity 1.6

Research question: What factors affect the growth of algae?

Objective: To explore the role of chemical fertilizers and acids in the development of algae.

Materials required: Pond water containing algae, three bottles, chemical fertilizers, vinegar etc.

Method

i. Bring algae-containing water from a nearby pond.

ii. Now pour an equal amount of algae containing water into three glass bottles so that they are half filled.

iii. Do not add anything in the first bottle, put a little chemical fertilizer in the second bottle and a little vinegar in the third bottle respectively. Name it accordingly from the outside.

iv. Observe the growth of algae at the interval every five days.

v. Write a conclusion based on the results obtained in 15 to 20 days.

Fig: 1.6 Observation of the growth of algae

Observation:

Fill in the table below with the results obtained based on the observations:

Date	Growth of algae in the first bottle	Growth of algae in the second bottle	Growth of algae in the third bottle

Conclusion:

Chemical fertilizers play a........role and acids play a ..... role in the growth of algae.

Its report should be written after research work. There may be different formats for writing a report. The report of the research work can be written as follows:

Research Title: Effects of chemical fertilizers and acids on the growth of algae.

Objective: To find out the role of chemical fertilizers and acids in the growth of algae.

Materials required: pond water containing algae, three glass bottles, chemical fertilizer, and vinegar.

Method

i. Water containing algae was brought from a nearby pond.

ii. Three glasses were half filled with an equal amount of water.

iii. Only pond water containing algae was kept in the first bottle and pasted a sticker named pond water.

iv. A little chemical fertilizer was kept in the second bottle and pasted a sticker named water containing chemical fertilizer.

v. A little vinegar was placed in the third glass bottle and pasted a sticker named water containing vinegar.

Observation:

The following results were obtained by observing at an interval of every five days.

Date	Growth of algae in the first bottle	Growth of algae in the second bottle	Growth of algae in the third bottle
Initial condition	The number of algae in all three bottles was almost the same.		
After 15-20 days	The growth of algae is seen to some extent.	The growth of algae is faster compared to the first bottle.	Algae started to die.

Conclusion:

Chemical fertilizers play a positive role in the growth of algae while acids play a negative role.

Activity 1.7

Which absorbs more heat among white and black colour? Prepare a report and present it to the class by deriving a conclusion after a brief research on the subject.

1.4 Survey

The process of collecting data related to a topic or problem directly and deriving a conclusion is called a survey. Questionnaires, interviews, discussions and observations are the guidelines for collecting data while doing a survey focusing on a problem or a subject.

In this way, conclusions are drawn after analyzing the collected data, and solutions to the issues or problems are obtained. Generally, the survey work is completed by following the steps given below.

a) Selection of objective

b) Choice of data collection method

c) Collection of data

d) Analysis of data

e) Conclusion

A report is prepared including the title of the study, the purpose of the study, tools or methods of data collection, analysis of the collected data and finally conclusions and suggestions are written after completing the survey work by following the above steps.

Activity 1.8

Perform a survey about solid waste management by visiting at least 50 houses in your community. Prepare a questionnaire for the survey. Analyze the collected data and prepare a report with conclusions and necessary suggestions

Sample of Survey Report Writing

The sample of survey report writing which has been done in activity 1.8 and can be written as follows:

Title: A study on solid waste management in one of the villages of Kathmandu.

Background

The surveyed area is a culturally rich village located in the inner city of Kathmandu. There are many temples, monasteries and archaeological monuments in this village. People do business, office jobs and farming for living. Solid waste has emerged as a problem in this village due to the modern lifestyle. In this survey, study was done to find out how the people living here manage the solid waste that comes out of their houses daily.

It is expected that the findings from this survey also help in the management of solid waste in other areas too.

Objective: To study solid waste management in the study area.

Data Collection Method:

A questionnaire was developed to collect data on solid waste management, and 50 households were selected for the survey. Necessary data was collected based on the prepared questionnaire.

Analysis of Data:

From the analysis of collected data, it was found that 50 percent of houses used to throw solid wastes into municipality vehicles without separating degradable and non-degradable, 30 percent of houses used to separate degradable wastes and make compost manure and the remaining 20 percent used to utilize degradable waste for making compost manure and the non-degradable to make various materials. The obtained results are presented in a bar diagram.

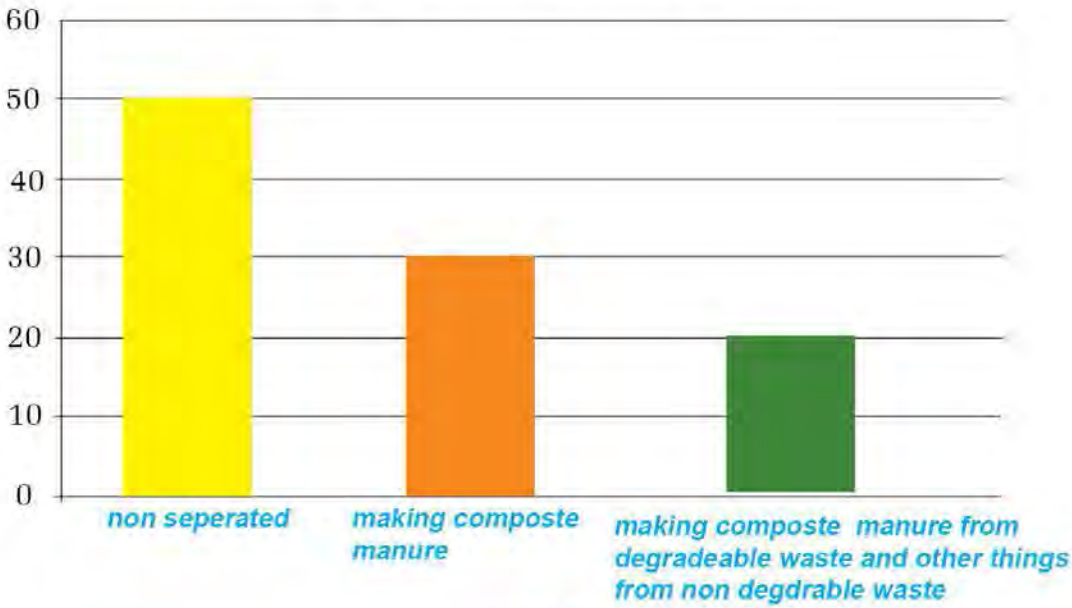


Fig: 1.7

Conclusion:

The results obtained from the above survey show that the practice of recycling and reusing solid wastes has started in the survey area.

Annex 1: Survey Questionnaire

1. **What do you do with the solid waste that comes out of your house?**

   a) Give it to waste collection agencies.

   b) Manage some of the waste at home and give the rest to the waste collection agencies.

c) All wastes are managed at home.

2. What do you do with biodegradable waste?

a) Make compost manure from it.

b) Throw it on the road or in the river.

c) Hand it over to waste-collectors.

3. What do you do with non-biodegradable garbage?

a) Use it to make different materials.

b) Collect and give it to the collection agency.

c) Burn or bury it.

Activity 1.9

Prepare a report by surveying at least 30 individuals or families through interviews, questionnaires or any other means on the various methods they use to preserve food materials.

Exercise

1. Choose the correct alternatives.

a) What is the process of experiencing an object, event or process carefully through the sense organs?

(i) test (ii) hypothesis

(iii) curiosity (iv) observation

b) Which of the following methods is suitable if one has to study whether the farmers of a region use more chemical or organic fertilizers?

(i) observation (ii) test

(iii) research (iv) survey

c) Which of the following would you stop your friend from doingin the laboratory?

(i) Tasting or smelling laboratory chemicals.

(ii) Wearing a lab coat.

(iii) Boiling water in a beaker.

(iv) Using test tube holder while heating it.

d) What should be done while performing a chemical reaction that produces fumes?

(i) Hands should be kept away.

(ii) It should be carried out on a table.

(iii) It should be kept on a stand. (iv) It should be carried in a hood.

e) Which is the first step of a scientific study?

(i) investigation (ii) observation

(iii) testing (iv) experimentation

2. Distinguish between:

(a) Observations and tests

(b) Research and survey

3. Write the reason:

a) Precautions should be taken while conducting experimental work.

b) A report is prepared after the experiment and survey are done.

c) Observation is the first step in scientific learning.

4. Write the answers to the given questions:

a) What is observation?

b) What is the importance of observation in scientific work?

c) What is done in scientific work when there is not enough information from observation?

d) What precautions should be taken while carrying out a scientific experiment?

e) List the things that should be done and should not be done while working in the laboratory.

f) Whatshould we pay attention to while researching?

g) In what conditions is the survey conducted?

h) What is meant by survey tools? Write with examples.

i) Elina is interested to study the requirements of sunlight for green plants. Suggest a clear method for her how to conduct that study.

j) A class had to be conducted in the absence of the science teacher in grade eight. Prepare a worksheet for conductin a practical class on the study of plant and animal cells.

2 Information and Communication Technology

Modern information and communication technology and scientific advancements have simplified and increased the efficiency of human life. Our daily lives are made easier, more instinctive and spontaneous by information and communication tools including the computer, internet, digital camera, CC camera (Closed Circuit camera), radio, television etc. Similarly, information and communication equipment like ATMs, photocopiers, scanners, printers, routers, and Wi-Fi devices have made human livesmore efficient, smarter and practical. With the development of technologies, the use of Artificial intelligence (AI), virtual reality, robotics and cloud computing are also increasing day by day. For the accountability of online transactions, the Computer Code of Conduct, cyber law, and other aspects of Internet security should be followed strictly. In this chapter, we will discuss the application of these ICT tools.

Fig 2.1 Information and Communication Devices

2.1 Tools of Information and Communication Technology

Fig 2.1 ICT Tools

Information and communication technology refers to theintegrated tools of communication. Radio, television, newspapers, computer, projectors etc. are the tools of information and communication technology. These tools create, display, store, transmit, and exchange information. Information and communications technology (ICT) has influenced all aspects of life significantly. Therefore, ICT is a wide subject in the modern age. Modern organizations and different professionals depend heavily on network computing and communication technologies. The use of such technologies is increasing mainly in the fields of education, business, management and entertainment. In this lesson, we will study the introduction and general use ofATMs, photocopiers, scanners, printers, routers, Wi-Fi devices, television, and set-top box.

Activity 2.1

What type of devices of information and communication technology do you use every day to accomplish different tasks? Find the application of these devices and fill in the table below:

S.N.	ICT devices	Application in daily life
1	Computer	To use the internet and store data.
2	....	....

Automatic Teller Machines (ATMs)

ATM stands for automatic teller machine in its full form. It is an electromechanical machine that provides automated banking services. It helps the customer to make their transaction easily without the help of a branch office, representative or teller. Cash can be withdrawn from ATM using a debit card or credit card. ATMs help customers conduct transactions by providing fast, easy andautomated services such as cash withdrawals, cash deposits, bill payments and account to account fund transfers etc.

Basic parts of ATM

Input and output devices are the main parts of an ATM. It makes it convenient for customers to deposit or withdraw cash. A brief description of the input and output devices in an ATM is given below:

Fig 2.3 ATM.

Input devices

Card reader: The card reader recognizes the data stored in the magnetic stripe located at the back of the ATM card. Account details are retrieved by the card reader and sent to the server. Once the card is inserted into the designated slot of the ATM, the card reader allows the cash dispenser to dispense cash to the user based on the instructions received from the server.

Keypad

The keypad is a standard input device found in most ATMs. It is used to enter the Personal Identification Number (PIN) to authenticate the user and access their accounts. The keypad typically consists of a set of 10 numeric keys (0-9) and several additional function keys such as "cancel", "clear", "enter", and "language". Users are required to enter their PIN on the keypad to complete a transaction.

Output devices

Speaker: Many ATMs also have an audio system that provides spoken instructions and feedback to users, especially those who are visually impaired. The audio system may also provide an audio confirmation of the transaction.

Display Screen

The display screen is an essential output device found in all ATMs. It provides users with visual information about their transaction, such as the balance in their account, transaction status, and prompts for entering information.

Receipt Printer

The receipt printer is another critical output device found in ATMs. It prints out a receipt with the details of the transaction, such as the amount withdrawn or deposited, the remaining balance, and the date and time of the transaction.

Cash Dispenser

A cash dispenser is an important output device of the ATM that dispenses cash to the user at the end of the transaction. The highly sensitive sensors used in the ATM allow the cash dispenser to administer a specified amount of cash according to the user's needs. ATMs perform cash deposits, cash withdrawals, account statements, account balance statements, PIN code changes etc.

Precautions to be taken while using ATMs

a) ATM cards and PINs should be kept safe and should not be given to anyone.

b) The PIN should be changed from time to time.

Activity 2.2

Visit the nearby bank ATM location with your parents. Watch how the cash is withdrawn from the ATMs. Try to use ATMs under parental supervision and with their consent.

Photocopy Machine

A photocopy machine makes the copy of documents. Xerography technology is used in most photocopy machines. For many years, photocopying was informally known as xeroxing because most photocopiers used xerography. Xerography is a dry process. It uses light as an electrostatic charge on a sensitive photoreceptor. A photocopy machine needs light, heat, pressure, chemicals and electrostatic charge to function. A photocopier is a machine for making copies of graphic content and is commonly used in business, education, and government sectors. A scanner, printer, computer network, etc. are also connected to modern photocopy machines.

Fig 2.4 Photocopy Machine

Methods of using photocopy machine

Here are the general steps to use a photocopy machine.

1. Turn on the machine

To use the photocopier, the first step is to make sure that the plug is connected to a nearby power outlet or not. Then press the button to switch on the machine. Most photocopiers have the power button on the top, but some machines may have the switch button on the side. If the machine does not respond when the button is switched on, it may be in sleeping mode. Before going to the next step, make sure that there is enough paper in the paper tray. The paper tray is usually located at the front of the machine. If there isn't enough paper or the tray is empty, we should keep paper in it.

2. Put the paper in the copier:

At this stage, the cover (top) of the photocopier should be lifted and the document to be copied should be placed on the glass surface. The document to be photocopied should be placed in the machine with the content facing down. Guide marks are also included on the glass to align the document so that it is straight and centred. After placing the document, the cover should be closed.

3. Select the paper size and type

Most photocopy machines have settings to adjust the paper size and type. Select the appropriate size and type based on the document you want to photocopy.

4. Adjust the settings

Use the control panel of the photocopy machine to adjust the settings, such as the number of copies, the darkness or lightness of the copy, and any other desired features like colour or black and white printing. Many photocopy machines have only black and white mode.

5. Start the photocopy

Press the "Start" button to begin the photocopying process. The machine will scan the document and produce the required number of copies.

6. Collect the copies

Once the photocopy is complete, collect the copies from the output tray. Make sure to check the quality of the copies before proceeding.

Activity 2.3

Make a photocopy of an image on an A4 size paper and display it to your class.

Scanner

An input device used to digitize a picture or text printed on paper and store it in a computer is called a scanner. Some photocopiers can scan documents to create soft copies of the originals. A scanner is an input device that digitizes the picture from the required source for photographic prints, posters, magazine pages, computer editing, and display. A scanner works through Optical Character Recognition

(OCR) technology. This process is performed by a scanning head and uses one or more sensors to detect letters or images as light or electrical charges.

Fig 2.5 Scanner

The majority of scanners are flatbed machines with a flat scanning surface. As a result, it can scan extensive content with ease. Generally, scanners are attached to a computer system and use scanning software. It works to resize the photo or picture and modify the image. A hard copy of the scanned image can be printed if a printer is connected to the computer otherwise it can be stored in digital format. These days, a smartphone app can also be used to perform scanning work.

Activity

Scan a document at school using a smartphone or scanner with the assistance of theteacher and present it in your class.

Printer

A printer takes electronic data stored on a computer or other device and produces a hard copy. Since the printer prints digitally stored files in a computer or other device, it is also called a hardcopy output device. A printer is the most popular device used to print textual materials and photos among the external devices of the computer Nowadays, there are different types and capacities of printers available in the market for different purposes. Some printers only produce plain black and white prints, while others also produce multicoloured prints. Printer speed is measured in Character Per Second (CPS), Line Per Minute (LPM) and PagesPerMinute (PPM). The printing methods may be different in different printers such as dot print, ink-jet print, laser print etc.

Fig 2.6 Printer

Common Steps to use a Printer

1. Ensure that the printer is connected and turned on: Make sure that the printer is properly connected to your computer or mobile device and that it is turned on. Check that there is paper in the paper tray and that there is enough ink or toner in the cartridges.
2. Open the document or image to be printed: Open the digital file that you want to print. This can be a document, image, or another type of file.
3. Choose the printer: If you have multiple printers connected to your device, choose the printer you want to use from the list of available printers.
4. Choose the print settings: Select the desired print settings, such as the number of copies, orientation, paper size, and print quality. Some printers may have additional settings, such as double-sided printing or borderless printing.
5. Preview the print: Before printing, preview the print to ensure that it looks as you intended. You can usually do this by clicking on the "Print Preview" option.
6. Print the document or image: Once you are satisfied with the print preview, click on the "Print" button to start printing. The printer will start printing the document or image based on the settings you selected.
7. Collect the printout: Once the printing is complete, collect the printout from the output tray. Make sure to check the quality of the printout before proceeding.
8. Turn off the printer: When you have finished printing, turn off the printer and disconnect it from your device if necessary.

Note that the specific steps may vary depending on the model of the printer, so it's always a good idea to consult the user manual for detailed instructions.

Activity 2.4

Go to the computer labat your school. Make a Word document of your bio-data on a computer and print it with the assistance of your teacher. Observe the printing process while printing documents.

A Router

A router is a network connecting device that helps to connect different wired or wireless networks. A router helps to send data from one network to another. It works on the principle of IP (Internet Protocol) address. Nowadays DSL and Optical fibre router are more popular in the market. Routers are mainly of two types; i.e. wired and wireless.

Fig 2.7 Router

Uses of a Router

i. A router is used to connect hardware devices and other servers to a network at a remote location.

ii. It exchanges data at a higher speed. So, it is used in both wired and wireless communication.

iii. Routers are frequently used by internet service providers to transmit data in the form of email, websites, voice, or video files from source to destination. Additionally, it can transmit data across the globe with the aid of the target IP address.

iv. Wireless routers can be used in a client-server format that permits sharing of the Internet, video, data, voice, and hardware resources by configuring a Virtual Private Network (VPN).

Wi-Fi

Wi-Fi is the short form of 'wireless fidelity'. Wi-Fi is a type of wireless networking system. Communication between devices is established through radio waves in Wi-Fi. It allows Wi-Fi-enabled devices to connect to the Internet and exchange information, digital documents, images, movies, etc. Wi-Fi is a popular wireless networking technology. Wi-Fi was invented by NCR Corporation in the Netherlands in 1991. We can exchange information or data between two or more devices by using Wi-Fi.

Fig 2.8 Wi-Fi

Wi-Fi was developed for computing devices such as computers and laptops, but nowadays it is widely used in electronic devices such as mobile phones, televisions and digital cameras.Wi-Fi is commonly called Wireless Local Area Network (LAN). Wi-Fi technology allows local area networks to operate wirelessly. It is becoming more and more popular for domestic and business uses every day. There are three methods for Wi-Fi signal transmission which are as follows:

i. Base station network or Ethernet connection: This is the main host network from where the network is connected to the router. It helps to bring the network signal to our house.

ii. Access Point or Router: It is a bridge between wired and wireless networks. A Wired Ethernet connection is used in the router to convert wireless connections. It also spreads the signal around in the form of radio waves.

iii. Devices: We use mobile, computer etc. devices with the help of which we use wireless internet.

Set-Top Box

Fig 2.9 Set-top Box

A set-top box (STB) is a device that receives digital signals, and decodes and displays television channels. A set-top box is a hardware device. The signal received by the set-top box can be a television signal or an internet data signal. The signal can be received via cable, optical fibre or telephone connection. The set-top box allows the user to view various programs received from the service provider over the Internet. The set-top box converts the television signal into audio-visual content that can be displayed on a monitor, captured and recorded. In the past, set-top boxes were mainly used for cable and satellite television. Nowadays, Internet facilities are also available in the set-top boxes provided by various Internet service providers.

Activity 2.5

Observe the TV set-top box in your home. Make a list of different parts in the set-top box by identifying them.

2.2 Introduction of a Search Engine, Website and ISP

Search Engine

The search engine is a communication program to search the content on the internet.The search engine is a software system that provides necessary details to users from information placed on the Internet. To get information on any topic, we can use a search engine to find a website related to that topic. Refining your content with a search engine is used for search, saving time and allowing for more precise results. Differentiating between official and non-copyrighted content is simple with a refined search. Even if don't know the address of the website related to the subject are trying to get, can search by just typing a word. Among the search engines used today, the most used is Google. Due to the excessive use of Google search engines, searching for something new or a topic is usually called 'Googling'. Google has provided various services such as emailing, and translating from one language to another through Google Translator along with the search engine

Numerous websites publish the information that we need to use the Internet. We may not know the name of that website. In this case, we can get information by typing only the keyword with the help of a search engine. A search engine is a special type of software that is used to search for content ona website. From the huge amount of information available on the Internet, search engine assists us in finding the information we require. Some of the major search engines are:

1. www.google.com
2. www.yahoo.com
3. www.bing.com
4. www.ask.com
5. www.altavista.com

Activity 2.6

To find the Curriculum Development Center website, go to any browser's search engine, click the search button, and type in Curriculum Development Center. Choose the www.moecdc.gov.np link from the list of links to access the educational resources you require.

Website

Fig 2.10

A website serves as a hub for the collection of multiple web pages and the storage of information about an organization. Any government or non-government organization or business person can create a website on the Internet. Nowadays there are many websites on the Internet where various organizations keep their information. The website starts from www. The full form of www is the world wide web. The website of any organization or person is not compatible with any other website in the world. So, every organization has a specific website address which is called a Web address or Universal Resource Locator (URL). A website for a curriculum development centre is www.moecdc.gov.np which contains a variety of educational resource materials. A mobile or computer browser, such as Google Chrome, Microsoft Edge, Safari, Mozilla Firefox, etc., is required to access any website.

Parts of the Website

A website is a collection of web pages hosted on a web server and consists of the following parts;

i. Webhosting:Web hosting is a service that allows individuals and organizations to make their websites accessible on the internet. A web hosting company provides server space to store website files, which can then be accessed by internet users via a domain name.

ii. Web address:A web address, also known as a URL (Uniform Resource Locator), is a unique address that identifies a specific website on the internet. A web address typically consists of three parts: Web addresses are used to navigate to specific websites, pages, or resources on the internet using a web browser.

iii. Homepage: The homepage is the first and most important part of a webpage. It appears first when the user visits the website. The home page defines the look of the website and provides links for the user to browsethe desired page of the website.

iv. Digital Content: Each web page in a website contains various types of digital content. Good content placed on the webpage makes the website more effective and attractive.

v. Navigation Structure: Navigation structure in a website refers to the organization and arrangement of the pages and sections within the site. It helps users easily navigate and find the content they are looking for.

Activity 2.7

Go to the search bar of any web browser, type www.moecdc.gov.np, and press the enter key. Homepage with several options will be displayed choose one of them, such as a Textbook, a catalogue of textbooks for various classes will appear. You can choose the textbook of your class and download it.

Internet Service Provider (ISP)

Internet service provider refers to a company that provides access to the Internet to personal and business customers. These enable customers to search the web, shop online, conduct business as well as connect with family and friends digitally. ISPs provide their clients with a variety of services, including domain and email hosting, and web hosting.

Fig 2.11 ISP's Services

To use this service, the customer has to pay a certain amount to the ISP organization as per their package. This amount also varies according to the amount of data used by the customer or the data plan that the customers want to purchase. Internet Service Providers are also known as Internet Access Providers or Online Service Providers. A provider of information services, storage services, Internet network service providers (INSPs), or a combination of all of these, is referred to as an ISP. In the initial phase, internet service was limited to some government agencies and some departments of certain universities. Towards the end of the 1980s, technology was developed to provide Internet access to the common people through the World Wide Web. Telenet is the world's first Internet Service Provider (ISP) and started its service in 1974. Mercantile Company first started internet service in 1994 in Nepal.

Features of ISP

i. ISP provides high-speed internet service.

ii. Most ISPs provide email addresses to their customers.

iii. Most ISPs protect their customers against problems such as phishing, malware etc.

iv. Some ISPs also provide web hosting services.

2.3 Social Networking Site

Fig 2.12 Various Social Networking Sites

This era is the era of technology. There is a saying that goes, "Technology is a useful servant but a dangerous master," attributed to historian Christian Lous Lange.

Social networking sites are also known as social networks or social media. Social media is a collective form of online communication channel dedicated to community-based interaction, content sharing and collaboration. While using social media, users have responsibilities which they must fulfil by following the norms of social media. Some examples of social media are Facebook, Messenger, YouTube, Twitter, Instagram, Google Plus, Tiktok, Blog, etc. The number of Facebook and Twitter users in Nepal is increasing day by day. Any social network has its advantages and disadvantages. Social media has numerous advantages if we can use it properly, but there are a variety of drawbacks if we abuse it.

Introduction to the Blog

A blog is a short version of a weblog. It is an online journal or informational website where an author or group of authors share their thoughts on a personal topic. Although blogs started as personal diaries, there are more than 570 million blogs on the web nowadays. Blogs are becoming widespread not only for personal use but also in economic, political and social fields. Blogs are also considered important in business. The main purpose of a blog in business is to connect the produced content with the customer. Great blogging makes a business more credible. The blog should be updated frequently. Compared to blogs, websites are static in nature. Blogging is the process of equipping a webpage with tools to facilitate the process of writing, postingand sharing content on the Internet. Similarly, a person who runs and controls a blog is called a blogger.

Creating Blog

Creating a blog is relatively easy and can be done in just a few simple steps. Here is given how to open a blog account:

i. Choose a Platform: The first step in creating a blog is to choose a platform. There are many free and paid platforms available including WordPress, Bloggerand Squarespace. WordPress is the most popular blogging platform, with over 60 million websites using it.

ii. Choose a Domain name: A domain name is the address of your blog. It should be easy to remember and related to your blog's content.

iii. Select a Hosting provider: A hosting provider is a service that stores your blog's content and makes it available to users on the internet. There are many hosting providers available, including Blogger.com, WordPress.com, Bluehost, and SiteGround etc.

iv. Choose a theme: A theme is the design of your blog. It determines how your blog looks and feels. Most platforms offer a variety of themes to choose from, or you can purchase a custom theme from a designer.

v. Start writing: Once you have your platform set up, it's time to start writing! Write high-quality, engaging content that is relevant to your audience. You can also add images, videos, and other multimedia to make your blog more engaging.

vi. Promote your blog: To attract readers, you'll need to promote your blog. Share your posts on social media, participate in online communities related to your niche, and engage with your readers to build a following.

Creating a successful blog takes time and effort, but with the right strategy and dedication, it can be a rewarding experience.

Activity 2.8

Open a blog on the school computer or your parents' smartphone with the help of the teacher/parent, then enter any ideas or write a quick article that you prefer.

Opportunities for Social Networking

Social media has helped to spread information and communication over the world. The use of social media has spread to almost every nation. People from villages and cities everywhere are addicted to social media. If used correctly, social media can be a powerful tool in the world of communication. Some of the advantages and disadvantages of social media are briefly described below

Benefits of social media

a) Strong Medium

Social media is not only a place to share personal sorrows and joys, it has also become a platform for intellectual debate. Recently, social media has also emerged as a powerful means of the election campaign and agenda-setting. Therefore, nowadays social media has become a powerful means of personal expression.

b) Brand Development

Users can get information about any business by using social media. This helps businessmen to achieve professional success. It is also found that people involved in various businesses advertise through social media.

c) Customer Interaction

The positive feedback given by different customers in the business can be an inspiration for other customers, while the negative feedback can point out their weaknesses in the business and guide the way to improve.

Activity 2.9

Start up your parent's smartphone or the PC at school which includes several forms of social networking sites. Choose YouTube from the list, then enter "NCED Virtual" in the search field and press the Enter key. Virtual class videos of different subjects of different classes appear as shown in the picture. Open and watch the video of the topic you need.

Disadvantages of Social Media

Every technology is not only a blessing but also a curse. This statement applies to social media as well. Recently, many side effects of social media have also been exposed. Along with its popularity, it has created many dangers or risks which are as follows:

a) Health problems

People who use social media excessively are at risk of becoming victims of mental illness. They often have problems like depression and insomnia. Blue light emitted from mobile or computer screens inhibits the production of the hormone melatonin that controls our body's "body clock". Melatonin acts to make us feel sleepy. But when its production stops, we stay up late. Many types of health problems arise if we do not sleep well.

b) Fake accounts

It is seen that by creating a fake account in the name of a person with any name, sending friend requests to more and more people and taking unauthorized advantage of it. Some people use Facebook and Twitter to spread spam and malware.

c) Confidential information leak

In this, especially, the employees of any company use social media informally to publicize technical information, so that the confidential information of the company gets out.

d) Targeted phishing attack

Targeted phishing attacks are used to steal money or confidential information. Cyberbullying is an example of phishing.

Project work

Make a Group discussion with friends about the dangers of social media, the precautions to be taken and the benefits of social media. Present the findings on chart paper.

2.4 General Introduction of Cybercrime, Computer Code of Conduct, Cyber Law and Internet Security

Cybercrime

Fig 2.13 Various Cybercrime-Related Activities

Cybercrime is defined as any crime against a person or group that harms someone's reputation or causes physical or mental trauma through electronic means. Cybercrime is also known as computer crime. The use of computers for illegal activity such as theft of intellectual property, identity theft, violation of privacy, etc. falls under cybercrime. In cybercrime, especially banks and financial institutions, government websites or famous people are targeted through the Internet. Cybercrime is considered a serious crime. Most cybercrimes attack individuals, institutions or government information.

A Common Form of Cybercrime

i. Identity Theft: Identity theft is the misuse of personal information to gain unauthorized access to financial services or steal financial assets.

ii. Cyber Terrorism: Cyber terrorism is a cybercrime committed against any person, group of persons or government to cause serious harm or extort donations.

iii. Cyberbullying: Cyberbullying refers to electronic media such as social mediaor using mods to threaten, intimidate, harass, or humiliate someoneor any other form of mental torture.

iv. Hacking:Hacking or shutting down a website or computer network through unethical meansis called hacking.

v. Defamation: Every person has the right to speak on the Internet platform. But if someone's statement harms the reputation of any person or organization, then it is considered defamation and it is also considered a type of cybercrime.

Apart from those mentioned above, obscene content and abuse spread on the web, harassment and suffering, spreading hatred and inciting terrorism, distributing child pornography, attracting minors to sex, etc. are also cybercrimes.

Project work

Attacks against bank ATMs, privacy breaches, the dissemination of offensive content online, the spread of unwanted rumors, and other such crimes are some of the major cybercrimes that take place in our society. Create and post posters with messages to discourage these and other occurrences.

Computer Code of Conduct

Activity 2.10

A list of dos and don'ts when using a computer is provided in the table below. As listed in the table, observe the dos and don'ts you are aware of and complete the table.

S. N.	Action to be taken	Action not to be taken
1.	Listening to music, watching videos and reading the news.	Do notdownload or copy a file that is protected by copyright.
2.	....	....
3.		
4.		

A computer code of conduct, also known as a code of ethics, is a set of guidelines that outlines the ethical and professional standards expected of individuals who use computers and technology. This prevents the user from committing illegal acts such as being cheated or involved in bad deeds. While using Information and Communication Technology (ICT) users, programmers, operators or anyone else must follow the code of computer ethics. One should not steal information, software, data file or any personal or collective record using computers, smartphones, tablets etc. to causeharm to others, spoil them or use computer viruses to do unethical acts. It is the responsibility of all of us to follow the code of computer ethics. The list below, provided in point form, includes some computer usage guidelines.

a) Respect for Intellectual Property: Users should respect the intellectual property rights of others and not copy, distribute, or use copyrighted materials without permission.

b) Security: Users should take appropriate security measures to protect their data and systems from unauthorized access, viruses, and other threats.

c) Professionalism: Users should behave professionally when using computers and technology, including avoiding offensive or harassing behaviour.

d) Accuracy: Users should ensure that the information they provide or publish is accurate and truthful.

e) Compliance with laws and regulations: Users should comply with all applicable laws and regulations related to computer and technology use.

f) Reporting violations: Users should report any violations of the code of conduct to the appropriate authorities.

Concept of Cyber Law

Cyberlaw, also known as Internet law or digital law, is the legal framework that governs the use of the Internet, computers, and related technologies. By defending access to information, privacy, communication, intellectual property, and freedom of speech connected to the use of the Internet, websites, email, computers, smartphones, software, and hardware, cyber laws prevent or mitigate the large-scale harm caused by cyber-criminal acts. Cyber laws provide legal protection to people who use the Internet. Understanding cyber law is extremely important for anyone who uses the Internet. Cyber law is also known as the "law of the Internet". Simplycyber law is the legal system to combat computer crime and harassment. It has strict provisions to punish cyber criminals. Cyber laws give legal authority to digital signatures and electronic documents that are then used in electronic banking, shopping and e-commerce. It creates rules for the construction of a justice system related to computer crime.

The Computer Fraud and Abuse Act (CFAA) was enacted in 1986, as an amendment to the first computer fraud law, to address hacking in the USA. The government of Nepal passed "The Electronic Transaction and Digital Signature Act-Ordinance" popularly known as "Cyber Law" on 30th Bhadra 2061 BS (15 September2004). The government of Nepal has passed the "Electronic Transactions Act, 2063 (2007)" and "Electronic Transaction Rules, 2064". Major areas of cyber law include computer crimes such as hacking, digital signatures, Internet of Things (IoT) and identity theft.

Cyber Act in Nepal

With the increasing incidence of cybercrime in Nepal, it has become necessary to make a separate law. "The Electronic Transactions Act, 2063" deals with various offences of cybercrime, the salient features of which are as follows:

i. Hacking or destroying any computer system knowingly without authority will be punished with imprisonment up to three years or a fine of two lakh rupees or both.

ii. Access to any computer system without authority will be punishable with imprisonment up to three years or a fine of two lakh rupees or both.

iii. Knowingly damaging data from computer systems will be punishable with imprisonment of up to three years or a fine of two lakh rupees or both.

iv. Five years imprisonment or one lakh for publishing illegal material through electronic means.

v. Computer fraud is punishable with imprisonment for two years or a fine of one lakh rupees or both

In addition to the above-mentioned Act, "The Act Relating to Children, 2075"prohibits taking any immoral pictures of children. In addition, the publication and distribution of any pictures of children are prohibited. Similarly,"The copyright act, 2059" protects the copyright of ideas including computer programs. It prohibits people from copying, modifying or using the original work for their benefit. "The Privacy Act, 2075" places responsibility on public organizations to protect individuals' data. They cannot transfer such data to anyone without the owner's consent. Under this, the law provides that anyone who violates privacy by transferring someone's data without consent will be punished with three years of imprisonment or a fine of 30,000 rupees or both.

All the above-mentioned laws issued by Nepal for cybercrime are still not enough. The country needs to address the loopholes in these laws and encourage their citizens to report incidents of cybercrime. E-commerce, social media and cyber terrorism, among other areas of cyberspace, also require comprehensive legislation.

Project work

Make a groupby the teacher's directions, and then present a table in each group detailing the offences committed while using computers and the Internet and the associated penalties through group discussion and reference material research.

Internet Security

Internet security focuses on the specific threats and vulnerabilities of online access and Internet use. Various security strategies are involved to protect the activities and transactions conducted over the Internet. These strategies are intended to protect users from threats such as hacking into computer systems, email addresses or websites. Using various software on the Internet, hackers can steal personal data such as bank account information and credit card numbers etc. In today's digital world, many of our daily activities rely on the Internet. Various forms of communication, entertainment, financial and other related activities are completed online. This means that a lot of data and sensitive information is constantly being shared over the Internet. The Internet is often private and secure, but it can also be an insecure channel for sharing information. There is a high risk of security by cyber criminals. Internet security is a matter of priority for individuals and official purposes.

Data entered into web forms, as well as overall authentication and security of data delivered over Internet Protocol, are all covered by Internet security in general. Internet security is a branch of computer security. It covers internet, browser security, website security and network security. The purpose of Internet security is to find ways to protect against various attacks on the Internet.

Risk of Internet security

The internet has become an integral part of our daily lives, and while it offers many benefits, there are also risks associated with internet security. Some of the most common risks of internet security include:

Malware: Malware is a type of software that is designed to harm or exploit a computer system. Malware can come in many forms, such as viruses, worms, Trojan horses, and spyware. Malware can steal personal information, damage files, and even take control of a computer system.

Phishing: Phishing is a type of social engineering attack that involves tricking people into giving away their personal information. Phishing attacks usually come in the form of emails, text messages, or pop-up windows that appear to be from a trusted source.

Identity theft: Identity theft is a type of fraud that involves stealing someone's personal information, such as their name, date of birth, Social Security number, and credit card information. This information can be used to commit various types of fraud, such as opening credit card accounts or taking out loans in the victim's name.

Hacking: Hacking is the process of gaining unauthorized access to a computer system or network. Hackers can steal sensitive information, install malware, and even take control of computer systems.

Botnet: Botnets are a significant threat to internet security, as they can be used to carry out large-scale attacks that can disrupt critical services, steal sensitive information, and cause significant financial damage. Protecting against botnets requires a multi-layered approach, including deploying effective security software, keeping software and systems up-to-date, and educating users about safe online behaviour.

Measures of Internet Security

Internet security requires various measures to properly protect data. Many measures can be taken to improve internet security, and some of the most effective ones include:

i. Use strong passwords: Strong passwords that are complex and difficult to guess can help protect against unauthorized access to online accounts.

ii. Enable two-factor authentication: Two-factor authentication adds an extra layer of security to online accounts by requiring a second form of authentication, such as a code sent to a mobile phone.

iii. Keep software up-to-date: Keeping software, including operating systems and applications, up-to-date with the latest security patches can help protect against known vulnerabilities.

iv. Use reputable antivirus and security software: Antivirus and security software can help protect against malware and other cyber threats.

v. Use a firewall: A firewall can help block unauthorized access to a network or computer.

vi. Back up important data: Regularly backing up important data can help ensure that it can be restored in the event of a cyber-attack or data loss.

vii. Educate users: Educating users about safe online behaviour, such as avoiding suspicious emails or links, can help reduce the risk of cyber-attacks.

2.5 Introduction of Robotics and Virtual Reality

Robotics

Robotics is an interdisciplinary branch of computer science and engineering. Robotics involves the design, construction, operation and use of robots. The goal of robotics is to design machines that can help humans. The fields of mechanical engineering, electrical engineering, computer engineering, and mathematics are integrated by robotics.

Robotics develops machines that can assist humans and imitate human actions. Robots can be used to perform hazardous tasks that humans are unable to complete with the aid of programming, such as following orders in space, disposing of explosives, performing a range of tasks in the deep sea, and working securely in areas with radiation threats.

Fig 2.14 Robot

Computer programming has given robots the capacity to do tasks automatically. Computer programming is simply understood as software. Robots mainly have two parts software and hardware. Hardware is a physical structure that can be shaped by humans and can be physically touched. Some robots look like humans, while others look like machines. This computer programming is done by the tasks that they are designed to perform. The robot functions as a robotics program. Robotic process automation (RPA) imitates human action, and intelligent machines can be built using this model.

The following list includes the applications for robots as well as some of the crucial tasks they carry out are given below:

1. **Manufacturing:** Robots are widely used in manufacturing processes to automate repetitive and dangerous tasks such as welding, painting, and assembling pieces of machinery.
2. **Healthcare:** Robots are used in healthcare to assist with surgeries, deliver medications, and provide physical therapy to patients.
3. **Agriculture:** Robots are used in agriculture to automate tasks such as planting, harvesting, and crop monitoring, which can improve efficiency and productivity.
4. **Logistics:** Robots are used in logistics to automate tasks such as packing, sorting, and transporting goods, which can reduce costs and increase efficiency.
5. **Exploration:** Robots are used in space exploration and deep-sea exploration to gather data and samples from environments that are dangerous or difficult for humans to access.
6. **Education:** Robots are used in education to teach students about robotics and programming, and to provide a practical learning experience.
7. **Entertainment:** Robots are used in the entertainment industry, such as in theme parks and movies, to provide interactive experiences for audiences.
8. **Security:** Robots are also used in security to monitor and patrol areas, detect and defuse explosives and other dangerous devices, fire control, rescuing.

Virtual Reality


Fig 2.15 Application of Virtual Reality

Virtual reality (VR) refers to a computer-generated imitation of a three-dimensional environment that can be interacted within a seemingly real or physical way using special electronic equipment. This immersive technology creates an artificial environment that simulates a user's physical presence in a virtual world, allowing them to interact with digital objects and spaces as if they were real.

Virtual reality technology typically consists of a display screen that is worn over the eyes, providing users with a stereoscopic view of the simulated environment. The display is often coupled with headphones or speakers to provide an immersive audio experience. In addition, motion-tracking sensors can be used to track the movements of the user's head and hands, allowing for natural and spontaneous interaction with the virtual environment.


Fig 2.16 Application of Virtual Reality

Virtual reality has a wide range of applications, including entertainment, gaming, education, training, and simulation. For example, VR can be used to create immersive and interactive gaming experiences, simulate dangerous or complexreal-world scenarios for training purposes, or provide a virtual tour of a historical site or museum exhibit. Virtual reality can also be used for therapeutic purposes, such as exposure therapy for anxiety disorders or to help treat post-traumatic stress disorder.

Overall, virtual reality technology provides a powerful tool for creating immersive and interactive experiences that can be used for a wide range of applications, from entertainment to education and many other different fields.

Application of Virtual Reality

Real-world situations are modelled by virtual reality technologies. This technology is utilized in several areas, including the military, sports, mental health, and daily living. The following are some examples of how virtual reality is used:

1. VR in the Military Field

VR is widely used in the military field. Virtual reality has been utilized by the military of developed nations for training. Virtual reality has been employed in military training to properly mimic hazardous training scenarios for soldiers and to fly in conflict zones, etc. VR technology is also used to treat post-traumatic stress disorder (PTSD). This treatment is also called Virtual Reality Exposure Therapy (VRET). Which is considered indispensable for soldiers returning from battle.

2. VR in the Education Sector

VR is also used in the education sector for teaching and learning activities. Using this technology, students can also be taken on virtual field trips such as museums, solar system tours, and the artificial feeling of going back in time to different eras. These days, virtual classrooms are being used for an increasing number of teaching and learning activities.

3. VR in the Sports

Virtual reality technology can be used by coaches and players to train effectively. Players can improve their performance each time by repeatedly watching and experiencing specific game scenarios. Similarly, this technology is also being used to improve the audience experience of live sports events. Various sports broadcasters have started streaming live games through VR and have arranged to sell virtual tickets for live sporting events. It can enable people anywhere in the world to watch any sports event. Additionally, it enables those who aren't able to afford to spend money to enjoy the game by providing a low-cost live broadcast from their area.

4. VR in the field of Mental Health

VR technology is used in Virtual Reality Exposure Therapy (VRET) and it is also being used in the treatment of emotional diseases like anxiety and phobia. For example, an anxious patient can meditate using VR to deal with stress sensitivity and increase coping skills. The VR technology can facilitate a safe environment for patients to face the components that they fear, whilst staying in a guarded and secure environment.

5. VR in Medical Training

VR technology is used by medical and dental students to practice surgery. This minimizes the risk of any harm. Practicing medicine through VR helps to improve the quality of medical training and also reduces the cost of medical training.

6. VR in the Field of Fashion

Nowadays, VR is also being used in the field of fashion. VR is used to display various fashion products, as well as to develop shop layouts. Some of the world's most famous brands are adopting VR technology to facilitate the fashion experience and entice consumers through advertising.

7. VR in the Field of Architecture

VR applications provide architects with scale as well as information to present their ideas and designs. Virtual reality applications will be advantageous for all types of construction projects, whether they are residential buildings, commercial buildings, or any other kind. This is because they will enable these projects to be visualized in a virtual environment to interpret every aspect of the project, such as safety precautions or reducing any discrepancy from the final design.

The uses and capabilities of technology are limitless. In addition to the above-mentioned uses,VR technology is also being used in fields such as research, entertainment health and safety, heritage and archaeology, fine arts, marketing, music and concerts etc.

2.6 Introduction and Application of Artificial Intelligence and Cloud Computing

Artificial Intelligence

Artificial Intelligence (AI) refers to the creation of computer programs or machines that can perform tasks that normally require human intelligence, such as understanding natural language, recognizing objects, making decisions, and solving problems. Artificial intelligence is an emerging technology that can act by understanding intelligence and human abilities through the use of machines. In the beginning, artificial intelligence was considered a technology that can imitate human intelligence, but nowadays it has been developed in many ways. Artificial intelligence has the power to enhance different types of work, connectivity and productivity. The capabilities of AI are expanding rapidly and its areas of application are increasing day by day

Fig 2.17 Artificial Intelligence

Artificial intelligence (AI) has also had a great impact on scientific inventions. AI can be classified into three main categories based on its capacity:

1. Narrow or Weak AI: This type of AI is designed to perform a specific task, such as speech recognition or image classification. These systems are not capable of doing anything beyond the task they were programmed to do.
2. General or Strong AI: This type of AI is designed to be as intelligent as a human being and is capable of performing any intellectual task that a human can do.
3. Artificial Superintelligence (ASI):This is a theoretical level of AI that would surpass human intelligence in every way and would be capable of solving problems that are currently beyond human comprehension.

Artificial intelligence can perform various tasks similar to human mind functions. It can comprehend human emotion and engage in social interaction in a group setting. An outstanding example of artificial intelligence is found in self-driving cars, generic robots, chatbots etc.

Sophia, the first humanoid robot was brought to Nepal in 2018 at the UNDP conference on "Technology for Public Services" and gave a keynote speech on science and technology, anti-corruption, and other topics.

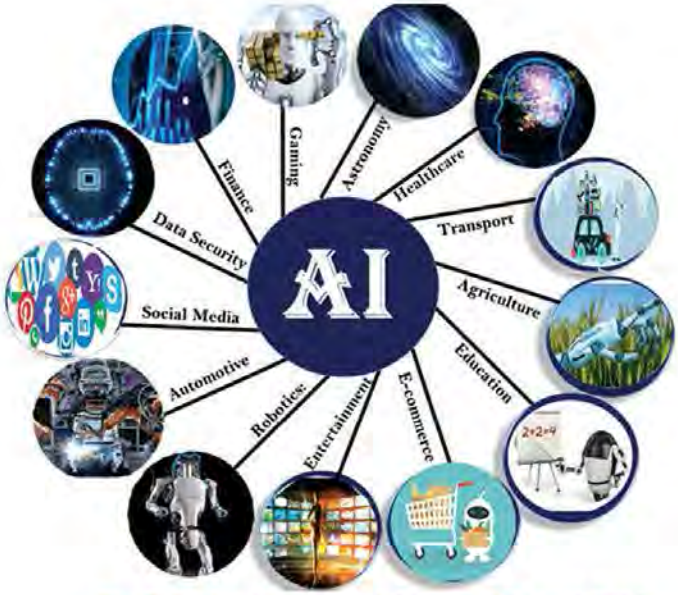


Fig 2.18 Application of AI in a different field

Application of AI

Artificial Intelligence has various applications in today's society. It is becoming essential for today's time because it can solve complex problems efficiently in multiple industries, such as healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and faster. Following are some sectors which have the application of Artificial Intelligence:

1. AI in Astronomy: Artificial Intelligence can be very useful to solve complex universe problems. AI technology can help us understand the universe such as how it works and its origin.

2. AI in Healthcare: In the last five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this field. Healthcare Industries are applying AI to make a better and faster diagnoses than humans. AI can help doctors with diagnoses and can inform them when patients are worsening so that medical help can reach the patient before anything happens.

3. AI in Gaming:Al can be used for gaming purposes. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

4. AI in Finance:AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.
5. AI in Data Security: The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world AI can be used to make your data safer and secure.
6. AI in Social Media: Social Media sites such as Facebook, Twitter, and Snap chat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyze lots of data to identify the latest trends, hashtags, and requirements of different users.
7. AI in Travel & Transport: Al is becoming highly demanding for travel industries. Al is capable of doing various travel-related works such as making travel arrangements to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interactions with customers for better and fast response.
8. Al in Robotics: Artificial Intelligence has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive tasks, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed. Humanoid Robots are the best examples of AI in robotics, recently intelligent Humanoid robots named Erica and Sophia have been developed which can talk and behave like humans.
9. AI in Agriculture: Agriculture is an area which requires various resources, labour, money, and time for the best result. Now a day's agriculture is becoming digital, and AI is emerging in this field. Agriculture is applying AI in agriculture robotics, crop monitoring and predictive analysis. AI in agriculture can be very helpful for farmers.
10. AI in Education: AI can alsobe used in the educational sector. AI chatbots can communicate with students as teaching assistants. AI in the future can work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

Cloud Computing

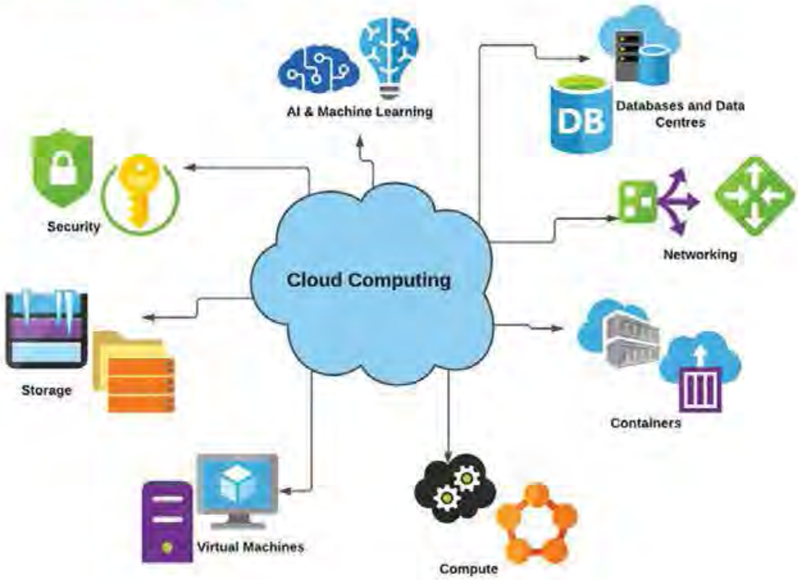


Fig 2.19 Cloud Computing

In the field of information and communication technology (ICT), cloud computing refers to the use of remote servers hosted on the internet to store, manage, and process data and applications, rather than relying on local servers or personal computers.

It is the latest technology based on the Internet. Instead of keeping various files on a hard drive or local storage device, cloud-based storage makes it possible to store them in a remote database. As long as an electronic device is within reach of the web, the data and software programs to operate it are accessible through cloud computing. Cloud computing has become a popular choice for people due to many reasons like cost savings, growth, speed, efficiency, performance and security. Cloud computing means that data or information stored in the cloud or virtual space can be viewed and used from anywhere. The companies that provide these computing services are called cloud service providers. Cloud computing services can be both public and private. Internet-based public cloud providers charge a fee for their services. On the other hand, private cloud services only provide services to a certain number of people. Generally, we charge for cloud computing services based on usage. Cloud service providers like

Datahub, Silver Lining, and Cloud Himalaya are working in Nepal.

Advantages of Cloud Computing

There are several advantages of cloud computing some of which are described below:

1. Cost-effectiveness:

Cloud computing eliminates the need for businesses to purchase and maintain their IT infrastructure, which can be very expensive. Instead, businesses only pay for the computing resources they actually use.

2. Accessibility:

Cloud computing allows users to access their data and applications from anywhere in the world, as long as they have an internet connection.

3. Reliability:

Cloud computing providers typically have redundant systems and backup measures in place, which means that businesses can be confident that their data will always be available.

4. Security:

Cloud computing providers often have better security measures in place than many businesses can afford to implement themselves, which means that data is typically more secure in the cloud than it is on-premises.

Project work

Search the internet to learn about using virtual reality in Nepal. Based on your research, create a PowerPoint presentation and present it to your class.

Exercise

1. Choose the best alternative:

(a) What is the main function of a set-top box (STB)?

i. Receiving the digital signal

ii. Displaying the television channel

iii. Decoding

iv. All of the above

(b) What is the fixed address of the website

i. www ii. URL

iii. wave browser iv. wave page

(c) Which type of cybercrime is related to Intimidation, defamation or any other form of mental degradation by using electronic means or modes such as social media?

i. Identity Theft ii. Cyberbullying

iii. Trade Secrets iv. Hacking

(d) What is the latest technology that can understand intelligence and human ability through the use of machines?

i. Robotics ii. Artificial Intelligence

iii. Virtual Reality iv. Google Plus

(e) In which category do digital signature falls which measures internet security?

i. Certification ii. Browser Selection

iii. email security iv. antivirus software

(f) Which of the following is an advantage of cloud computing?

i. Cloud migration ii. Global scale

iii. IT Governance iv. Unexpected Costs

2. Differentiate between:

a) Printers and Scanners

b) Search Engines and Websites

c) Virtual Reality (VR) and Artificial Intelligence

d) Computer Code of Conduct and Cyber Law

e) Robotic Humans and Humans

3. Answer the following questions:

a) What kind of technology is an ATM? Write its important functions.

b) Make a list of various parts of a photocopy machine.

c) What is a printer? Mention its function in brief.

d) What is a search engine? Illustrate the needfor search engines with examples.

e) Write the main features of ISP.

f) Mention the opportunities and benefits of social media.

g) What is cybercrime? What are the forms of cybercrime?

h) Mention the dangers of internet security and ways to avoid them.

i) What is computer ethics?

j) What is Artificial Intelligence? What is the main objective of artificial intelligence?

k) What is robotics? Mention some important tasks performed by robots.

l) What is meant by Virtual Reality? Write the various sector in which it is used.

m) What is cloud computing? Write down any two services provided by cloud computing.

n) Which is device is used to convert hard copy to soft copy?

o) What is a collective form of online communication channel dedicated to community-based interaction, content sharing and collaboration?

p) What is the act of shutting down or abusing a website or computer network by unethical means?

q) What is the name of the software program that makes copies from one computer to another?

r) What is the legal framework to combat cybercrime and harassment?

s) Write the full form of the following terms.

(i) ATM	(ii) www
(iii) URL	(iv)Wi-Fi
(v) ISP	(vi) AI
(vii) VR	

3 Living Beings and Their Structure

Let's observe the given figures and discuss on following questions:

Fig. 3.1

Questions:

a. According to Fig. 3.1, what may be the fundamental unit of the structure of living beings?
b. Can we classify living beings based onthe type and structure of the cells present in their body?
c. Is it possible to see all the organisms shown in fig. 3.1 with the naked eye?

There are different kinds of plants and animals on earth having microscopic to developed and large body size. Animals have usually a head, trunk, tail and limbs in their body and plants also usually have root, stem, leaves, flowers and fruits with them. Many small and microscopic organisms do not have such distinct organs or parts in their body. However, all the body parts of organisms are composed of very tiny and microscopic units called cells. With the very perfect coordination of the functions and placement of all these cells, different physiological and metabolic activities are continuously undergoing inside their body by which they are being able to survive. Living beings are classified into different groups and subgroups based on their body structure.

3.1 Cell

Let's discuss on the following questions about plant and animal cells:

a. Are all the cells found in the bodies of various species similar?

b. Do all types of cells perform a similarfunction?

The cell is thebasic unit of every life. The body of every organism,whether it is microscopic or gigantic, is composed of one or many cells. All the mechanisms of lifeprocesses like digestion, respiration, reproduction, internal transportation, photosynthesis etc are accomplished inside or by the action of these cells through biochemical reactions and contraction-relaxation motion. Because of these reasons, cells are also called the functional unit of life. Therefore, cells are structural as well as functional units of life. The branch of biology, that deals with the study of the cell is called Cytology.

Activity: 3.1

Take a leaf of water hyacinth or any floating plant. Make slices of the petiole of the leaf with a razor blade as thin as possible. Stain the cut slices in safranin for a few minutes and wash them thoroughly with clean water. Select one of the thinnest slice, put it on a clean slide, cover the specimen (the stained slice) with a drop of glycerin and finally with a coverslip.A cover slip should not have any air bubbles below. Now, our temporary slide of the petiole of the floating plant is ready. Observe the slide under a microscope. What may be these tiny roomsseen in the section? Are they the cells? Discuss the observation in the class.

Let's know

The cell was first discovered by Robert Hooke in 1665. He used the word 'Cellulae' for the small rooms seen in the thin slice of cork under the microscope developed himself, which meant 'tiny rooms' in Latin. He concluded that slices of the cork were composed of such tiny cellulae or cells. Later on, various experiments and studies by Theodor Schwann, Mattias Jakob Schleiden, Rudolf Virchow etc concluded that the body of all living organisms is built by the composition of one or many cells. When this conclusion was forwarded, cells are considered the fundamental (structural as well as functional) unit of life.

Ruber Hooke (18 July 1635-3 March 1703

3.1.1 Shape and Size of Cells

Observe the given figure and discuss the following questions:

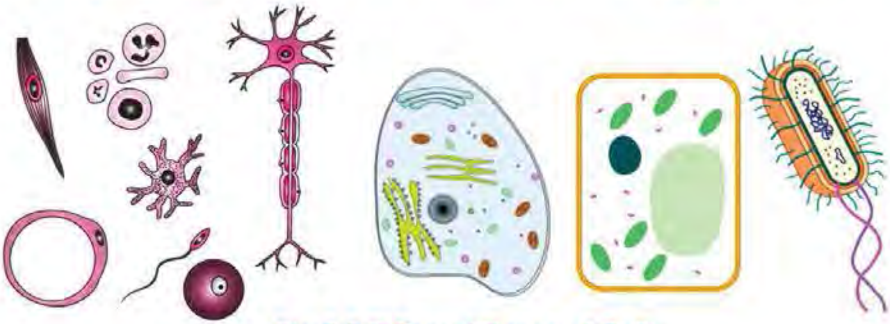


Fig 3.2 Different Types of Cells

a. What are the different shapes of the cells shown?

b. Are these all cells found in the same organism?

Cells are of different shapes and sizes. Generally, animal cells are irregular in shape. They may be oval, spherical, rod-like, elongated, cubical or columnar in shape. Nerve cells are threadlike thin and long but most of the muscular cells have spindle shapes. Plant cells are generally hexagonal. Bacterial cells have mainly four shapes: spherical, rod-like, filamentous and spiral. Most of the cells are too small to see with the naked eye but some cells are quite bigger also. Eggs laid by animals/birds are also single cells. In the present world, the cell of Mycoplasma (a kind of bacteria) is the smallest one having a size of only about 0.2 microns and the eggs laid by ostrich are the biggest cells having 15-18 cm in diameter.

Structure of Cell

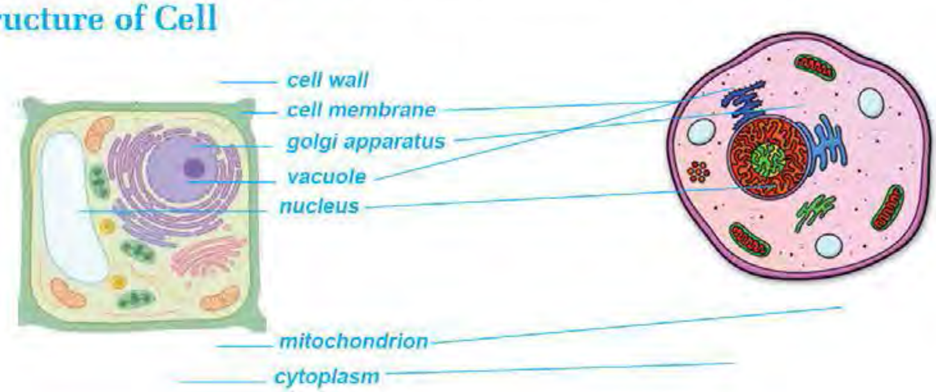


Fig. 3.3 Plant cell and Animal cell

A cell is composed of different parts. We can simply divide the part of cells into four groups: cell covering, cytoplasm, cell components and nucleus.

Activities 3.2 Observation of Onion Cells

Objective: To prepare and observe temporary slides of plant cells and draw a labelled diagram

Material required: An onion, a blade, a needle, a brush, a watch glass, forceps, a slide and a cover-slip, safranin, glycerin and a microscope.

Procedure

i. Take out a thin translucent peel of onion and make its small pieces with a blade.

ii. Place these small cut pieces of onion peel into the watch glass having safranin for staining with the brush.

iii. After a few minutes, wash the stained pieces thoroughly with clean water in another watch glass.

iv. Put a drop of glycerin in the middle of a clean slide.

v. Put a piece of stained peel into the drop of glycerin with the help of the needle carefully and make it flat gently.Put the coverslip over the specimen without any air bubbles trapped under it.

vi. Temporary slide is ready to observe under the microscope.

Fig. 3.4

Observation and Discussion

Observe the prepared slide under a microscope carefully. You will see many small cells within the specimen. Draw the figure of those cells in your practicalsheet that has to represent the shape, size, components and features of the cells and submitit to your teacher.

Note: Take a tomato peel, the outer translucent cover of a Zebrina leaf or the outer cover of Aloe Vera instead of the thin and translucent peel of an onion in the above activity.

Activities 3.3 Observation of Cheek-cells

Objective: To prepare and observe temporary slide of cheek-cells

Materials required: A toothpick, a slide and a coverslip, a needle, methylene blue, a clean solution of common salt, a dropper and a microscope

Caution: Never use a sharp and pointed needle of metal instead of a toothpick while scratching out cheek cells. This experiment should be performed under the supervision and guidance of your teacher.

Procedure

i. Scratch carefully the inner surface of your cheek with a clean and sterilized toothpick to get the tiny mass of cheek cells.

ii. Place a drop of 1% methylene blue and a drop of salt solution on the centre of a slide and place the mass of cheek cells in the mixture.

Fig. 3.5

iii. Gently cover the mass of cheek cells with a coverslip with the help of a needle to avoid air bubbles.

iv. Now, a temporary slide of cheek cells is ready for observation.

Observation and discussion

Observe the slide under a microscope and compare the shape, size and components of these cells with the cells seen in Activity 3.1. Draw a clear figure of cheek cells and submit it to your teacher.

Note: Instead of human cheek cells, one can have an inner thin layer of chicken skin from a butcher's shop.

Parts of a Cell

1. Covering of Cell

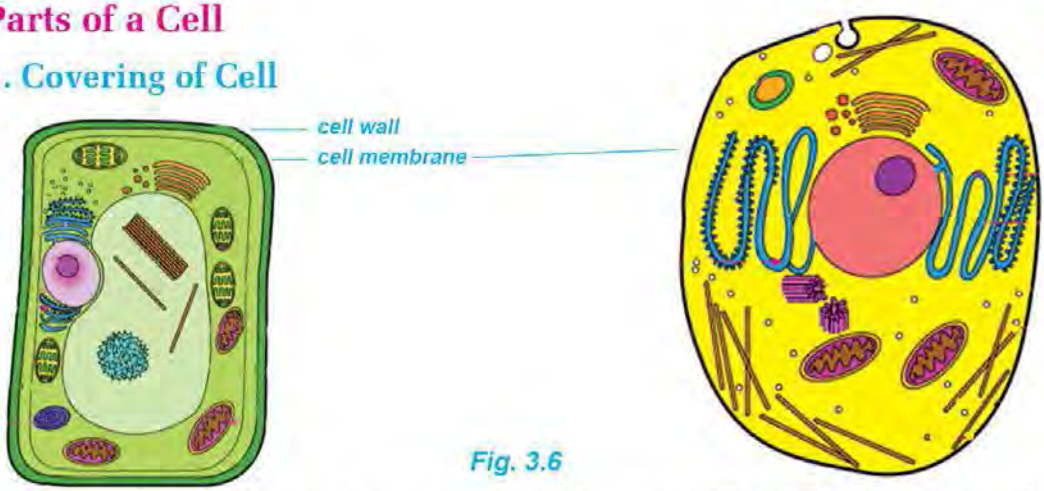


Fig. 3.6

The covering is the outermost layer of a cell. The cell wall and cell membrane are the coverings of cells. The cell wall is found only in bacterial, fungal and plant cells. It is absent in most of the Protozoans and animal cells. The cell wall is generallya tough, rough, semi-elastic and nonliving substance. The cell membrane (also called Plasma membrane) is found in all types of cells. In animals and most protozoans, the cell membrane is the outermost layer of their cells.But in bacterial, fungal and plant cells, it lies just beneath the cell wall. The cell membrane is comparatively much smoother and elastic than the cell wall and it is a living substance.

Functions of the cell wall and cell membrane

1. Cell wall provides mechanical support and fixed shape to the plant, bacterial and fungal cells.
2. Cell wall protects the cell from fungi, viruses and bacteria.
3. Cell wall presents at the roothairs of plants helps to absorb soluble minerals from soil and water.
4. Cell membrane controls and coordinates intercellular transportation of fluids as it is living and semi-permeable in nature.
5. In unicellular protozoans like amoeba, the cell membrane helps in making pseudopodia for capturing food and locomotion, excreting metabolic wastes and protecting the body from the external environment

2. Cytoplasm

There is a viscous, sticky and clear semi-liquid called cytoplasm. It is located in between the cell membrane and the nucleus of a living cell. Cytoplasm is composed of water, soluble salts, minerals, proteins, vitamins etc. Cytoplasmic components like ribosomes, plastids, mitochondria, Golgi-bodies, endoplasmic reticulum, vacuoles etc. are found in the cytoplasm.

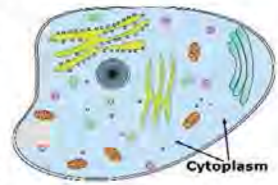


Fig. 3.7

Function of Cytoplasm

1. Metabolic activities of lifeprocesses are accomplished within the cytoplasm.
2. Cytoplasm helps to balance the amount of water and minerals in body organs.
3. Cytoplasm contains cell components like mitochondria, Golgi body, plastids etc.

3. Cell Components

Various functional sites inside a cell are called cell components. Cell components are of two types: Cell organelles and cell inclusions. Cell organelles are living sites and each of them performs specific metabolic activitieswhich are essential for lifeprocesses. There are different types of cell organelles and most of them are found in both plant and animal cells, whereas some are found in plant or animal cells only. Cell inclusions are non-living things present inside the cytoplasm. They are generally droplets of free water, crystals of salts and minerals, enzymes, hormones, vitamins and waste materials excreted by the cell. Cell inclusions act as raw materials and sources of energy generation which are used by various cell organelles for metabolic activities.

Some of the cell organelles are mentioned below:

Mitochondria (singular: mitochondrion)


Fig. 3.8

There are many mitochondrias in a cell. They are cylindricalor filamentous in shape and bound with a double membrane. The inner membrane is highly folded making zigzag spaces inside it where mitochondria conduct cellular respiration to generate energy. The energy generated by mitochondria is used by other cell organelles to carry out cell activities. Therefore, mitochondria act as 'power-houses' of cells without which cells cannot survive.

Mitochondria use glucose and oxygen to produce carbon dioxide, water and heat energy. Heat is utilized by the cell but carbon dioxide and water are excreted.

Function

1. The main function of mitochondria is to generate energy for the survival of the cell. In the presence of the mitochondrial enzymes, oxidation of glucose molecules continuously takes place inside mitochondria which generate plenty of heat energy. This heat energy is stored in ATP (adenosine triphosphate) molecules in the form of chemical energy and distributed to cell organelles where it is necessary.
2. Mitochondria also contain some DNA molecules which transfer hereditary character.

Plastid

Plastids are colourful organelles found only in plant cells, some bacterial cells and in some protozoans. Based on colour, plastids are of three types:

Fig. 3.9

A) Chloroplast

It is green-coloured plastid. It contains a green pigment called chlorophyll. Chloroplasts are generally round or oval in shape but in spirogyra, it is spiral ribbon shaped. Chloroplasts are bounded bya thin double membrane.

Function

1. Chloroplast makes plants green.
2. In the presence of sunlight, it conducts a photosynthesis reaction to make carbohydrates from carbon dioxide and water molecules. Carbohydrate is the basic nutrient for all organisms. All green plants are considered as 'Producers' in the ecosystem because of their food-making ability.

3. It helps to make fatty acids and amino acids in leafy vegetables.
4. Chloroplast contains DNA which helps in transferring hereditary characters.

B) Chromoplast

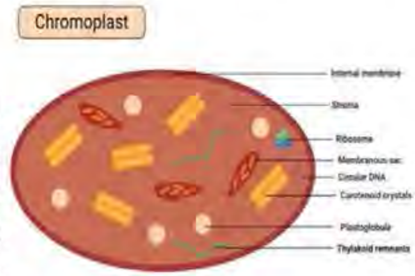


Fig. 3.10

Chromoplasts are all colourful plastids, except green. They are found in colourful parts of plants like flowers, ripen fruits, seeds and some leaves. Chromoplasts are somewhat flat in shape and they provide different colours to various parts of plants which directly helps in the pollination and dispersal of seeds.

Function

1. Chromoplasts make flowers colourful. The colour of the flower attracts insects and birds for pollination.
2. Colourful ripen fruits and seeds attract birds and animals to disperse seeds.

C. Leucoplast

Leucoplasts are colourless or white plastids which are oval in shape.They are found in the colourless or white part of plants like roots, white flesh of fruits and in the white part of cotyledon or endosperm of seeds.

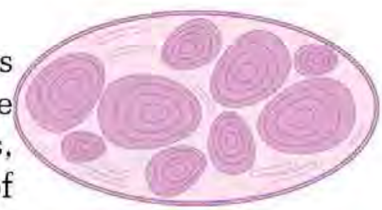


Fig. 3.11

Function

Leucoplast stores starch, protein and fat (lipids) for future use.

Ribosome

Ribosomes are very small in size and the only organelles in the cytoplasm withoutan outer membrane. They are found freely in the cytoplasm or attached tothe surface of the Endoplasmic reticulum. They are found in mitochondria and chloroplasts too. Like other organelles, ribosomes also have some DNA molecules.

Fig. 3.12

Function

1. They synthesize proteins from different amino acids. Therefore, ribosomes are also called protein factories.
2. They take part in gene expressiondue to the presence of DNA. Gene expression means DNA is active to make protein or RNA molecules suitable for the organism.

Endoplasmic Reticulum, ER

Fig. 3.13

The endoplasmic reticulum is a highly folded membranous organelle making zigzag canals from the nucleus to the cell membrane. Shortly, it is called ER. The inner surface of its canal is smooth but the outer surface of some ER looks granular due to the sticking of many ribosomes on it. The ER with ribosomesis called 'rough ER' and that without ribosomes is called 'smooth ER'.

Function

1. It makes a structural framework and provides mechanical support to the cell. Therefore, ER is also called the endoskeleton of the cell.
2. As ER contains many enzymes, it helps in the metabolism of the cell.
3. During celldivision, ER helps to make new cell membranes. It helps to construct the Golgi body in the cell.
4. ER actively takes part in the cellular transport system.

Golgi body

Fig. 3.14

Golgi body in cells was discovered by an Italian scientist Camillo Golgi in 1898, so the name is kept in honour of his name. This organelle looks like a bunch of bananas and is composed of layers of flattened membrane-enclosed sacs called 'cisternae' and some vesicles. The Golgi body is also called the Golgi apparatus.

Function

1. Golgi body helps to secrete gum, mucus, sweat, saliva, tear etc.
2. During cell division, the Golgi body contributes to making new cell membranes(in animal cells)and new cell-plate (in plant cells).
3. Golgi body also helps in the internal transportation of cells and sorting of proteins.

Lysosome


Fig. 3.15

Lysosome is a very small and round organelle with a single-layered membrane. It is found mainly in the cells of the liver, kidney, pancreas, spleen and some meristematic cells of the plant. Lysosome contains plenty of digestive enzymes.

Function

1. Lysosome produces a lysosomal enzyme which digests protein, lipid (fat), and glycogen (complex carbohydrate) to provide energy to the cell.
2. Lysosome also digests dead and fragmented cells to provide extra energy in animals. When the level of the lysosomal enzyme becomes high, the organelle itself is digested. For this self-digesting mechanism, lysosomes are also called suicidal bags.
3. During the germination of seeds, lysosome present in meristematic cells provides nutrients to the germinating embryo.

Vacuole

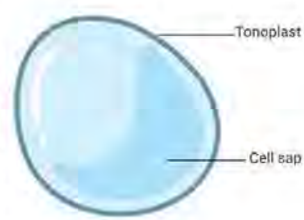


Fig. 3.16

Vacuole is not a true organelle but a space bounded by a tonoplast membrane which is generally filled with water, mineral salts and enzymes etc. These liquid substances in the vacuole are called 'cell-sap'. Vacuoles in animal cells are very small and in old plant cells are quite bigger. Cells of aquatic bacteria generally have air vacuole that helps themto float on the surface. Contractile vacuoles in protozoan cells contribute to intracellular transportation and food vacuole in amoeba stores, digests food and excretes wastes.

Function

1. Vacuoles balance the amount of water and salts in the cytoplasm.
2. It collects metabolic wastes of organelles before they are excreted out of the cell membrane.

Activity 3.4

Objective: To prepare models of an animal cell and a plant cell

Material required: Thermocol sheet, knife, colour pencils

Procedure

1. Take an appropriate sheet of thermocol.
2. Draw the layout of the plant cell and animal cell on the thermocol with colour pencils.
3. Carefully cut the thermocol with the knife or paper cutter to have the model of plant and animal cells as shown in the figure below.

Fig. 3.17 Model of animal and plant cell prepared by using thermocol

Discussion and Conclusion

Present your models of plant and animal cellsin your class, compare each other's models and write a conclusion about these cells.

Note:

If thermocol is not available, one can use locally available material like clay, hey, colourful threads, colourful clothes etc to prepare the model of plant and animal cells.

Project work

Observe the cell components carefully from the school's computer lab by using internet. Prepare power point slides and present it in your class.

4. Nucleus

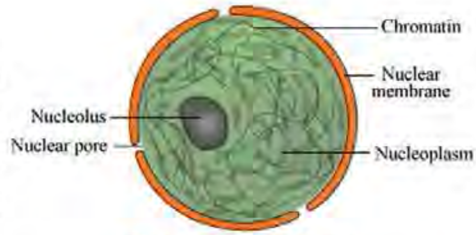


Fig. 3.18 Nucleus

The nucleus is the central part of a cell. It is round and enclosed by a double-layeredperforated membrane. The nucleus is found in most of the cells of eukaryotic organisms viz. plants, animals, protozoans and fungi. Bacteria are prokaryotic organisms and they have no distinct nucleus in them. They have only genetic material without any covering instead of a nucleus. Nucleus controls and coordinates the function of every cell organelle, so it is also called 'the brain of a cell'. A nucleus has mainly four parts:

1. Nuclear membrane
2. Nucleolus
3. Nucleoplasm
4. Chromatin fibres

Nuclear Membrane

The nuclear membrane is the outer covering of the nucleus which is composed of two perforated layers of lipid (fat) and protein. It is an elastic membrane and protects the nucleus. It allows the solution of various biochemicals to go in to and out of the nucleus. It also synthesizes antibiotics and enzymes.

Nucleolus

It is a round and non-membranous unit of the nucleus. It disappears during cell division and reappears after cell division It is composed of protein and RNA molecules and helps in cell division by assisting to make spindle fibres (which are used to pull chromosomes towards respective poles during a phase of cell division).

Nucleoplasm

The liquid solution of water, amino acids, minerals, nucleic acids and enzymes present inside a nucleus is called nucleoplasm. Nucleolus and chromatin fibres are scattered within the nucleoplasm. It assists the nucleus by balancing the amount of water, providing enzymes and synthesizing DNA and RNA molecules. Nucleoplasm gets all the necessary things from the cytoplasm outside the nucleus through many tiny holes in the nuclear membrane.

Chromatin Fibres

The complex network of ultra-thin, long and invisible thread-like structures is called chromatin fibres. They are the genetic material of the nucleus that control and coordinate all the function of the cell. Chromatin fibres are made of a super ultra-thin and long polymer of DNA molecules and histone protein. The number of chromatin fibres is fixed according to the species of organism. For example, every nucleus of a human cell has 23 pairs of chromatin fibres. Chromatin fibres transfer parents' genetic character to their offspring (children).

Chromatin fibres are changed into visible chromosomes during cell division. At that time they look thicker and shorter. After the completion of cell division, they are again changed into thin, long and invisible chromatin fibres.

Fig 3.19 cells and parts of nucleus seen in microscope

Function of Nucleus

1. All metabolic activity and internal transportation of the cell are controlled and coordinated by the nucleus.
2. It inherits (transfers) genetic character from parents to their offspring through reproduction.
3. During cell division, the nucleus itself takes part actively. First, it disappears and makes a pair of new nuclei.After the division of the nucleus,the cell is divided into two from the centre to have a nucleus in each newly formed cell.
4. Nucleus is directly involved in the reproduction process of unicellular organisms.

Activity 3.5

Observe a permanent slide of the cell under a high-power microscope and draw its labelled diagram. Show the labelled diagram to your teacher.

Comparision between plant and animal cell

Activity 3.6

Divide all students of your class into three groups named A, B and C and tell them to observe the permanent slides of plant and animal cells to find out the special features seen in the observation. Tell Group A to write the typical features found only in an animal cell, tell Group B to write a similar report on a Plant cell and tell Group C to write the common features found in both plant and animal cells. Fill the written features by all three groups on a chart paper, exhibit it in the class and conduct a discussion program.

Features found only in animal cell	Features found only in plant cell	Common features found in both animal and plant cell

3.2 Interrelationship among cell, tissue and organ in human body

Observe the given figure and discuss

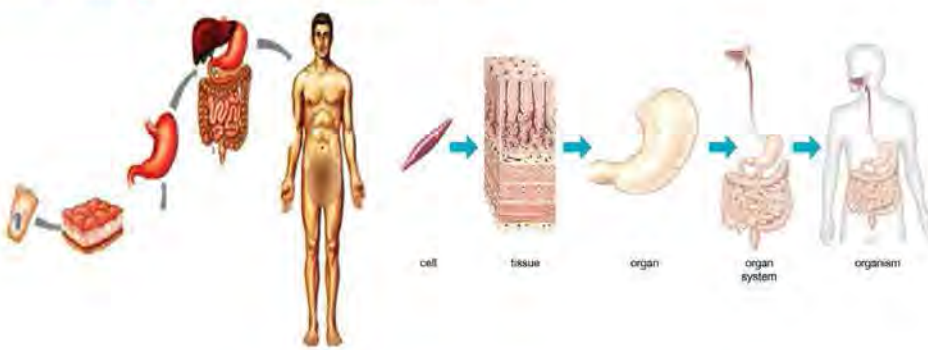


Fig 3.20 cell, tissue, organ, system and body

a. How is an organ formed as shown in the above figure?

b. Do cells help in the functioning of organs?

c. How is the whole body of human beings constructed?

The human body itself is a very complex creation of nature where different cells, tissues, organs and systems play a vital role to keep the body alive by conducting various metabolic activities smoothly. The human body has different types of cells. Tissues are formed from the combination of similar or dissimilar cells. Various tissues are combined at certain sites of the body to make a specific organ which has to perform one or more specific functions. Direct connection and coordination of different organs make an organ-system to perform a specific function. The connection and coordination of such organsystems make a complete functioning body. The task of digestion, respiration, reproduction, transportation, assimilation, excretion etc all begin from the functioning of one or many cells. It is the cell, that makes every tissue and begins every chemical, physical and physiological function of the body. For example, a muscle fibre is shown in the above figure from which muscular tissue in the body is formed.

Among the various organs of the digestive system, muscular tissue is found in the middle layer of the foodpipe, stomach and intestine. This tissue creates rhythmic contraction and relaxation of these organs by which the food inside them is gradually pushed behind. The digestive glands present on the inner wall of the stomach and intestine secrete various digestive enzymes to digest different nutrients present in the food we eat. It means that the muscular and glandular tissues of the digestive system are directly helping in the digestion of food at different sites of the digestive system. From this example, we can conclude that cells, tissues, organs and organsystems are interrelated to each other forthe construction and functioning of the body of organisms.

Exercise

1. Select the correct option from the followings:

a. What is called the branch of science that deals with the study of the cell?

i) Histology ii) Cytology

iii) Cytogenetics iv) Anatomy

b. In which form is the energy generated in a cell stored before it is distributed to organelles?

i) DNA ii) RNA

iii) RBC iv) ATP

c. What is the common feature of the nuclear membrane and cell membrane?

i. they help in internal transportation

ii. they are composed of Pectin

iii. they are non-elastic in nature

iv. they inherit heredity to offspring

d. What is indicated by 'R' in the given figure?

i) Nucleus ii) Chloroplast

iii) Mitochondrion iv) Vacuole

e. Which of the following function is done by both plant and animal cells?

i) Photosynthesis ii) Cellular respiration

iii) Transpiration iv) Guttation

f. What would happen if there was no cell membra

i) cell organelles would be lost ii) cellwould die

iii) cell couldn't conduct metabolism iv) nucleus would be lost

g. Which of the following is a function of the nucleus for the growth and development of the body?

i) to synthesize protein

ii) internal transportation of cell

iii) to take part in cell division

iv) to control and coordinate all the functions of cell

2. Differentiate:

a) Cytoplasm and Nucleoplasm

b) Chloroplast and Chromoplast

c) Cell wall and Cell membrane

d) Cell organelles and Cell inclusions

3. Give reason:

a) Ribosomes are also called 'protein factories.

b) Cell wall provides a fixed shape to plant cells.

c) Metabolism occurs in the cytoplasm

d) Cell is considered as the basic unit of life.

e) There should be proper coordination among cells, tissues and organs to conduct the life process.

4. Answer the following questions:

a) What is a cell?

b) Draw a labelled diagram of plant and animal cells.

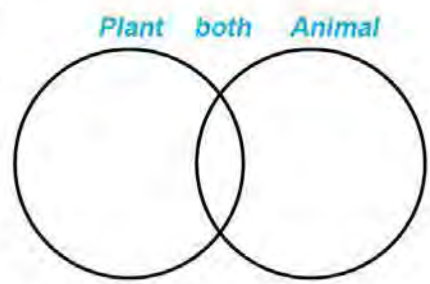
c) Where are the mitochondria located in a cell? Write their functions.

d) Which organelle of the cell undergoes self-digestion and why?

e) Make a list of cell organelles and cell inclusions found in a cell.

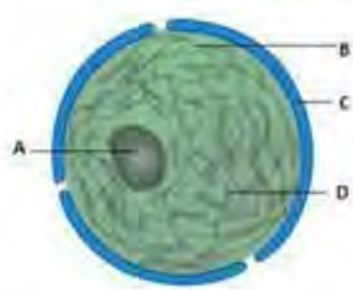
f) Mention the function of plastids in a plant cell.

g) Complete the Venn diagram by comparing plant and animal cells.



h) Mention the role of the Golgi body and Vacuole in a cell.

i) Study the given figure carefully and answer the following questions:



i) Copy this figure in your exercise book and label 'A', 'B', 'C', 'D'

ii) What is the function of 'B'?

iii) What happens if there is no nucleus in a cell?

j) Among various organelles of a cell, which one is the most important in your opinion and why?

k) What would happen in the plants' life processes if there were no chloroplasts in them?

l) What is the reason that the nucleus is also called 'the brain of cells'? Clarify.

m) If there were no metabolic processes in a cell, what effect would occur in the life processes of the organism?

Glossary:

Cork	:	Slightly conical lid of bottle or flask made of rubber or cork- cambium of certain plants' stem
Oxidation reaction	:	Process of generating heat energy in a cell by the decomposition of glucose molecules in the presence of oxygen
ATP	:	Adenosine triphosphate. Molecules that store the heat energy obtained from the oxidation of glucose in the form of chemical energy
Eukaryotes	:	Cells or organisms having developed nucleus
Prokaryotes	:	Cells or organisms having no distinct nucleus
Aleurone	:	Layer of single or multiple cells full of nutrition that encloses the endosperm of monocot seeds, especially grains
Cellular transportation	:	Movement of water, minerals and gases in and out of living cells.

3.3 Classification of living beings

Study the figure of given organisms and discuss:

mustard *Yarchagumba* *tortoise* *mushroom* *sunflower* *lizard*

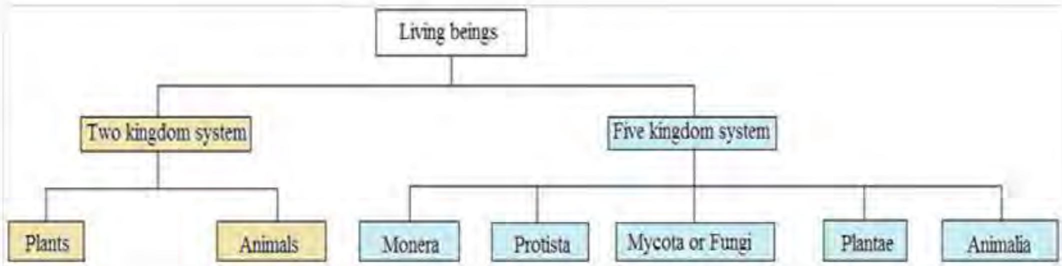
Fig 3.21

i. Make three pairs of living being from the given figure based on some common features.

ii. With which common feature, you made the pairs?

iii. What may be the differences between the organismswhich you made pairs?

There are many types of living beings on Earth. Every type of life has its typical characteristics with which it differs from other types of living beings. Living beings differ from each other by their habitat, mode of nutrition, type of reproduction they have adopted, physical structures etc. Though, living beings differ from each other in many aspects if we observe them carefully. We can also find some similarities between them. For example, a bat flies and a rabbit runs, but both of them give direct birth and feed babies their milk until they grow enough to take other solid food. Therefore, bats and rabbits can be kept in the same group called mammalia. In the same way, all known and discovered organisms are classified into different groups and subgroups. The objective of the classification of living beings is to make their study quite easy and systematic. Classification of living beings not only makes their study easier but also imparts knowledge about the trend of organic evolution on Earth. Living beings can be classified in different ways but there are mainly two systems to classify them. They are the 'Two kingdom system' and 'Five kingdom system'.



classification chart of living being

3.3.1 Two-Kingdom System of Classification

The two-kingdom classification system of organisms is proposed by Swedish biologist Carl (or, Carolos) Linnaeus in 1753. Based on structure and characters, he has classified all the organisms of the earth simply into two kingdoms: Plant and Animal. Therefore, this system of classification is called the two-kingdom system.

Basis of Two-Kingdom System Classification

The main basis of the two kingdom systems is nutrition, movement, growth and development of the body and the mode of reproduction. In general, movable, heterotrophic modes of nutrition and limited growth of the body up to a certain phase of lifespan are the basis to keep any organism in the animal kingdom. Similarly, non-movable organisms with the autotrophic mode of nutrition and unlimited growth throughout life are kept under the plant kingdom.

Special Features of Two-Kingdom System

1. All living beings are divided into plant and animal kingdoms.
2. This is the first scientific system of classification of living beings.
3. It is simple by which plants and animals can easily be distinguished.

Drawbacks of Two-Kingdom System

1. The living beings which cannot conduct photosynthesis also kept in the same section of plant kingdom. For example, algae and fungi both are kept in the plant kingdom.

2. Prokaryotic bacteria and Eukaryotic algae are kept in the same kingdom.
3. Two kingdom system does not separate unicellular and multicellular organisms.
4. Two kingdom system is not able to include organisms like Lichens.

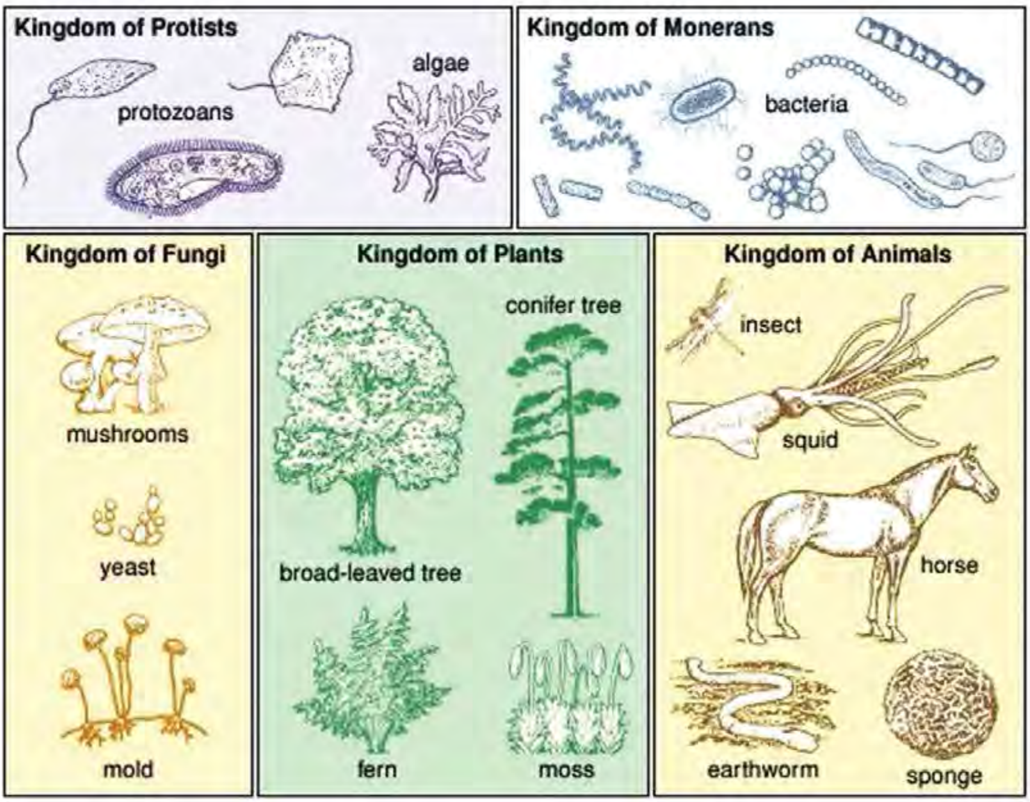


Fig 3.22. Organism in five Kingdom System

After 234 years, by improving the drawbacks of the two-kingdom system, an American ecologist R.H. Whittaker proposed a five-kingdom system in 1969. His classification is based upon certain characteristics of the organism like mode of nutrition, thallus organization, cell structure, phylogenetic relationships and mode of reproduction. He has proposed five kingdoms asMonera, Protista, Mycota or Fungi, Plantae and Animalia.

Basis of Five Kingdom System Classification

Based on types of cell (prokaryotic or eukaryotic), body structure (unicellular or multicellular), mode of nutrition (autotrophic or heterotrophic), role in the ecosystem (either producer or consumer or decomposer) and phylogenetic relationship (trend of evolution from least developed to more developed), Whittaker has divided all the known organisms into five kingdoms. Here, all unicellular prokaryotes like archaea, mycoplasma, and bacteria are kept under the kingdom Monera. All unicellular eukaryotes except free-living fungal cells are kept under the kingdom Protista.All saprophytic (that feeds on dead bodies) and parasitic fungi that exhibit extracellular digestion are kept under the kingdom Fungi or Mycota.All autotrophic green organisms are kept under the kingdom Plantae and multicellular eukaryotic consumers are kept under the kingdom Animalia.

Special Features of Five Kingdom System

1. Unicellular and multicellular organisms are kept in separate kingdoms.
2. Prokaryotes and eukaryotes are also separated.
3. Autotrophic and heterotrophic organisms are kept in Plantae, Animalia and Mycota kingdoms respectively.
4. In this system organisms are arranged in sequential form from least developed to more developed which also refers to the trend of organic evolution.

Activity 3.7

Collect 20 different organisms or their photograph from your surrounding environment and place them in the given table. Also, discuss the reason for their classification.

Two kingdom system		**Five kingdom system**				
Plant	Animal	Monera	Protista	Fungi	Plantae	Animalia

3.4 Microorganism

Activity 3.8

Take an egg. Break a part of it at a side andleave it in a beaker for some days. After a few days, observe the changes that occurred in the egg. Why did it happen? Discuss with your classmates and try to conclude the reason.

There are many types of organisms in our surroundings. Some of them are too small to see with the naked eye. These microscopic organisms are found in air, water, soil, unsaved food, dirt and on/in the body of living dead and decaying organisms. They are called microorganisms and have direct and indirect influenceson our daily life.

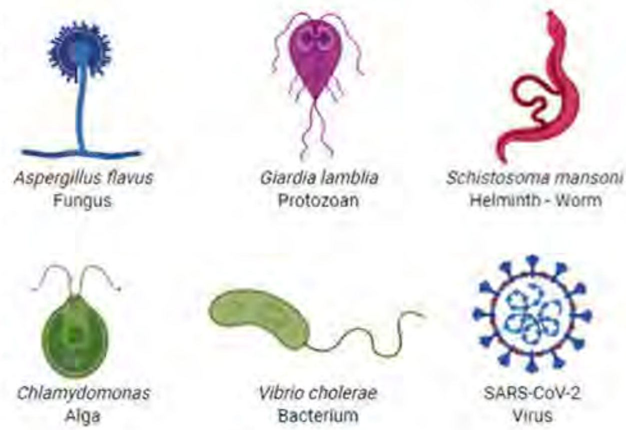


Fig 3.23

For example, in the above case, the broken egg has decayed and become smelly due to the action of some microorganisms. Bacteria, some fungi (yeast, slime mold), some algae (Chlamydomonas, chlorella) and protozoans (amoeba, paramecium, plasmodium, vorticella) etc are some examples of microorganisms. Microorganisms are commonly called 'germs' or 'microbes'. The branch of biology that deals with the study of microorganisms is called microbiology.

Practical Work 3.3

Observe the permanent slides of microorganisms like an amoeba, paramecium, yeast etc. in the lab and prepare short notes about their characters with a diagram and submitthem to your subject teacher.

Activity 3.9

Prepare power-point slides of microorganisms like viruses, bacteria, amoeba and fungi about their structure, size, habitat, mode of reproduction and their importance for the environmentby visiting the computer lab and present in your class for discussion.

(A) Virus

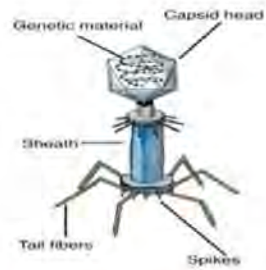


Fig. 3.24 bacteria

Viruses are the smallest germs that can infect plants, animals, bacteria, fungi and any other microorganism including other viruses too.The meaning of its name is taken as a 'molecule of poison'. The virus is not an actual organism because it has no cell (acellular)therefore it does not belong to any kingdom. The body of a virus consists only of nucleic acid (DNA or RNA) which is enclosed in a protein case called a capsid. Some viruses have an extra outer covering called an envelope. It may have various shapes and sizes. The virus shows the characteristics of both living and non-living things, therefore called a 'bridge or link organism'. When a virus is inside the living host cell, it behaves as living and when it is in an external environment, it behaves as a non-living thing. Inside a host cell, a virus can increase its number by using the biomolecules of the host cell damaging it, therefore they are also called 'obligatory parasites'. Viruses are found everywhere in the air, water, soil etc. Viruses do not eat, drink or breathe, therefore, there is no metabolism inside them. Rhinovirus, Coronavirus, Tobacco mosaic virus, Bacteriophage, Virophase etc, are some examples of the virus.

(B) Bacteria

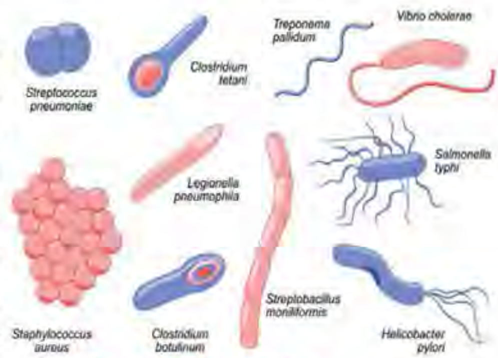


Fig. 3.25 bacteria

Bacteria are unicellular prokaryotes and therefore belong to the kingdom Monera. The bacterial cell may be spherical, filamentous, cylindrical etc. Bacteria can be found in all environments i.e. air, water, soil, in and on the body of other organisms. Some of them are found in extremely hot and cold environment too. Their body is enclosed within a tough covering called a capsule which helps them to tolerate such extreme environment. Some bacteria are autotrophic but most of them are saprophytic because of which they play the role of decomposersfor the ecosystem.

Some bacteria are parasitic and causevarious diseases to plants and animals. Cyanobacteria, Rhizobium, Salmonella, Azotobacter and Pseudomonas are some examples of bacteria.

(C) Amoeba

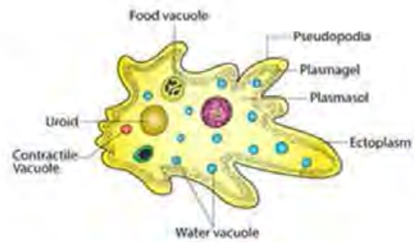


Fig. 3.26 Amoeba

Amoeba is an example of a unicellular eukaryote. It is found in water, moist soil, decaying organic substances and the body of host organisms. It has no fixed shape as it can protrude pseudopodia from any point of its cell membrane. It moves, swims, and captures food with the help of temporary pseudopodia. The process of digestion, excretion, reproduction etc is done by its single cell. Amoeba is of various types. Entamoeba histolytica is a type of amoeba which lives in contaminated water and causes Amoebiasis dysentery if enters into the intestine of host animals. Naegleria is another example, which lives freely in water but can infect animals if drunk such water.

(D) Fungi

Fig. 3.27 Fungi

Unicellular or multicellular eukaryotic organisms having cell wallbut no chlorophyll are called fungi and they are kept under the kingdom Mycota. Fungi usually grow on dead and decaying substances and get nutrition from there, therefore they are also called saprophytes. Some fungi are parasitic and they infect plants and animals to cause fungal diseases. Their body is composed of very thin thread-like mycelia (singular mycelium). Mucor, mushroom, yeast, yarchagumba (Cordyceps), penicillium, Puccinia (plant rust) etc. are some examples of fungi.

Activity 3.10

Objective: To prepare a temporary slide of mucor

Required material: a piece of bread, a glass slide, a cover-slip, cotton blue (staining agent), a brush, a beaker, water, watch glass, and a microscope

Procedure

1. Soak the piece of bread in water and leave it for a few days in the lab keeping it in a watch glass. After a few days, mucor is grown in the bread.
2. Place a drop of cotton blue in the middle of the slide and put some mycelia of mucor in the drop of the cotton blue. Cover the mycelia with a coverslip with no air bubble trapped. A temporary slide of mycelia of mucor is now ready to observe under the microscope.

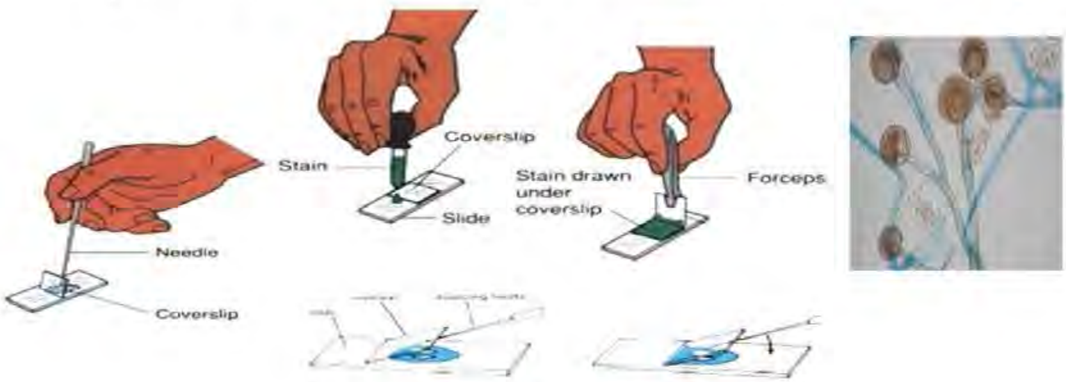


Fig 3.28

Observation and Discussion

Now observe the slide under the microscope and prepare a 'practical sheet' with appropriate drawings and characters to show to your teacher.

3.4.1 Effects of Microorganisms

Positive Effects

1. Some amoeba, like Amoeba proteus feed on bacteria, so they are used to control bacteria.

2. Most of the bacteria are decomposers. They decompose excreta and the dead body of organisms. While decomposing, they convert complex organic molecules into simple inorganic molecules/minerals which increases the fertility of the soil. By this, bacteria are helping to keep the ecosystem in balance. Nitrosomonas, Clostridium, and Nitrobacter are some examples of decomposing bacteria.

3. Rhizobium bacteria present in the rootnodules of leguminous plants absorb atmospheric nitrogen and make nitrate which increases the fertility of the soil and agricultural productivity.

4. Lactobacillus and Lactococcus are the bacteria found in milk and help to convert milk into yoghurt. Streptococcus lactis bacteria are used in producing cheese from milk.

5. To develop the products of medical science like insulin (hormone), antibiotics, vaccines, vitamins, antiseptics, antiserum etc, bacteria and fungi are used.

6. Yeast (a fungus) can convert carbohydrates and protein present in foodstuffs into acetic acid and alcohol. This process is called fermentation. Distilleries use yeast to ferment foodstuffs to produce alcohol and acids.

7. Nepalese use yeast to produce alcohol and to prepare pickles, Gundruk (fermented veggies) etc on a domestic scale.

8. Bacteriophage virus can kill bacteria. Because of this reason, this virus can be used to control some bacterial diseases like plague, dysentery, diarrhoea etc. and in the treatment of water.

9. In genetic engineering, many viruses are being used to replace, transfer, repair, and synthesis of genes to develop high-yielding plants and animals.

10. Virus is the link between living and non-living things, its study has great significance to understand the origin of lives and the trend of their gradual evolution.

(B) Negative Effects

1. The causative agents of most communicable diseases are microorganisms. They can spread disease to all types of plants and animals. Disease decreases the quality and productivity in every sector of agriculture like farming, fish-farming, sericulture, apiculture, horticulture, animal husbandry, nursery etc. Tuberculosis, AIDs, Pneumonia, typhoid, Covid, etc are spread due to these microorganisms. Tobacco mosaic, common blight, and root rotting-like plant diseases are also due to the infection of any one of these microorganisms.

2. Fruits, vegetables, cooked food etc. start smelling and decaying if kept unprotected for some hours or days in an open environment. Microorganisms like Clostridium bacteria enter into such food through air, water or any medium and make the toxic substance. If such contaminated food is consumed then the person will sufferfromdiarrhoea, vomiting, fever, dehydration, dry mouth (xerostomia), headache etc. Such conditions due to contaminated food are called foodpoisoning. Clostridium, Norovirus, Salmonella, Giardia, and Mucor-like microorganisms cause foodpoisoning.

3. Occurrence of pimples and abscessesof wounds is all due to infection by harmful microorganisms. If the toxin produced by the infecting microorganisms once enters the bloodstream, sepsis at different sites of internal organs may occur to make them fail and most probably kill the victim. To be safe from such terrible conditions, wounds and pimples should be kept clean with a gauge soaked in an appropriate antiseptic like Dettol/betadine/savlon, dress the wound timely, use prescribed antibiotics and be careful in personal hygiene.

4. Microorganisms cause the spoiling of stored cereals, vegetables, and other foodstuffs due to which farmers/owners have to bear the great loss.

5. By the action of microorganisms on disposed organic wastes at dumping sites, foul smell spreads which pollutesthe surrounding environment.

3.4.2 Methods of food preservation

Observe the given figure and discuss the following questions:

Fig 3.29

a) Before storing, why are cereals dried enough in sun?

b) Why are lemons dipped in salt and oil?

c) Why is Gundruk dried in sun? What happens if it is not done so?

In daily life, different kinds of foodstuff are preserved with a different methods to be used for a long time. With preservation, the nutritional value of the foodstuffs can be conserved and they can be kept safe from infectious microorganisms. The nutritional value of food can be conserved by avoiding decomposition reactions among the molecules of nutrients and blocking the entry of microorganisms. To do this, a suitable physical and chemical environment should be provided for the foodstuffs. Protecting from infectious microorganisms and conserving the nutritional value of food is called food preservation. Some methods of food preservation are mentioned as follows:

1. Dry Preservation

Using a certain temperature and maintaining certain moisture, the drying of foodstuff before storing is called dry preservation. It is a very easy and cheap method. Because of dryness, microorganisms cannot affect them and due to certain moisture (very less) the nutritional value of food is maintained and they can be stored at room temperature for a long time (months or even years). In our country, people are using this technique for a very long time to preserve cereals, dry meat, dry fish, dry fruits, nuts, dry veggies, fermented veggies etc. This technique prefers a moderate temperature between 20°-30° Celsius for some days either in sun or in an oven or electric dryer until they are completely dry externally and keep very less moisture internally.

2. Wet Preservation

Preservation of foodstuffs by dipping in certain liquids which can block the entry of infectious microorganisms is known as wet preservation. To avoid microorganisms, the foodstuffs must be germs-free themselves and to do this, they must be washed or boiled and dried well before dipping into a preferred liquid. Generally, concentrated salt solution, citric acid (juice of any citrus fruit), vinegar, mustard or olive oil etc are used in wet preservation. The vessels must be lidded airtight to avoid the entry of germs/spores through the air to keep the foodstuffs inside safe. In Nepal, pickles of lemon, chilly, ginger, garlic, fenugreek (Methi), radish, bamboo shoot (Tama) etc are stored using the wet preservation method since ancient times.

3. Cold Preservation

Preserving food by keeping them in closed cabins or rooms with very low temperatures (generally -18o to 4.4o Celsius) is called cold preservation. Most of the infectious microorganisms will be completely passive or killed under this range of temperature. Keeping raw or cooked food in fridges in the kitchen or storinga mass of raw vegetables and fruits in coldstores for months are some examples of cold preservation. Preserving some of the agricultural production like potato, ginger, turmeric, squash (Skuss), fresh paddy etc in the dry and well-covered pit for future use is still in practice.

Fig 3.30

Project work

Perform an awareness program in your community with the help and active participation of the representatives from the ward office, schools, public health,office etc. to prevent various epidemics and pandemic diseases like Covid-19, Dengue, Cholera, and Typhoid. Prepare a report of findings from the program in the given format and publish your report in school in the presence of teachers, guardians, health workers and local people.

Diseases	affected population	Symtom of Diseases	General effect of Diseases	Serious effect of Diseases	Prevention programme	awarness activities

Glossary:

Chemosynthesis : Food-making process by some bacteria using their chemicals.

Metabolism : Chemical reaction inside living cells to keep the cell alive.

Exercise

1. Select the best answer from the given alternatives:

   (a) Who proposed the 'Two kingdom system' of classification?

   i) Whittaker ii) Haeckel iii) Linnaeus iv) Aristotle

   (b) To which kingdom do protozoans belong according to the 'Five Kingdom system'?

   i) monera ii) protista iii) mycota iv) animalia

   (c) Why are bacteria called decomposers?

   i) t hey cause diseases

   iii) they survive in extreme environment

   ii) they infect wounds

   iv) they decay dead bodies and excreta of organisms

   (d) Which virus causes COVID-19 ?

   i) SARS CoV-1 ii) SARS CoV-2

   iii) Corona virus iv) Flu virus

(e) What is the main thing to be followed while preserving foodstuffs?

i) to prevent germs iii) to prevent from decaying of food

ii) drying well iv) keeping cold

(f) Which of the given is a feature of the 'Five Kingdom system'?

i) Classified according to phylogenetic order.

ii) Classified based onthe mode of nutrition and lifecycle.

iii) Classified based on chlorophyll and growth.

iv) Classified based onthe movement of the body.

(g) What should be done to preserve fresh and wet Gundruk (fermented veggies)?

i) It should be dried extremely in sun.

ii) It should be dried in shadow.

iii) It should be dried maintaining the required percentage of moisture.

iv) It should be kept airtight in a bottle or a can.

2. Differentiate :

(a) Bacteria and Virus

(b) Two kingdom system and Five kingdom system

3. Give Reason :

(a) Virus is called a very small infectious particle but not an organism.

(b) We should not consume stale and smelly food.

(c) Five kingdom system has provided an appropriate position to almost all organisms.

(d) Fruits do not get spoiled if preserved after drying well.

4. Answer the following questions :

(a) What is a microorganism? Give an example from each category.

(b) What are the methods of food preservation? Describe any one method and also mention the importance of food preservation.

(c) What is foodpoisoning? Mention its causes and the measures to be safe from it.

(d) Why is the Five Kingdom System more advanced than the Two Kingdom System?

(e) Make a list of any two diseases caused by each category of microorganism.

(f) What are the common words for microorganisms?

(g) What is Classification? How does classification make the study of organisms easier?

(h) Write any four advantages of microorganisms.

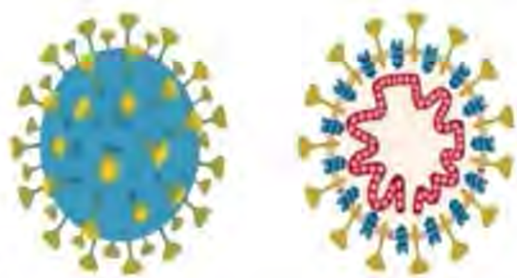
(i) Mention the merits and drawbacks of the Two kingdom system.

(j) Mention the basis and features of the Five Kingdom system.

(k) Study the given figure and answer the following questions :

i) What are shown in the figure?

ii) Name a disease caused by it and two preventive measures for the disease.



(l) Two kingdoms system has not differentiated prokaryotes and eukaryotes, how is this corrected by Five kingdom system? Describe in brief.

(m) How is amoeba being used by mankind for beneficiary purposes?

(n) Fungus sometimes grows in pickles kept in a bottle or jar. Why does it happen? What should be done to protect pickles from fungal attacks?

4 Biodiversity and Environment

Observe the given figure and have a discussion.

Fig 4.1

Questions:

1. Is the physical environment in the first figure suitable for a rhino? If yes, why? If not, what kind of environment would be suitable for them?
2. In the second figure, people are collecting fodder and firewood from the forest. What consequences may occur to the surrounding environment when people collect such things in excess quantity?
3. Which system of farming is shown in the third figure? What are the advantages of adopting this system in hilly regions?
4. What may be the reason for collapsing a part of the road shown in the fourth figure? What may be the permanent solution to such incidences?

Many types of organisms are found on the earth. Every type of them has its typical characteristics that make them different from other organisms. But every organism is interrelated with each other for their existence. Differences seen in physical appearance, habitat, and the mechanism of lifeprocesses of various organisms represent the natural biodiversity. Living things are acquiring their every need from the surrounding environment. Whatever things and services are being obtained by human beings and other organisms from the environment is the Service of the Ecosystem.

For example, people are getting fodder and firewood, fruits and medicines, timber, water etc.from the forest. These are the services of the ecosystem to living beings. Excessive use of such services of the ecosystem harms their sources and they won't sustain for a long time. Therefore, the wise use of these services and their conservation while conducting any social, economic, cultural and developmental project helps their sustainability and balancing environment.

4.1 Biodiversity

Study the given figure and discuss it with your classmates:

Fig 4.2

i) Are all monkeys shown in the above figure have the same characteristics? If not, what may be the reason?

ii) Do all these monkeys live in similar habitats?

iii) Which characters of rhino, monkey, tiger and deer are similar and which are different?

iv) What is indicated by the variation found in different living beings?

There are varieties of organisms having different habits and habitats on Earth. Different types of organisms have different characteristics from each other and they live in different habitats. Varieties found in different organism of different habitats is called biodiversity. Organisms found in water, desert, cold climate, tropical (hot and moist) climate etc. have different body structures and physical characteristics. There is some variation among the individuals of the same species too. For example, height, girth, number and length of leaves, position and number of the ear of maize plants on the same farmland are also not the same. Different organisms exist in different environments with different physical structures and abilities is called biodiversity. Biodiversity indicates the 'species richness' of the earth.

According to the 'Earth Summit' held in 1992 in Rio de Janeiro (Brazil), biodiversity can be defined as the variations among organisms of the same or different varieties regarding their genus, species and habitat or the ecosystem to which they belong.

According to Convention on Biological Diversity -CBD, biodiversity is defined as the variation among aquatic and terrestrial organisms.

Activity 4.1

Objective: To study the biodiversity of grassland.

Material required: Measuring tape, nails, cord or rope, plastic bags, scissors.

Procedure

1. Make a square on grassland with the help of measuring tape and hoist four nails at four corners.
2. Tie the cord or rope around the four nails to declare a 1m2 area.
3. Now the square quadrate sampling on grassland for the study of biodiversity is ready.

Fig 4.3 Quadrat sampling

Observation and discussion

Collect every single plant and animal that is grown or found within the area of quadrate sampling and keep them in separate plastic bags. After clearing the quadrate sampling area, count the collected plants and animals separately, fillup the given chart and present it to your subject teacher.

Plants		**Animals**	**living beings found in the highest number**
Name	Number	Name	Number
crabgrass	12	grasshopper	4
....	....	....	....
....	....	....	....

Types of Biodiversity

Plants and animals fall under living beings. Therefore, biodiversity simply means the diversity in plants (floral diversity) and animals (faunal diversity). Varieties of plants found in a certain environment are the floral diversity and the different types of animals living there is faunal diversity. For example, all plants grown in a pond or lake are floral diversity and the animals in the water or near the water represent faunal diversity. Based on nature of existence, biodiversity can be divided into three disciplines:

(a) Genetic diversity (b) Species diversity

(c) Ecosystem diversity

(a) Genetic diversity

Genetic diversity simply refers to the variation among the individuals of same or different species. Genetic diversity is due to some variation in the structure and composition of genes. It is common to find different characters among the individuals of different species (for example, the differences between crows and cuckoos, tigers and lions etc.), but within the same species too, several differences can be pointed out. All humans of the present world belong to the same species, i.e. Homo sapiens, but we can observe many variations among them including structure and colour of hair, skin, eye; body height, the structure of eye-lid and eyebrow, hair pattern, the shape of the nose, density of body hair etc.

(b) Species diversity

Species diversity refers to the number and type of species living in a certain environment. It helps to count the number of species at a certain place. For example, different types of producers, herbivores, omnivores and carnivores are found in an ecosystem. Each such category has a vast variety among them. All frogs belong to the genus 'Rana' which alone has more than ten different species and they all havetheir distinct characteristics.

(c) Ecosystem diversity

Ecosystems are of two types, aquatic and terrestrial. According to climatic conditions, there are various subtypes of them. The terrestrial or land ecosystem of tropical climate and alpine climate differs in many aspects. Producers, herbivores, omnivores, carnivores and decomposers of these ecosystems exhibit so many differences in various aspects. Interaction between the organisms of closely located two or more different ecosystems brings further complexities in their structure. The variety of ecosystems based on physical components like air, water, minerals, temperature, intensity of light and a wide variety of local and migrant organisms in them is called ecosystem diversity.

Importance of Biodiversity

The physical and biological environment of a place sustains in balanced condition only if it is rich in biodiversity. Organisms are freer and more independent in a balanced and species-rich environment and they can easily fulfil their need for habitat, nutrition, reproduction etc. This shows the importance of biodiversity for every individual. Some importance of biodiversity can be listed as follows:

a. Biodiversity guarantees the nutrition and livelihood of every organism.

b. Biodiversity helps to keep the environment in balanced condition and increases the productivity of the ecosystem.

c. Biodiversity helps the sustainable use of biological resources.

d. Biodiversity helps in the conservation of the environment and sustainable development.

e. Biodiversity enhances ecotourism and uplifts the nation's economy.

f. Biodiversity helps individuals to adapt even in adverse conditions like thevarious consequences of climate change.

Present Status of Biodiversity in Nepal

Although Nepal occupies only 0.1% area of the world's area, it is very rich in biodiversity due to its varied altitude which ranges from the lowest 59 m to 8884 m from sealevel. Nepal has a tropical to alpine climate with mineral-rich fertile soil. Nepal receives plenty of rainfall during summer and winter monsoons as well. Because of all these reasons, there are so many varieties of microbes, fungi, plants, worms and insects, fishes, amphibians, reptiles, birds and mammals.

Regarding biodiversity, Nepal stands on the world's 27th, Asia's 10th and south-Asia's 2nd position. Nepal keeps the world's 3.2% plant and 1.1% animal variety. There are more than 118 types of ecosystem sand more than 15 types of forests in Nepal.

Some very peculiar and rare plants and animals are found only in Nepal. Spiny babbler (Turdoides nipalensis) is found only in Nepal inthe mid-hilly region; the One-horned rhino and Bengal tiger of the Terai region and Himalayan Wild Yak which are very rare animals are found here. The occurrence of 32 species of rhododendron and native Marsi rice of Jumla which grows at the world's highest altitude (3050 m) are some examples of the species-rich biodiversity of Nepal.

Table: 4.1 Some important flora of Nepal

Plant group	In world	In Nepal	Percentage of Nepal
Lichens	more than 17,000	850	5
Algae	56,579	1,001	1.76
Fungi	98,998	2,467	2.45
Bryophytes	16,236	1,213	7.47
Pteridophytes	12,000	580	4.83
Gymnosperms	1,021	41	4
Angiosperms	369,400	6,973	1.87

Table: 4.2 Some important fauna of Nepal

Animal group	In world	In Nepal	Percentage of Nepal
Mammals	more than 4,765	185	3.96
Birds	9,799	886	8.90
Reptiles	more than 7,870	78	0.99
Amphibians	more than 4,780	118	2.47
Fishes	10,000	187	1.87
Butterfly	17,500	651	3.27
Spiders	39,490	175	0.44




Tiger Kade Vyakur Rhododendron Chyriya saal

Fig 4.4

Activity 4.2

Visit a place near your school which is rich in biodiversity and make a list of observed animals and plants. Prepare a visit report and submit it to your subject teacher including 'objective, introduction of the visited site, materials required, observation, discussion and conclusion'.

Causes of Biodiversity Degradation

Look at the figure below and discuss the issue.

Fig. 4.5 Grazing

(a) What consequences may occur due to excessive grazing in forest areas?

World's entire ecosystem and biodiversity are getting ruined due to natural calamities and irrational human activities. Improper urbanization, industrialization, mining of rocks-minerals-ores, constructions and agricultural activities are gradually causing deforestation, erosion, and desertification of land affecting the world's climate and entire wild lives. Because of all these reasons, many wild lives are on the verge of extinction and some of them are already extinct. For example, the snow leopard of Nepal is on the verge of extinction and the pigmy hog (dwarf wild boar) is already extinct. Declination of the number and types of different plants and wild lives because of over impact in their life-cycle due to natural calamities and human activities is called biodiversity degradation. The main causes of biodiversity degradation are as follows:

(a) Excessive grazing in natural forests leads to damaged seeds and seedlings, decelerates the growth and production of new plants and finally the decline of forests.
(b) Level of chemical pollution increases due to excessive industrialization which adversely affects the biodiversity of the surrounding environment.
(c) Improper mining and blasting of rocks and minerals cause sound pollution, landslides and soil erosion due to which many plants and wild lives will be affected.
(d) Construction of roads, buildings, dams, bridges etc.without proper planning can harm the habitat of many wild lives.
(e) Collecting excessive fodders and firewood leads to deforestation and affects the sources of water.
(f) Declaring jungle to get land for farming and residency to meet the demand of increasing population decreases forest area and valuable species.
(g) Forestfire kills many wild lives and plants.
(h) Floods and landslides also destroy many plants and wild lives.
(i) Global warming due to climate change is affecting the livelihood of many plants and animals.
(j) Illegal trade and poaching of wild animals also decrease their number.
(k) Many encroaching and parasitic plants gradually displace native plants from forests. Cat-weed (Banmara) displacing many terrestrial and water hyacinths displacing many aquatic plants in Nepal are some examples.
(l) Excavating rocks, gravel and sand illegally and irrationally from rivers lead to landslides at river banks, drying nearby farmlands and deteriorating biodiversity.

Conservation of Biodiversity

The conservation of plants and wild lives is the conservation of biodiversity. Conservation of biodiversity balances the natural environment. The declining number of flora and fauna causes a great impact on the entire ecosystem, therefore, biodiversity must be conserved. There are two methods in practice to conserve biodiversity: In-situ conservation and Ex-situ conservation.

Table 4.3 Methods of conserving biodiversity

Conservation of Biodiversity	
In-situ conservation	**Ex-situ conservation**
National parks Hunting reserves Conservation of natural sites or topography Wildlife reserves Conservation areas	Botanical garden Zoo Nursery Safari parks Aquarium Seed banks, gene banks, embryo banks, sperm banks etc.

In-situ Conservation

The method of conservation in which wild lives are conserved in their natural habitat is called In-situ conservation. This method is easy and the best method as wild lives can live by interacting with physical and biological components openly and naturally. With the In-situ conservation method, all types of wild lives can be conserved whether they are endangered or not. The challenges of the In-situ method are forest-fire, communicable diseases and mainly poaching or illegal hunting for making some benefit. Because of the larger area of In-situ conservation, it will be difficult to control such unwanted activities. In the present context, there are 12 national parks, 1 wildlife reserve, 1 hunting reserve and 6 conservation areas in Nepal as the practice of In-situ conservation where native wild lives are being protected as far as possible.

Table 4.4 Areas of In-situ Conservation of Nepal

National park	Wildlife reserve	Hunting reserve	Conservation area
1. Chitwan 2. Sagarmatha 3. Bardia 4. Rara 5. Khaptad 6. Langtang 7. Makalu-Barun 8. Shey-Foksundo 9. Shivapuri10. Parsa 11. Banke 12. Shuklafanta	1. Koshi Tappu	1. Dhorpatan	1. Annapurna 2. Kanchanjangha 3. Manaslu 4. Krishnasaar 5. Gaurishankar 6. Api-Nampa

Ex-situ Conservation

The method of conservation in which wild lives are conserved beyond their natural habitat but providing their natural environment as far as practicable within a small boundary or cage is called Ex-situ conservation. This method is more effective for endangered species of both wild lives and plants. Because of limited area, looking after them and their treatment, case-study etc. become very easier but disliking the prison-like captivated life by wild animals and compulsory management of their regular diet and other physical environment make this method more laborious and costly. Botanical gardens, zoos, safari parks etc. are some examples of Ex-situ conservation.

Besides In-situ and Ex-situ methods, there are some other measures to conserve flora and fauna; which can be listed as follows:

(a) Controlling poaching and illegal trade of wild lives and their certain body parts,

(b) Establishing furthermore protected areas,

(c) By controlling overgrazing, forest fire, pollution, irrational urbanization and industrialization

(d) By making and implementing strong law and order regarding poaching and illegal trade of wild animals and plants,

(e) By making people aware through education regarding the importance of biodiversity for everyone and the duty of a good citizen about their protection.

Project work

1. Visit any protected area like a national park or a safari park near your home or school with your parents or teachers. Prepare a report including the types of protected animals and plants, their present status, the method of conservation adopted and general information about the protected area and present in your class.

2. Prepare an informative video or report about the protected area and conserved wild lives by visiting the computer lab of your school and show it to your class.

Exercise

1. Choose the best alternative:

(a) Where was the Earth Summit about Biodiversity 1992 held?

i) China ii) Brazil

iii) Africa iv) Japan

(b) Which of the given alternative is related to faunal diversity?

i) Animals ii) Plants

iii) Animals and plants iv) Only mammals

(c) Riya is thinking to conserve an endangered plant. Which of the following action going to be taken by her represents the Ex-situ method of conservation?

i) She plants the plant in the community forest.

ii) She plants the plant in the same forest where it was obtained from

iii) She plants the plant in her kitchen garden

iv) She plants the plant on a riverbank

(d) Which one of the following represents the significance of biodiversity?

i) Fodder and firewood are obtained from forests.

ii) Forests maintain greenery

iii) Tourists often visit attractive forests for fun

iv) There is always some fear of wild animals from forests.

(e) What percentage of plant species in the world is found in Nepal?

i) 1.1% ii) 3.2%

iii) 10% iv) 0.1%

2. Differentiate:

(a) In-situ conservation and Ex-situ conservation

(b) Genetic diversity and Species diversity

3. Give a reason:

(a) There is some variation among the individuals of the same species.

(b) It is difficult to conserve any native species with the Ex-situ conservation method.

(c) Forestfire devastates biodiversity.

(d) Nepal is rich in biodiversity.

4. Answer the following questions:

(a) What is biodiversity? Give examples.

(b) What are the methods of conserving biodiversity? Explain any one of them in brief.What are the conserving measures of biodiversity?

(c) What are the common impacts of human activities on biodiversity? Explain.

(d) Explain the present status of the biodiversity of Nepal.

(e) Explain the causes of the degradation of biodiversity in points.

(f) What is the role of 'species richness' in biodiversity?

(g) Mention the types of biodiversity.

(h) Study the given picture and answer the following questions:

i) Which type of method of conservation of biodiversity is shown in the picture?

ii) State the advantages of this model and its procedures in biodiversity conservation.

4.2 Sustainable development

Observe the given pictures and discuss the questions below.

Fig. 4.6

(a) What may be the reason forthe landslide while constructing the road in the first picture?

(b) Does this road last long?

(c) What parameters should be followed while constructing roads in such places?

(d) As shown in the second figure, why is it necessary to make such a barrier at the places of landslide?

(e) Except for making a barrier, what next can be done to prevent landslides?

Read this part of the story carefully and attempt the following questions:

Norbu was helping his father at a paddyfield,it was full of water being prepared to transplant paddy saplings. In the meantime, the ridgeat a place of the field collapsed due to overload and pressure and water started flowing down. Norbu's father stopped to plough and both of them tried to stop the water by keeping mud at the collapsed ridge but couldn't do so. Due to extra water, the ridge of the lower terrace also collapsed. Norbu, then diverted the flow of water inanother direction, only then they could repair the ridge of the paddy field once again.

(a) Why the collapsed ridge couldn't be repaired with mud?

(b) What would happen if they had used leafy twigs with mud while repairing the collapsed ridge? Could it be sustained?

(c) What could be done to the edge to prevent collapsing?

Human beings are fulfilling most of their needs from natural sources and different ecosystem services. To meet such demands, there must be suitable infrastructures. While constructing such infrastructures, we must think about their sustainability so that we can be benefitted from them over a long course of time. For this, we must think about the economic, social, cultural and environmental aspects of the projects we conduct. Considering economic, social, cultural and environmental aspects while constructing and operating any project for mankind is called sustainable development. According to the report of Brundtland Commission 1987, 'Development that meets the needs of the present generation without compromising the ability of future generation to meet their own needs' is called sustainable development. Sustainable development keeps the goal forthe future and makes the base for continuous achievement. For example, if preventive measures forthe landslide are adopted well while constructing a bridge at such risky sites, only then the bridge last long and many generations will be benefitted from it.

Activity 4.3

Objective: To prepare a model of clean-green and well-managed (ideal) village

Materials required: Clay, wood, bamboo pieces, cardboard paper or hard paper, rope, fevicol or glue, scissors, colour, pencil, eraser etc.

Procedure

1. Copy a picture of any clean-green village from the internet.
2. Using the materials, make a 3D model of the village.While making the model, consult your subject teacher as per need.

Fig 4.7

3. Let the model dry in shadow for a few days
4. Use different colours to decorate the model in a natural way as far as possible.

Discussion and Conclusion

Present the model in your class and conduct a talkprogram about different aspects of sustainable development considered while making the model and explore a conclusion about sustainable development.

Fig. 4.8

Aspects of Sustainable Development

Sustainable development has harnessed and addressed different issues of human society like poverty, the physical infrastructure of developmental projects, social inequality, climate change, pollution and environmental imbalance, biodiversity,appropriate management of forests, peace and justice. Different dimensions addressed by sustainable development are called the aspects of development. There are three main aspects of sustainable development which are also called the pillars of sustainable development because without harnessing all these three aspects, the development will be only for a short period and rather they may destroy the possibility of a better project instead. The three pillars of sustainable development are as follows:

(a) Economic aspects (b) Social aspects

(c) Environmental aspects

(a) Economic aspect

The economic aspect of sustainable development indicates the continuous and balanced economic development of people and nations. It aims to achieve strong and progressive economic status by rational distribution and use of resources without discrimination. It advocates full contentment (satisfaction) of the present generation in economic activities like production, distribution and consumption of goods and services. But it does not believe inthe exploitation of resources.

(b) Social aspect

People from different backgrounds, thoughts and statuses live in our society.Proportionate and impartial progress of the whole community only can support sustainable development in their society. For this, poverty elimination, a common approach to resources, empowerment of women and marginalized groups, people participation, preservation of cultural identity, peace and social justice are to be maintained and implemented properly. This is what the social aspect of sustainable development means. For an affluent (rich) and prosperous society, all these social aspects of sustainable development must be addressed.

(c) Environmental aspect

For an affluent and prosperous human society, the surrounding environment must be productive and reliable. For this, the fertility of the land, water, air, minerals, climate and biodiversity of plants and animals must be conserved. Proper utilization of natural resources by balancing the surrounding ecosystem is the environmental aspect of sustainable development. For the overall development of mankind, a continuedsupply ofenvironmental services in sufficient amounts is a must. While conducting any development project, we must not hamper natural resources. We should focus on the conservation of the environment while constructing roads, bridges, dams etc. Likewise, erosion of riverbanks, landslides at construction sites etc. should be prevented and the natural habitat of plants and animals must not be destroyed.

Principles of sustainable development

The principles of sustainable development must be adopted in every kind of developmental work. It is the guideline of the act while conducting any kind of such work for their sustainability. The principles are as follows:

(a) Principle of the ecosystem and biodiversity conservation

Keeping the caring capacity of the earth in mind, the norms of maintaining natural resources, ecosystems and biodiversity while conducting developmental projects are called the principle of ecosystem and biodiversity conservation. This principle emphasizes the conservation of natural resources, the use of renewable sources of energy, the search for other alternative sources, pollution control and biodiversity conservation.

(b) Principle of population control and human resource management

Human beingsare organisms that utilize and consume much more natural resources than any other organism. To achieve the goal of sustainable development through different knowledge and skills of human beings and tocontinue the supply of natural resources, the human population must be kept within a limit. The assumption of keeping the human population within a limit for limiting the use of natural resources for their sustainability is known as the principle of population control andhuman resource management. This principle advocates the duty of responsible human beings to control their population,to promote their knowledge and skills through education, training, awareness programs etc.

(c) Principle of culture conservation and public participation

A single person cannot contribute much to anything but public participation in any task has great power to accomplish it. People only participate in developmental activities if their traditional and cultural values are addressed for their prosperity and happiness. The assumption of conserving the cultural heritage and developing positive concepts in the community about sustainable development is called the principle of culture conservation and public participation. This principle emphasizes social justice and peace in society. For example, if people participate to construct an irrigation canal in their village, they all take ownership and the canal lasts long.

Importance of sustainable development

The act of development that addresses and harnesses every aspect of society and the environment is called sustainable development. It conserves and utilizes natural resources rationally, ensures the habitat of plants and animals, maintains social justice, conserves traditions and cultures and establishes happiness and prosperity in society. Therefore, in the present context, there is great importance on sustainable development. Some of such importance of sustainable development can be listed as follows:

(a) Sustainable development balancesthe environment and controls pollution.

(b) Sustainable development conserves natural resources and awakens people about their rational use.

(c) The infrastructures of megaprojects are constructed according to the norms of Sustainable development.

(d) Sustainable development gradually eliminates social inequality and establishes social justice, peace and harmony among people.

(e) Sustainable development emphasizes delivering economic opportunity proportionately to every people in society.

Activity 4.4

Write a short essay on the topic 'Necessity, importance and different aspects of sustainable development forthe conservation of environment' and present it in your class.

Sustainable Development Goals and Nepal's Efforts

The goals set for 2016 to 2030 for long-lasting development, are the worldwide goals of sustainable development. These goals were set and approved by the 70th general assembly of UNO with 193 participating countries in 2015. The Sustainable Development Goals (SDGs) which came into implementationin 2016, contains 17goals, 169 targets and 232 indicators. The goals of sustainable development that include different economic, social and environmental aspects within a timeframe is the roadmap of the world's common goal on this issue. Nepal also has developed a similar roadmap for sustainable development including some more indicators which are necessary for our context. The goals of sustainable development are directly or indirectly related to the betterment of the environment although Agenda 15 emphasizes the betterment of both environment and biodiversity. It includes the practice of better use of terrestrial ecosystems, their rehabilitation and conservation, proper management of forests, preventionof desertification of land and protectionof biodiversity.

Except for the above-mentioned goalsrelated to environment and biodiversity, some other goals like food security;assurance of inclusive,impartial and quality education, life-long opportunity forpeople to uplift their level of education, regularity in the supply of drinking water and sanitary goods,developing strong infrastructure, generating employment, minimizing the impacts of climate change, conservation and rational use of seas, oceans and coastal regions etc. are also included.

To achieve the goals of sustainable development according to the national framework and indicators, the Nepal government also has planned 12-year programwhich reflects the long-term strategy of government for sustainable development.

To address the issue of food security, the implementation of the policy for the conservation of farmland and native crops is the main thing. Similarly, exploring new ones and conserving identified watersheds for safe drinking water also demand sustainable infrastructures. Biodiversity is directly affected as a consequence of climate change. Climate change, on one hand, has affected the lifecycle of marine life and on other hand, it causes floods, landslides, forest-fire, hyper precipitation (long and heavy rain), drought, partial precipitation, desertification etc which disturbs natural balance and habitat of terrestrial flora and fauna.

According to 'The global circulation model', the imbalance of the environment at one part of the earth affects the environment of the whole earth because the ocean and atmosphere are common to all. Therefore,the global mission of pollution control, reduction of emitting carbon dioxide, well-planned industrialization and urbanization and rational and proportional use of natural resources,like issues of conservingthe global environment can be achieved only through the full support of all countries.

Fig. 4.9

Intending to become a 'Developing country' by 2030, Nepal has been conducting various programs like poverty elimination, mitigating the effects of climate change, biodiversity conservation programs, budgeting for quality education, community development programs etc. to achieve the goals of sustainable development. These programs are being conducted through periodic plans and annual budgets. Some of the efforts in this regard are as follows:

(a) Conservation programs of water resources, watersheds and biodiversity ata local level are still in operation since 2009 through a council called 'Climate Change Council' to minimize the impacts of climate change and for its correction. To draw the world's attention towards the consequences of climate change, the Nepal government held a cabinet meeting at Kalapatthar, the basecamp of Mt Everest at an altitude of 5550m in 2009 and by the largest lake Rara, situated at the altitude of 2990 m in 2018. Similarly, an appropriate dam and drainage systemare constructed at Tsho-Rolpa glacial lake situated at Rolwaling valley (4580 m) of Dolakha district in 2020 to prevent the probability of its burstingat any time. As a consequence of global warming, the volume of water in Tsho-Rolpa Lake is increasing more rapidly due to the fast melting of Himalayan ice.

(b) To conserve the forest, Nepal has been launching a community forest program since 1970.After the implementation of the Act on community forest in 1993, both area and density of forest have been increased considerably by handing over the responsibility of management of community forests to the local people.

(c) Nepal government is implementing various programs under the Fourteenth three-year plan 2016-19 for poverty elimination emphasizing vocational/technical education and income generating skills, employment generating programs, biodiversity conservation awareness programsand campaigns of education, sanitationand health for all.

(d) With the thought of a 'Neat,Clean and Green environment'the fifteenth Periodic plan has assured the right of people to live in a healthy environment by controlling pollution, managing solid wastes, maintaining greenery in their residential and work-places.

(e) National Environment Policy 2076 BS has aimed the assurance ofpeople's right to live in a clean and tidy environment by managing domestic and industrial wastes, promoting and maintaining greenery and facility of the drainage system, public toilets in public places, cities etc as far as possible.

(f) The Environment Conservation Act 2076 BS is in execution since its promulgation which has emphasized people's human right to live ina neat and tidy environment by providing compensation from environmental degraders for their loss, maintaining the balance between environment and development, to minimize the effect of climate change on nature, environment and biodiversity and facing the challenges caused by climate change and global warming.

Exercise

1. Choose the best answer from the given alternatives:

(a) Report of which commission has defined sustainable development clearly?

i) Kyoto report ii) Agenda-30

iii) UNO iv) Brundtland

(b) Which aspect of sustainable development emphasizes social justice?

i) Economic ii) Social

iii) environmental iv) Cultural

(c) Which of the following point represents the importance of sustainable development regarding biodiversity?

i) Sustainable development manages irrigation systems in bare lands.

ii) Sustainable development helps to make roads for connecting remote places.

iii) Sustainable development emphasizes poverty elimination and a hygienic lifestyle.

iv) Sustainable development emphasizes the balancing of the surrounding ecosystem.

(d) Which number among the goals of sustainable development, the goal of biodiversity is related?

i) No. 13 ii) No. 14

iii) No. 15 iv) No. 16

(e) In the context of the declining snow of the Himalayas, which among the following points represents the main challenge to sustainable agro managementof the region?

i) gradual desertification of farmland

ii) frequent occurrence of floods and landslides

iii) drying of land due to less snowing

iv) decreasing fertility of the land.

(f) Which strategy of community development is more suitable for Nepal for the impartial approach of every citizen in natural resources according to the principle of sustainable development regarding social justice?

(i) Income-generating projects, community forest and awareness programs.

(ii) Environmental conservation for sustainable development

(iii) Environmental degradation and promotional program.

(iv) Social harmony and management of solid wastes.

2. Differentiate:

(a) Development and Sustainable development

(b) Social and Environmental aspects of sustainable development

3. Give reason:

(a) Environment must be considered while implementing developmental works.

(b) Sustainable development helps to establish social harmony.

(c) Degradation of biodiversity affects sustainable development.

4. Answer the following questions:

(a) What is sustainable development? Give an example.

(b) What are the principles of sustainable development? Describe any one of them in brief.

(c) 'Skilled human resource is the foundation as well as the destructor of sustainable development'. Clarify this statement on your own.

(d) Describe the importance and necessity of sustainable development for a balanced environment.

(e) What is sustainable development goal? Illustrate the effort of Nepal to harness the goals of sustainable development.

(f) If any road is being constructed in your town/village, give any three suggestions to the construction company for the sustainability of the road.

(g) What are the aspects of sustainable development? Describe briefly the interrelationship between various aspects of sustainable development with a suitable venn diagram.

(h) Suggest to your local government what it needs to do for the achievement of the goals of sustainable development regarding biodiversity.

5 Life process

Observe the given picture and discuss in the group.

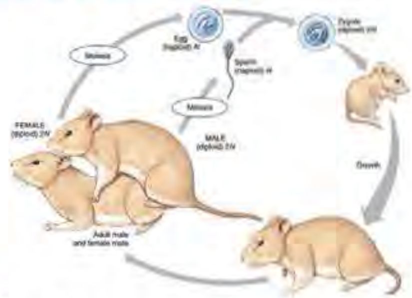


Fig.5.1

(a) Do the process shown in the above pictures occur at any stage of life?
(b) As a baby rat is produced in the second picture, what is formed in the picture of plant?
(c) According to the above pictures, what similarity can be found in reproduction in plants and animals?

All organism have capacity to produce offsprings. In the life cycle of organisms, the mechanism of producing reproductive units in males' and females' bodies, their fusion to make the very first cell of new life and its development into a baby organism of the same kind is called reproduction. In general, reproduction in flowering plants takes place by the formation of seeds in flowers and germination of the seeds into new plants. In non-flowering plants, direct growth of new plants occurs through their root or stem or leaf and other parts. Some of the lower plants and fungi make special units of reproduction called spores. In higher animals, males and females are separate and they make reproductive cells or gametes in their reproductive organs. After mating between an adult male and an adult female of the same species, the fusion of their gametes leads to develop new life which gets birth either directly from the mother's womb or through the hatching of eggs. Organisms which are least developed and have a poor ability of fertilization continue their race asexually. In this way, reproduction is an essential lifeprocess for the continuation of generations.

5.1 Reproduction

Observe the given pictures and discuss :

Fig.5.2

(a) Before hatching, which events occur in the hen?
(b) What may be the reason behind the production of grains in corncob?
(c) What would happen if chickens do not hatch and maize is not produced in cob?

There are many kinds of organisms on Earth. All these organisms are giving birth to their kind anyway. Animals reproduce either through eggs or giving direct birth or adopting any of the asexual methods. In plants, reproduction occurs either through the seeds or spores or any of the asexual methods. Giving birth to own kind through any biological method by organisms is called reproduction. Reproduction is an essential and internal quality of every organism through which they are continuing their generation.

Importance of Reproduction

(a) Reproduction prevents the extinction of organisms by continuing their generation.

(b) Reproduction balances the death rate of organisms by giving new births.

(c) Reproduction is the basis of existing of new generations.

(d) Reproduction balances the magnitude of biodiversity in the ecosystem.

Project work 5.1

Observe the process of reproduction in five different organisms available in your surrounding and discussafter completingthe given table :

Name of organisms	Type of organisms	Type of reproduction
Ant	Animal	Through eggs
....	....	....

Asexual reproduction in plants and animals

Find out the answer through the internet or any other source after observing the given pictures for discussion :




Fig.5.3

(a) Where are the flower-like reproductive parts in fern plants?

(d) Does fern produce seeds?

(c) How does hydra increase its population?

Organisms reproduce in various ways. Advanced organisms have separate male and female reproductive organs to produce male and female gametes and they reproduce their kind by fusion of male and female gametes. A fused female gamete is called a zygote which gradually develops into seed or baby animals. But some organisms reproduce through a specific organs without the fusion of gametes. New younones are developed through such organs by fragmenting, budding or specific reproductive units.The reproduction through a specific organ without the fusion of gametes is called asexual reproduction. The asexual reproduction is found in many organisms. Asexual reproduction is of various types.They are:

(a) Fission

(b) Budding

(c) Fragmentation

(d) Regeneration

(e) Sporulation

(f) Parthenogenesis

(a) Fission

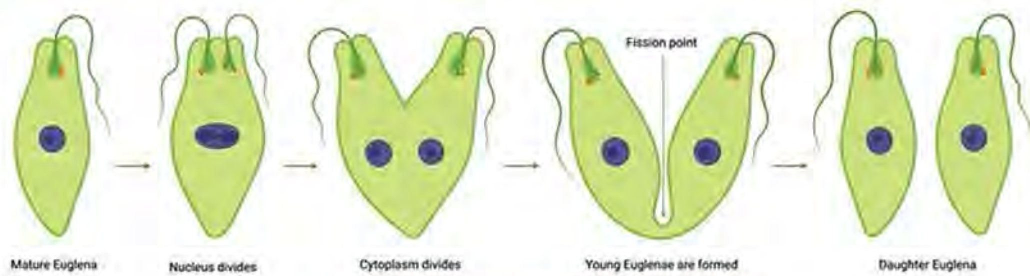


fig.5.4 binary fission in Euglena

The formation of new organism by splitting parent body is called fission. It occurs only in unicellular organisms like prokaryotic Monera and eukaryotic Protista. After fission, the parent cell does not exist, it is broken into new smaller cells of its kind. There are two types of fission: binary and multiple. The splitting of a matured parent cell into two halves is called binary fission. In this, the parent cell splits longitudinally or transversely into two new cells. Therefore, binary fission may be longitudinal or transverse. All unicellular organisms like amoeba, paramecium, euglena, archaea, bacteria, chlorella, Anabaena, and blue-green algae adopt binary fission for reproduction. In multiple fission, the body (cell) of a living being is divided into more than two pieces and every piece develops into an individual cell (body). Multiple fission is adopted mainly by Plasmodium, Chlamydomonas, Vorticella and almost all protists and algae.

Fig .5.3 Multiple fission in chlaydomas

Activity 5.1

Observe the permanent slides of binary and multiple fission of amoeba, paramecium, euglena, plasmodium, Chlamydomonas etc under a microscope, draw their figure on the practical sheet and submit to your subject teacher. And, discuss about the method of asexual reproduction in them.

(b) Budding

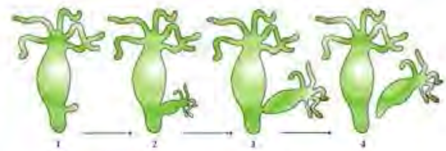


Fig. 5.6 budding in hydra

Yeast, hydra, obelia, taenia, corals, and jellyfish like lower organisms adopt the budding process for asexual reproduction. In this method, a small bud appears on a body (or, cell) which gradually grows into the complete organism and separates from the parent body.

(c) Fragmentation

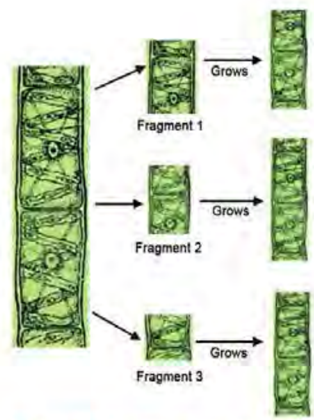


Fig 5.7 fragmentation in spirogyra

With various physical activities of developed animals, wind and water, the body of some plants gets fragmented into many pieces and every piece grows into a new plant. Themechanism of growing fragments into completely new plants in their natural habitat is called fragmentation. Many lower plants like spirogyra, Marchantia, ferns, lichens, mucor etc follow this method.

(d) Regeneration

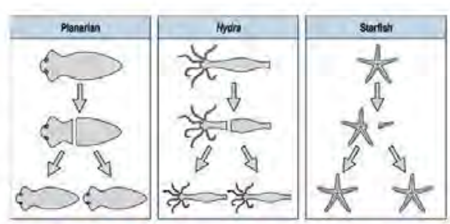


Fig 5.8 Regeneration in hydra starfish and planeria

Regeneration usually occurs in lower animals like a hydra, tapeworm, planaria, starfish, earthworm, leech etc. The growth of a cut or separated piece of the body into a whole new body is called regeneration. In this process, the separated part of the body doesn't die if kept in its natural habitat and starts to grow into a complete body. The lost part in the parental body also grows for compensation.

(e) Sporulation

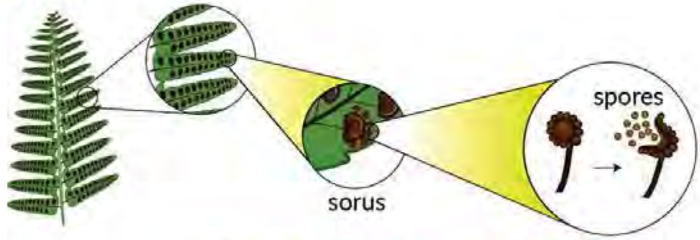


Fig 5.9 Sporucation in leaf of fern

Ferns, mushrooms, Marchantia, mucor etc lower plants reproduce asexually by producing spores. Reproduction through spores is called sporulation. A spore is a special type of reproductive unit and it is a single cell. Spores are produced in capsules called sporangia (singular: sporangium). The biological process of spore formation inside sporangia is called sporogenesis. After maturation, spores spread through wind and germinate into new plants if they get moist places with plenty of organic substances.

Activity: 5.2

Objective: To study the spores of the fern

Material required: A leaf of fern with matured sori, microscope, slide, brush

Procedure :

(a) Collect a leaf of fern with matured sori.

(b) Obtain some spores on a glass slide from sori with the help of a brush.

(c) Observe the cellular structure of spores under the microscope.

Observation and Discussion

Draw the cellular structure of a spore and discuss its feature with friends in class.

(f) Parthenogenesis

The development of a new body of organisms from unfertilized eggs is called parthenogenesis. It is a kind of biological miracle which occurs in some species of both plants and animals. The ovary and ovule in apples, pineapples, and cucumbers directly turn into fruits and seeds without fertilization. The unfertilized eggs of ants, termites, and grasshoppers also directly develop into their babies. The drone bees are also produced directly from the unfertilized eggs of the queen bee.

Significance of asexual reproduction

(a) Asexual reproduction does not need to produce and fuse male and female gametes.

(b) Asexual reproduction has no concept of male and female.

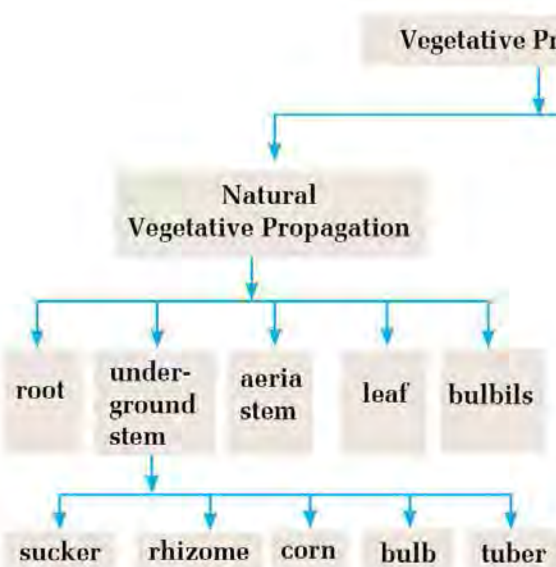
(c) Asexual reproduction can be initiated usually from any vegetative or somatic cell.

(d) Asexual reproduction develops a specific reproductive unit for continuous growth to a new body.

(e) Except for environmental effects, the organisms from asexual reproduction remain genetically identical to each other.

Questions to think about:

Have you seen the seeds of potato, banana and pineapple? In your opinion, how do they, reproduce? Discuss and present your conclusion in your class.



Vegetative propagation in plants

The body of a flowering plant has two main parts: vegetative and reproductive parts. Flower is the reproductive part of plants because the flower performs pollination, fertilization and formation of seeds inside fruits. All other parts except flowers i.e. root, stem and leaf are vegetative parts. The asexual reproduction through any one of the vegetative parts is called vegetative propagation. There are different types of natural and artificial vegetative propagation.

(a) Root (b) Underground stem

(c) Aerial stem (e) Bulbils (f) Leaf

(a) Root

The roots of some plants like roses, sissoo, guava etc have some buds. If such roots with buds are separated from their stem, the buds start to grow and give new stems. Asparagus, sweet potato, and dahlia also have stored plenty of nutrients and water in their root which also gives rise to new stems with leaves. A new set of roots also grows from the base of the new stem which later on develops into a separate plant.

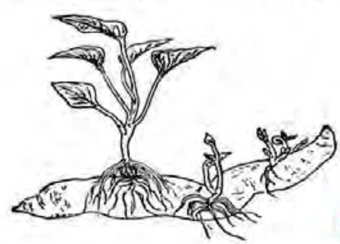


Fig 5.10

(b) Underground stem

Underground stems are of five types: i) sucker, ii) rhizome, iii) corm, iv) bulb, and v) tuber and they are more able for vegetative propagation. Suckers with a bunch of roots are developed under the main stem which later on develops as new plants in the case of mint, pistia, banana, bamboo, ground raspberry etc,. The rhizome is underground stem storing plenty of water and nutrients and lies almost flat just under the surface. Ginger, turmeric, calamus root (Bojho), and plants like ferns have rhizomes. Rhizome has given rise to many buds which grow as new plants in every next season. Colocassia (pindaloo) and gladiolus have corm, full of nutrients and water, at the base of their green shoot which produces few buds that can be grown into new plants. The bulb is another round-shaped underground stem found in onions, garlic, tulips etc. which are also enriched with nutrients and water and can give new plants from the buds they have. The underground stem of potatoesand yamsis calleda tuber. A tuber has some depressions called eyes (aankha) in the beginning, later on, buds arise from these eyes for propagation.

Fig.5.11 propagation through underground stems: Sucker of bamboo,Rhizome of ginger,Corm of colocassia,Bulb of garlic,Tuber of potato.

(c) Aerial stem

The aerial stem of some plants like sugarcane and crab-grass (Dubo) bear some buds at their nodes which, when comes in contact with moisture, can grow new shoots and roots and take the form of new plants. This is the reason that farmers use cut pieces of sugarcane to sow for new crops, crabgrass (Dubo) rapidly covers the entire field if provided with the required environment.

Fig 5.12

(d) Bulbils

In some plants, few buds are formed at nodes or the base of the leaf or on the top of the short-fleshy stem which is called bulbils. New roots and shoot grow from these bulbils to be the new plants. Pineapples, agaves (Kettuke), lily, onion, garlic etc propagate through their bulbils.

Fig 5.13

(e) Leaf

Leaf of some plants like bryophyllum, begonia, kalanchoe (Pattharchatta), sansevieria or snake plant,and crassula (jade plant or lucky plant) can give rise tothe new plant from their leaves.

Notches on the margin of a bryophyllum leaf bear a small bud each which gradually gives rise to new shoot and root systems. When an old leaf falls on the soil, many baby plants of bryophyllum grow from the fallen leaf. Leaves of the above-mentioned plants also give new plants more or less in a similar way.

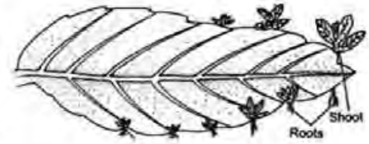


Fig 5.14

Project work 5.2

Objective: To demonstrate the samples of vegetative propagation.

Material required: Knife, plastic bags, cardboard paper, glue.

Procedure :

(a) Collect some samples of vegetative propagation through the root, stem and leaf of different plants.

(b) Let the samples dry in a room (not in direct sun) for a few days.

(c) Press the dry samples and keep them closed each in a plastic bag.

(d) Paste the plastic bags along with samples on the cardboard paper serially. Samples of vegetative propagation are now ready to demonstrate.

Demonstration and Discussion

Demonstrate the sample board in your class, conduct a discussion program and keep it safe in your science lab for future use.

Artificial vegetative propagation

Activity 5.3

Download a video about grafting in plants and some grafts from the internet and demonstrate it in class for interaction.

Production of new plants asexually using tools and techniques for the improvement of quality and quantity of crops or cashcrops is called artificial vegetative propagation. Plants from any of the artificial methods have good genetics and they start yielding much sooner than the plants which are grown from seeds. The reason for good genetics is nothing but the selection of genetically sound parent plants and that of earlier yielding is to spend less effort by plants to grow and to gain maturity. Cutting, Layering, Gootee, Grafting, and Tissue culture are some methods of artificial vegetative propagation.

Advantages of artificial vegetative propagation

i) With this, the breed and genetics of plants can be directed as per need.

ii) With the artificial method, fast-yielding plants can be obtained

iii) Many genetically identical saplings can be produced in a short period from a single parent plant.

iv) This technique is very useful for spreading plants which have no viable seeds.

(a) Cutting

The method of sowing cut piecesof leaf,stem and root of some plants to get new saplings is called cutting. Raspberry, ground raspberry, blackberry etc. can be grown from the cut pieces of their root whereas in sugarcane, rose, pear, lemon etc. stem is cut to sow for their new plants. Normally, a year-old twig should be selected for cutting and each cut piece should have at least two nodes. After a few days of sowing, new root and shoot start growing from the sowed pieces.

Fig 5.15

Fig 5.16

Activity 5.4

Follow the process of cutting to a rose or any other suitable plant in your school garden. Keeping the soil moistened, observe them for 15 days and note the changes that occur in them. Prepare a report and present it to your class.

(b) Layering

Layering is done to the plants having soft branches grown from the very lower part of the stem. The branch selected for layering is called the layer. 2-3 cm of the bark of the layer is removed and then the part is bent down in the soil and covered with soil. The soil is kept moist until a new root system is grown from the buried part of the branch without bark. then, it is separated from the parent plant and sowed elsewhere.

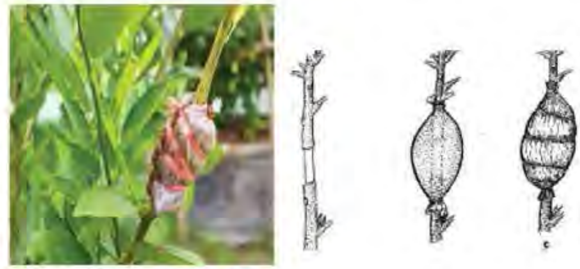


Fig 5.17

(c) Gootee

Gootee is also called 'air layering'. It is done by removing the bark of at least a year-old branches of litchi, mango, guava, orange, pomelo (Bhogate) etc by peeling off 2-3 cm bark of the layer and covering the part with soil enriched with minerals and plant hormones. The soil is tied well with a plastic sheet to prevent infection.

Nearly after a month or two, when a new root arises from the peeled-off part, it is separated from the parent plant and sowed elsewhere.

(d) Garfting

The process of joining two parts of closely related plants is called grafting. The grafting technique is used to prepare plantlets of fruit plants having good productivity. Out of two parts, the first one, which has roots is obtained from a year-old fruit plant germinated

Fig 18

from seed by cutting its upper part 20-30 cm from the ground, it is called stock. Another is a twig of a selected fruit plant having good quality and productivity. This part is called a scion or graft. Scion or graft should have a few nodes with or without a few half-cut leaves. The cut points of both parts are given appropriate shapes for fixing well. While selecting, cutting and joining them, we should keep in mind that there should be no disturbance in the internal conductivity between the stock and the scion. Grafting wax and planttape are used to join them airtight. After a few days, the wounds heal, and both parts are joined firmly and become a single plant. This plant soon starts yielding having the same quality as the plant from which the scion was taken. Nepal Agriculture Research Council (NARC) prepares thousands of grafted plantlets of varieties of fruits to enhance fruit farming and many farmers and consumers are being benefited. It also has supported the modernization of horticulture in Nepal.

Activity: 5.5

Objective: To graft a fruit plant

Materials required: Two similar and closely related potted fruit plants (for example lemon and pomelo), a grafting knife, grafting clay, planttape and a brush.

Procedure :

(a) Take two potted plants of the same family.

(b) Clean well the plant at the grafting area with the bush to avoid contamination.

(c) Make a scion and join at the stock of another.

(d) Tightly pack the area of grafting with grafting clay and planttape to prevent the flow of air.

(e) Keep the grafted plant in shadow.

(f) If possible, make a video of the whole process.

Observation and Discussion

Observe the newly grafted plant regularly for 15 days. Note the changes you observed in copy and submit it to your subject teacher and exhibit the video you have produced in your multimedia class for all your mates.

(e) Tissue culture

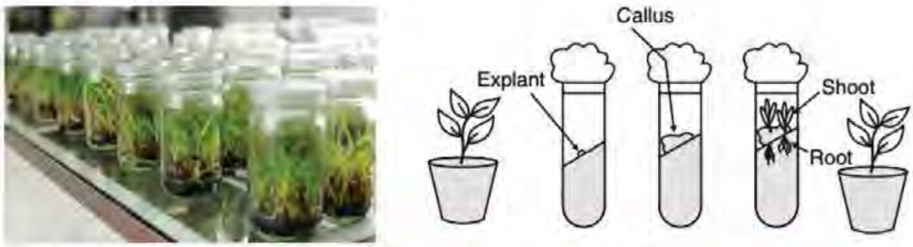


Fig 5.19 plant produced from tissue culture method

Tissue culture is an advanced and modern technique of artificial vegetative propagation of plants. With this technique, hundreds of thousands of disease-free and genetically desirable plantlets of any kind of plant can be produced within a limited time. Preparing several plantlets under a controlled environment inside the lab from a freshly cut small piece or cell or tissue of the parent plant (called ex-plant) providing an artificially prepared mixture of plant nutrients (called culture media) is called tissue culture. A small greenish mass of undifferentiated cells called callus is formed in culture media from a small piece of ex-plant later on, they turn into tiny plantlets (differentiated into root and shoot) with the help of different culture media mixed with some plant hormones.

Glossary:

Axis	:	an imaginary line or plant that divides any geometric object into two halves.
Media	:	a mixture of various essential nutrients to grow clones or microorganisms.
Mating	:	sexual intercourse between a couple of the same species for reproduction
Spore	:	Unit of asexual reproduction (single cell) produced by some lower plants and fungi.

Exercise

1. Choose the best alternative from the given answers:

(a) How are new organisms formed during regeneration?

i) growth of new life from the freshly fragmented part of the parent body

ii) regenerating the fragmented part into a whole body

iii) re-fragmenting the fragmented part

iv) direct development of body from fragmented part.

(b) What should be followed while propagating plants through cutting?

i) there should be few leaves in the cut part

ii) there should be new buds in the cut part

iii) the cut branch should be taken from the upper part of the stem of the parent plant

iv) there should be a few nodes in the cut part.

(c) Which of the following represents the meaning of reproduction?

i) mechanism birth and death

ii) to give birth to young ones at maturity

iii) biological process of giving birth

iv) forming seeds, laying eggs, giving birth

(d) Which type of reproduction is shown in the figure?

i) tuber ii) rhizome

iii) bulbils iv) corm

(e) If producing many plantlets from small ex-plant in a lab under the controlled environment is tissue culture, then which of the following sentence is related to this method?

i) Only a small piece of stem or branch of the parent plant is taken

ii) Whole part of the plant is taken

iii) Small cut pieces of both plants and animals can be taken for generating offspring

iv) It can be done only in non-flowering plants.

2. Differentiate :

i) Fission and Budding ii) Bulbils and rhizome

iii) Natural and artificial v. propagation

iv) Layering and Grafting

3. Give reason :

i) Asexual reproduction has no concept of male and female.

ii) The reproduction from the tuber of a potato is called vegetative propagation.

iii) Farmers will be benefitted from grafting techniques

iv) Tissue culture is considered the most advanced method among other methods of vegetative propagation.

4. Answer the following questions

(a) What is reproduction? Give an example

(b) What are the types of asexual reproduction? Describe any one of them if brief.

(c) Describe the budding process in Hydra with suitable figures

(d) Make a flowchart of the methods of vegetative propagation.

(e) What kind of reproductive unit is bulbil? Give an example.

(f) What are stock and scion in grafting? Describe the process of grafting with its advantage.

(g) What is layering? Draw a figure of layering with an example.

(h) Write down the name of the method of asexual reproduction in the following organism

Yeast, paramecium, pineapple, banana, planaria, begonia, ginger, onion, sugarcane, mucor,sweet potato,spirogyra

(i) Artificial vegetative propagation is more important and beneficiary to everybody. Justify this statement including some examples.

5.2 Sexual reproduction in plants and animals

Study the given figure and have a discussion :

Fig 5.20

(a) Before fruiting, which different processes have undergone in the mango tree?

(b) With which method of reproduction, calves are born from cows?

There are many types of reproductive processes. In multicellular eukaryotes, reproduction is done by the formation of gametes. Such organisms have distinct male and female reproductive organs. Some of them have only male or only female organs and they are called unisexual organisms. But, some organisms have both male and female reproductive organs in the same body. They are called bisexual or hermaphrodite organisms. For example, the mustard flower has both male and female parts but in human beings, the male has only male reproductive organs and the female has only female reproductive organs. Male reproductive organs produce male gametes and female reproductive organs produce female gametes. The reproduction by the fusion of male and female gametes of the same species is called sexual reproduction. The fusion of opposite gametes forms a zygote and the gradual growth and development of the zygote lead to the formingof a new body.

Charatcteristicsof Sexual Reproduction

(a) In sexual reproduction, the formation of male and female gametes takes place and they fuse to make a zygote.

(b) Body of organisms has separate male and female reproductive organs either in the same body or in a different body.

(c) It retains the ability of reproduction in organisms.

(d) The offspring from sexual reproduction are more adapted to changing environment.

(e) The offspring from sexual reproduction exhibit genetic variation.

(f) The possibility of organic evolution through sexual reproduction is very high.

5.2.1 Sexual Reproduction in Plants

Study the figure of the mustard plant alongside and discuss the given questions :

(a) Which part of the plant is the reproductive part?

(b) From which part, does the plant produce its grains?

(c) Does sexual reproduction occur in non-flowering plants like fern, and moss?

Fig 5.21 mustard plant

Sexual reproduction in plants is a little bit different than in animals. Flower is the reproductive part of flowering plants. A flower has male and female reproductive parts. Non-flowering plants have a special type of reproductive parts to perform sexual reproduction. The study of sexual reproduction in flowering plants can be divided into two steps: pollination and fertilization.

(A) Pollination

The adjoining figure of a flower shows different parts. Distinguish them into male and female parts and have a short discussion on them.

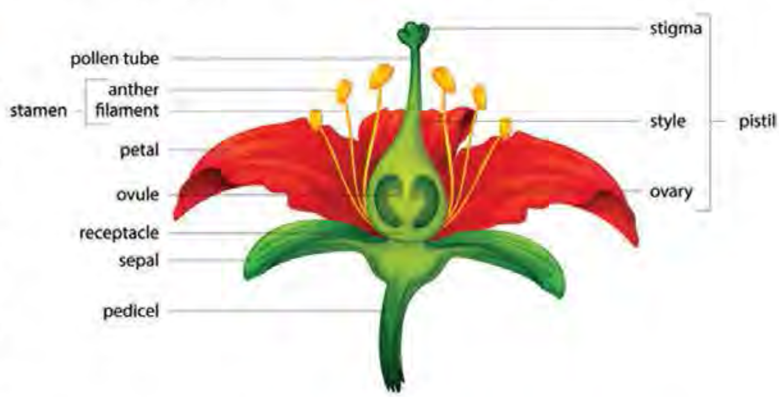


Fig 5.22 different parts of flower

The gynoecium of the flower is the female part. It has an upper stigma, middle style and lower ovals-shaped ovary. Thin filament-like parts are male androecium. On the top of each androecium, there is a pair of anthers.

Powder-like pollen grains are produced in the pollen sacs within anthers. When pollen grains are matured they are dispersed in air by bursting of anthers.

Fig 5.23

Transferring pollen grains onto the stigma of the same flower or different flowers of the same species is called pollination. A single pollen grain is unicellular, microscopic and covered with a double layer. Its outer cover is full of very thin hair-like structures with the help of which they stick on stigma. Pollination is of two types: Self-pollination and Cross-pollination.

Activity: 5.6

Objective: To study the pollen grains

Materials required: A flower, brush, slide, cover-slip, microscope

Procedure :

(a) Collect a bisexual or a staminate flower and carefully remove its corolla.

(b) Shed its pollen grains on the middle of the slide with the brush and cover the pollen grains with a cover-slip after keeping a drop of water over the grains.

(c) Observe the slide under the microscope.

Observation and Conclusion

Draw a neat and labelled diagram of a pollen grain on the practical sheet with its characteristics and present it to your subject teacher.

(a) Self-Pollination

Transferring pollen grains onto the flowers of the same plant is called self-pollination. Self-pollination occurs in both unisexual and bisexual flowers. Self-pollination mostly occurs in small, colourless or dull flowers without nectar and fragrance. Self-pollination may not require pollinating agents like bees, and butterflies. Self-pollination is of two types; if pollen grains are transferred onto the stigma of the same flower it is called autogamy and if it is transferred onto the stigma of different flowers of the same plant, it is called geitonogamy. Geitonogamy demands pollinating agents. Paddy, wheat, groundnuts, and lily generally adopt self-pollination.

Fig 5.24

Advantages of Self-Pollination

(a) Good hereditary character of the parent plant is preserved in self-pollination.

(b) Self-pollination assures the production of seeds.

(c) Self-pollination is easily carried out in nature.

Disadvantages of Self-Pollination

(a) Self-pollination does not contribute to developing new characters in offspring.

(b) Adopting only self-pollination gradually decreases the potentiality of reproduction.

(c) With self-pollination, the unwanted characters present in the race of organisms can not be corrected.

Cross-Pollination

Transferring pollen grains of a flower onto the flowers of different plants of the same species is called cross-pollination. Cross-pollination usually occurs in colourful and well-scented flowers having nectar and in which androecium and gynoecium mature at different times. Pollinating agents play a vital role in cross-pollination.

Let's know :

Based on the type of pollinating agent, there are several types of cross-pollination. Air takes pollen grains to the stigma of another plant in maize, pine, mango, litchi, etc; this is called Anemophily. In aquatic plants, water support for this process, and it is called Hydrophily. Insects like bees and butterflies are attracted to well-scented and colourful flowers and unknowingly perform pollination, which is called Entomophily. If small birds like a hummingbird, sunbirds, or tailor birds (fisto) come to the flower for sweet nectar and make pollination possible, it is called Ornithophily.

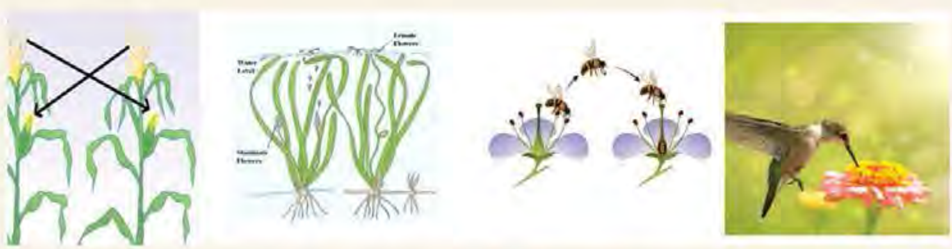


Fig 5.25 (Anemophily, Hydrophily, Entomophily and Ornithophily)

Project work 5.4

Visit some farmlands and kitchen gardens in your locality and observe pollination being done in flowers by insects. Then, fill in the table given below and present it in your class for discussion.

Name of plant	Type of pollination	Pollinating agent
(a) Mustard	Entomophily	Honey bee
(b)	....	....
(c)	....	....

Advantages of Pollination

(a) Pollination helps to create new plants with improved quality.

(b) Plants obtained from pollination will be more adaptive to the environment.

(c) Pollination causes the production of seeds to have more capacity for germination.

Disadvantage of Pollination

(a) Pollination depends upon pollinating agents, in the absence of which, it may not occur.

(b) It will be difficult to preserve the good genetics of plants through pollination.

(c) Offspring may get bad and unwanted hereditary characteristics.

Activity ; 5.7

Download a video of pollination from the internet and exhibit it among your friends for interaction.

(B) Fertilization

The fusion of a male gamete with a female gamete of the same species is called fertilization. Fertilization occurs inside the ovary in flowering plants. Pollen grains falling onthe stigma start germinating

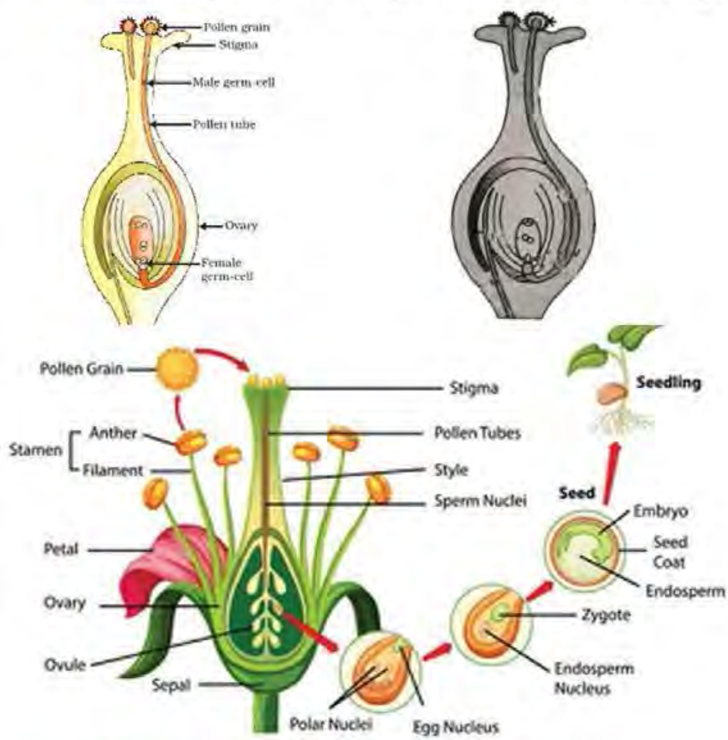


Fig. 5.26 Fertilization occurs in flowering plants

into pollentubes by absorbing water, glucose and other nutrients from the fluid of the stigma and they gradually penetrate style to reach the ovary. The nucleus present in the pollen grain is shifted to the pollen tube. On the way to the ovary, this nucleus is divided into two nuclei, which are now called male gametes. When the pollen tube reaches the ovary, both nuclei enter the ovule. One of the male gamete (nucleus) fertilizes the egg nucleus of the ovule (female gamete) and makes a zygote; the remaining male gamete fertilizes with a secondary polar nucleus and an antipodal cell forming an endospermic nucleus. In this way, there will be double fertilization in flowering plants. After fertilization, the fertilized ovule will be developed into a seed and the whole ovary is developed into the fruit.

Activity: 5.8

Objective: To study the germination of pollen grains on the stigma

Materials required: A matured flower, forceps, scissors, watch-glass, slide, microscope

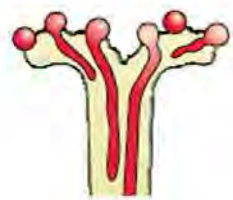


Fig 5.27

Procedure :

(a) Collect only the gynoecium of some flowers and keep them in a watchglass.

(b) Cut only the stigma of the gynoecium with scissors by holding the styles with forceps.

(c) Put the separated stigma on a slide and observe under the microscope.

Observation and Conclusion

Observe some germinating pollen grains of stigma. Draw their neat and labelled diagram in your practical sheet and submit it to your subject teacher.

5.2.2 Sexual Reproduction in Animals

Fig 5.28

Males and females are separate in most animals. When they become adults, they will be eligible for reproduction. Both males and females have special organs to produce maleandfemalegametes. For example, themale has testes to produce spermand thefemale has ovaries to produce eggs or ova (singular: ovum). Sperms and eggs are male and female gametes respectively. The process of producing gametes in the testes and ovaries is called gametogenesis.

The male reproductive cell or unit is called sperm and that of the female is called the ovum or egg.Sperm has an oval head and long tail but the ovum is quite bigger and round in shape. In human beings, sperm are produced in millions but in females, only one ovum is produced by an ovary in one month.

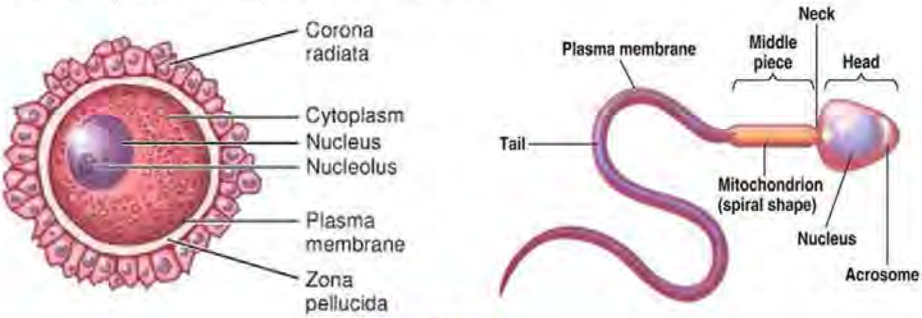


Fig 5.29

At the end of mating between a couple of animals, fertilization happens through the fusion of a sperm and an egg. Although, thousands of sperms circle an ovum, only one of them will be able to fertilize the ovum. Fertilization is the mixing of nuclei of a sperm and an ovum. After fertilization, the ovum is turned into a zygote which carries the nuclei of both sperm and egg. Zygote is the first cell of a new body to be born. The rapid development of the zygote makes the complete body of a baby organism. The duration required for a zygote to be developed into a complete body to be born or hatched is called the embryonic period or pregnancy period.

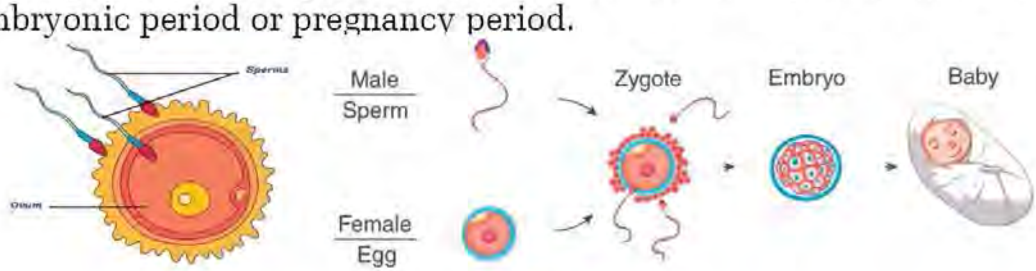


Fig 5.30

There are two types of fertilization in animals: External fertilization and Internal fertilization. The fertilization that is performed inside the female body at the end of mating is called Internal fertilization. In internal fertilization, the fusion of sperm and an ovum takes place inside the fallopian tube of a female. Provision of internal fertilization is in arthropods, reptiles, birds and mammals. But in fishes and amphibians, fertilization takes place outside the body of the female in the outer environment and this type of fertilization is called External fertilization. In external fertilization, the female lays many eggs in water or on substratum without mating and then after, the male releases sperm over the eggs to fertilize them.

Activity: 5.9

Objective: To study the eggs of the frog

Material required: A wirenet, watch-glass, hand lens, a permanent slide of frog egg, microscope

Procedure :

(a) With the help of a wirenet, collect some frog's eggs from nearby ponds or streams into the watch-glass

(b) Observe the eggs first with a hand lens and then after with a microscope. Compare the egg with the permanent slide of the frogeggs to know whether the collected egg is fertilized or not.

Conclusion: Prepare a report on 'External fertilization in frogs' comparing the structure and condition of collected egg with that of the permanent slide.

Exercise

1. Choose the best alternative from the given options :

(a) Where does fertilization take place in flowering plants?

i) In stigma　　ii) In ovary

iii) In ovule　　iv) In style

(b) What is called the pollination that is carried out by flies?

i) Self-pollination　　ii) Cross-pollination

iii) Pollen germination　　iv) Entomophily

(c) Which of the following statement indicates the meaning of pollination?

i) Pollination within the same flower

ii) Pollination between two flowers

iii) Pollination between genetically similar flowers

iv) Pollination between genetically dissimilar flowers

(d) Which part is indicated by 'B' in the figure alongside?

i) Pollen grain　　ii) Pollen tube

iii) Style　　iv) Germinating pollen grain

(e) Which of the following animal adopt internal fertilization?

i) Lizard　　ii) Frog

iii) Sea-horse　　iv) Salamander

(f) Which of the statements are true regarding fertilization?

i) Generally, the ovary changes into fruit and the ovule changes into a seed after fertilization

ii) In some plants, the ovary changes into the fruit without fertilization

iii) Firsts fertilization occurs in the stigma and second in the ovary

(IV) Fertilization occurs at first and then gametogenesis happens to make a zygote.

i) i and iiiii) i and ii iii) i and iv iv) all statements

(f) Which sequence is true regarding pollination in flowering plants?

i) anther, stigma, pollen grain, pollen tube

ii) anther, pollen grain, stigma, germination

iii) pollen tube, pollen grain, style, anther

iv) pollen grain, anther, pollen tube, stigma

2. Differentiate :

(a) Pollination and Fertilization (b) GametesandZygote

(c) Anther and Pollen grain (d) AutogamyandGeitonogamy

(e) External fertilization and Internal fertilization

3. Give reason :

(a) Pollinating agents have a great role in pollination.

(b) Both male and female organisms are required for sexual reproduction.

(c) External fertilization takes place either in water or on land.

4. Answer the following questions :

(a) What is pollination? Give an example.

(b) Compare the self-pollination and cross-pollination with diagrams and mechanisms.

(c) What is meant by double fertilization? Describe the process in brief.

(d) Draw a neat and labelled diagram of an ovum and a sperm.

(e) 'Four puppies were born at a home,' Which type of reproduction is this? Describe the importance of gametes in sexual reproduction.

(f) Make a graphical chart showing sexual reproduction in animals.

(g) What is gametogenesis? In which part of plants and animals does this process take place?

(h) Name the type of fertilization in given animals :

Human, Pigeon, Tortoise, Butterfly, Fish, Bat, Frog, Cow, Dragonfly, Whale.

(i) What effects would occur if there is no sexual reproduction in plants and animals? Clarify with a suitable example.

(j) 'If there is no pollination in plants, fertilization will be nearly impossible' Justify this statement with logic.

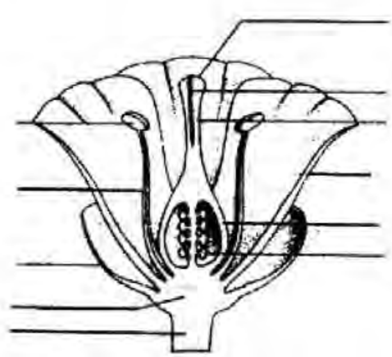
(k) 'Internal fertilization is safer than external fertilization'. How?

(l) How to do 'fragrance in flower' and the 'different time for anther and stigma to be matured' assure the pollination process? Describe in brief.

(m) Study the given diagram of a flower and answer the following question :

i) Label A, B C and D parts of a flower.

ii) What effect may occur in the fertilization process if part 'B' is removed?



5.3 Seed

Discuss the given questions :

(a) What is produced in plants as babies are born in animals?

(b) Do all plants produce seeds?

After fertilization in plants, the egg nucleus of the ovule is turned into a zygote. Due to sequential development, the zygote inside the ovule develops into an embryo. After the complete development of the embryo, the fertilized ovule becomes the seed having the capacity of germination under a suitable environment to become a sapling and then into a matured plant. Therefore, the seed is a part of the life cycle of flowering plants which can germinate into new plants of their kind. As babies are obtained in the lifecycle of animals, seeds are obtained in the lifecycle of flowering plants. Seeds are very tiny to quite large in size and oval or, elongated or wrinkled or round or having scaly wings etc in shape.

Fig 5.31

Project work: 5.5

Collect various kinds of seeds. Keep the collected seed separately in plastic bags and seal them with a candle and paste them serially on chart paper and submit them to your subject teacher for discussion.

Dispersal of seeds

In general, seeds are grown inside fruits. A single fruit may have one or many seeds. Seeds also ripen along with fruits and be separated from the fruits. Seeds of some plants are carried to distant places through carriers. Reaching of seeds from their origin to different places through the help of any one of the carriers is called dispersal of seed. Dispersal of seed is one of the adaptation of flowering plants by which they can reach a different environment and try to be adjusted. Generally, the following are the mechanisms of the dispersal of seeds :

(a) dispersal through wind
(b) dispersal through water
(c) dispersal by animals
(d) dispersal by gravity
(e) dispersal by bursting of pods

(a) Dispersal through the wind

Fig 5.32

Small and light seeds are dispersed through the wind. These seeds may have feather-like scales, wing-like scaly structures or small pouches of air which help seeds to be suspended in the air for a long time and wind can blow them to distant places. When their fruit is ripened and open, seeds start taking off from the fruits and dispersed along with the wind. Seeds of red silk cotton trees, Aak trees, Kans and other grasses like Dandelion, cotton, maple etc are dispersed through the wind.

(b) Dispersal through water

Fig 5.33

Seeds of hydrophytes, plants that grow at river banks and wetlands are dispersed through water. Such seeds are water-proof, light and floating type. When their fruits ripen and fall in the water, they are carried by water up to distant places. Lotus, Lily, Mangrove, Coconut, cattail etc are dispersed running or moving through water.

(c) Dispersal by animals

Fig 5.34

Fruits of many plants are edible and eaten by monkeys, deer, squirrels, mice, rabbits, birds, flyingfoxes etc. These animals eat soft and delicious parts of fruit but due to hard covering they either cannot eat or cannot digest their seeds, so they dispose of only seeds at different places. Human beings have transported the seeds of cereals, legumes, fruits, and vegetables throughout the world. Some seeds like cobblers pegs (Kuro),and cocklebur (Bhede Kuro) have spiky bristles all around with which they get stuck on animals' bodies and reach different places. Seeds of small fruits are eaten and swallowed along with fruits but seeds are egested here and there without being digested and they get a chance to grow. Seeds of Java plum (Jaamun), Chebulic Myrobalan (Harro), Myrobalan Beleric (Barro), Gooseberry (Amla), Guava (Amba), Pears (Naspaati), Myrica (kaafal), Raspberry (Ainselu) etc are dispersed by animals by swallowing and egesting.

(d) Dispersal by gravity

Dispersal by gravity is a normal method for those seeds in which either seeds or their fruits are dense and heavy. When such ripened fruits fall on the ground due to gravity, outer fruits decay and seeds are exposed to the outer environment and germinate if they get favourable conditions. Seeds of mango, apple, coconut etc are dispersed by this method.

(e) Dispersal by bursting of pods

In some plants, due to multiple reasons like the effects of sun, water, plant hormones and the turgor pressure created in the cells, their pods once burst after drying and the seeds inside such pods are ejected out forcefully around the parent plant. Seeds of mustard, ladies' finger, beans, peas, ipil ipil, chestnuts, thornapples (Dhaturo), rosary peas

Fig 5.35

(Laal gedi) etc are dispersed by bursting their pods.

Activity 5.10

Observe any ten different types of seeds and prepare a table as shown below to exhibit in your class for discussion.

Name of seed	Method of dispersal	Tentative distance of dispersion
(a)	....	....
(b)	....	....
....	....	....

Structure of seed

Let's discuss the following questions :

(a) What would be seen inside if we open the legumes soaked well in water for making curry?

(b) Is the structure of all legumes similar?

A seed is composed of mainly three parts :

(a) seed coat (b) embryo (c) endosperm

(a) Seed coat

It is the outermost covering of a seed. It is composed of multiple layers of cells and the seed coat has two layers. The outer thick layer is called Testa and the inner thin layer is Tegmen. Some seeds like coconut and litchi have tough seed coats. The seed coat protects seeds from the external environment and inhibits the germination of the seeds for a long time during unfavourable conditions.

(b) Embryo

The embryo is the main part of a seed. It is the fertile part as it turns into a plant when the seed germinates. The embryo has mainly three parts: cotyledon, radicle and plumule. During germination, the radicle develops into the root system, the plumule into the shoot system and the cotyledon turns into green embryonic leaves which initiates photosynthesis for the first time in the life of the plant. Besides turning into embryonic leaves, cotyledon also protects the radicle and plumule as well as preserves protein and starch for germinating embryos. Monocot seed has a single cotyledon, dicot has two or some pairs of cotyledons and gymnosperm has many such pairs in their seed. The first leaf in a monocot plant is developed from coleoptile.

(c) Endosperm

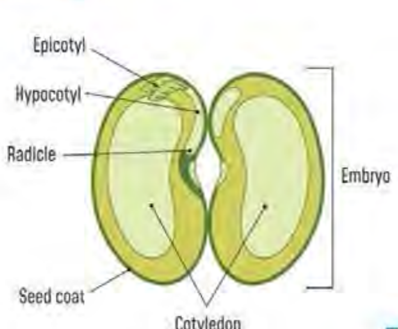
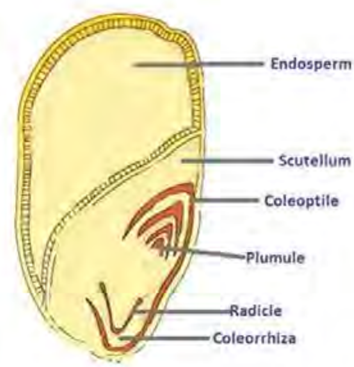


Fig 5.36



Part of the seed just under the seed coat is called endosperm. It occupies the largest volume of seed and preserves plant nutrients in the form of starch and proteins, which are used by embryo during the germination period until the new plant initiates making the food itself. Except for some, most of the dicot seeds do not have endosperm and they store such nutrients in cotyledons. All monocot seeds have endosperm to preserve nutrients and their cotyledon just protects the embryo.

Activity 5.11

Objective: To study the internal structure of soya seeds

Materials required: Some soya seeds, water, hand lens, forceps, beaker, watch-glass

Procedure :

(a) Soak soya or any dicot seeds in water for a few days.

(b) Keep some soaked seed in a watchglass and carefully remove the seed coat with forceps.

(c) Open cotyledons of peeled-off seeds carefully and observe their internal parts with a hand lens.

Observation and Conclusion

Draw the internal structure of the observed seed and label its different parts. Write a conclusion about the structure of the dicot seed after discussing the topic.

Germination of seed

The development of a new root and shoot system of a new plant from a seed is called germination. Different seeds have different germination capacities. If preserved well, some seeds can maintain their germination capacity for years. The state in which the seed remains unchanged without any process of germination is called dormancy. If a seed is provided plenty of moisture, oxygen and suitable temperature, it absorbs moisture and due to starting of a bio-chemical reaction inside the seedcells, the embryo becomes active. The Radicle of the seed first starts to germinate into the root system which is followed by the germination of plumule into the shoot system and cotyledons turn into embryonic leaves.

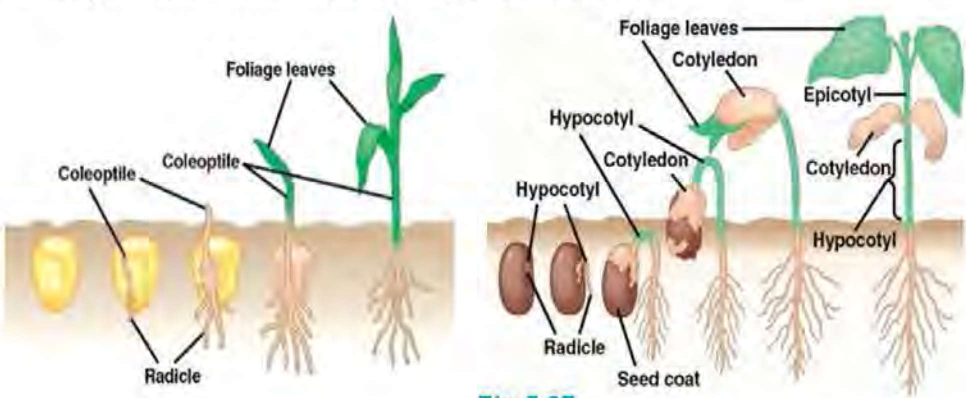


Fig 5.37

This whole state of a seed is called the germination of the seed. Germination of seed is followed by seedling. Seedling is the entire process of converting a germinating seed into a sapling ready to be transplanted on the desired site. For seedling, germinating seed prepares plenty of nutrients in the form of starch, protein minerals etc. Therefore, consuming germinating seeds is more beneficial than non-germinating grains.

Activity 5.12

Objective: To study the germination of seeds

Materials required: Some mustardseeds, a petri dish, absorbent cotton or a few circles of filter paper, water, a beaker

Fig 5.38

Procedure :

(a) Soak the seeds in water for a day.

(b) Keep soaked cotton or folded filter paper in the petri dish and sprinkle the soaked seed on the moist cotton.

(c) Leave the seed for a few days. Observe the seeds every day.

Observation and Conclusion

Observe the seeds every day and note the changes until they become plantlets. Present your conclusion on the germination of seeds in your class.

Factors affecting on germination of seeds

Many factors have an important role in the germination of seeds. Germination is affected by different internal and external factors. Moisture, temperature, air and light have a prime role in germination.

(a) Water

Seeds are stored only after drying enough in the sun. There is no metabolic activity in dry seeds. When they are soaked in water, the cells of the seed absorb plenty of water they break their dormancy, become active and start metabolism which initiates germination. Because of this, most of the seeds are soaked in water 24 hours before their sowing.

(b) Air

For the germination of seed, oxygen is essential. Oxygen generates energy in mitochondria which is necessary for their germination. During dormancy, cells of the seed are not breathing, not consuming nutrients and not generating any energy.

(c) Temperature

Seeds cannot germinate at too high or too lowtemperature. 16-24oC is the ideal temperature for most of the seeds to germinate. Suitable temperature helps to break up the dormancy of seed. When we bury seeds in the soil, they slowly get the geothermal or preserved heat along with oxygen and moisture and germinate.

(d) Light

Light is required just before and after sprouting their shoot system to begin photosynthesis for the production of nutrients. Light is a must for the seedling. Due to the lack of light in dense forests, dispersed seeds may not germinate for years at there.

Activity: 5.13

Objective: To study the effect of water on germination

Materials required: Three grains of the same seed, beaker, glass or plastic spatula, thread, water.

Procedure :

(a) Tie three same seeds with thread on a plastic or glass spatula two at two ends and one inthe middle as shown in the figure alongside.

(b) Fill half a beaker with water and place the spatula in the beaker in such a way that the middle seed should be half immersed in water.

Fig 5.39

(c) Keep the beaker with seeds in the lab for a few days.

Discussion and Conclusion :

Observe the seeds after 2-3 days, note down the changes seen in the seeds and write your conclusion about the factors of germination.

Importance of germination of seed

(a) As germination of seed results in the production of a new generation of plants, it is very necessary for the continuation of their race.

(b) Proper germination of seeds in farming increases productivity which is beneficial for farmers, consumers and the nation.

(c) Germinating seeds contain more nutrients than normal seeds, so it is better to let the seeds germinate before they are consumed.

(d) Proper germination of seeds of grass and trees in forests and pastures assists to conserve biodiversity.

Exercise

1. Choose the best alternative from the given options :

(a) Which method does thatch-grass (Khar) adopt to disperse their seeds?

i) through air ii) through water

iii) by bursting pods iv) by birds

(b) What is the main function of a seed?

i) to determine fruit ii) to produce a new plant

iii) to continue their race iv) to preserve nutrients

(c) Which of the following event occurs during germination?

i) Plumule and radicle become active and make cotyledon.

ii) Endosperm is turned into the root system.

iii) Stem is grown from the seedcoat.

iv) Cotyledons turn into embryonic leaves.

(d) Which of the following figure indicates seedling?

i) A ii) B iii) C iv) D

(e) Why are seeds not stored in moist or wet places?

i) to prevent the decaying of seeds

ii) to store seeds for a long time

iii) to prevent seeds from fungal attack

iv) to prevent germination

(f) Which statement regarding the 'dormancy' is correct?

i) it preserves the life and germination potential of seeds.

ii) it preserves nutrients in seeds.

iii) it protects seeds from air and water.

iv) it conducts biochemical reactions during the germination of seeds.

(f) Seeds of red silk cotton trees, Aak trees, Kans, maple etc which are dispersed through wind have either air sacs or wing-like structures. How do these structures help them to be dispersed?

i) these structures protect the seed from a strong current of air and are dispersed.

ii) these structures help seeds to burst when they are fully ripened.

iii) these structures help seeds to be exposed to fruits and then dispersed.

iv) theses structures decrease the density of seeds and help them float in the air while dispersing.

2. Differentiate :

(a) Dispersal of seeds and Germination of seeds

(b) Plumule and Radicle

(c) Dispersal of mustard seeds and Dispersal of myrica seeds

3. Give reason :

(a) Seeds start germinating if soaked in water.

(b) Seeds of red silk cotton are dispersed over a long distance.

(c) Seeds continue the race of generation.

4. Answer the following questions :

(a) What is a seed? Give examples.

(b) Write the methods of dispersal of seeds and explain any one of them with a figure and example.

(c) What is meant by seed dormancy? How does it help seeds?

(d) Explain the germination process of seeds with a suitable diagram.

(e) What is the role of air in the germination of seeds?

(f) Mention the importance of the germination of seeds in points.

(g) Read the given passage and answer the following questions :

Suryanaraya dug his field well with a tractor to sow wheat and put compost manure. The next day he sowed wheat and dug the field once again which helped to bury all seeds in the soil. After a few days, he went to the field to observe the condition. At the moistened part, the seedling was good but at the dry part, germination and seedling were not uniform

i) Why did Suryanarayan again dig the field after sowing wheat?

ii) What may be the reason for seeds not germinating inthe dry part of the field?

iii) What should be done for proper seedlings at every corner of the field?

(h) Name the method of dispersal for the given seeds :

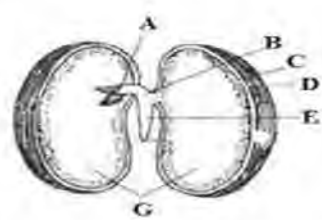
Mango, chestnut, maple, gram, cobblers pegs (Kuro), sesame seed (Teel), pumpkin, coconut, pear.

(i) Study the given figure and answer the following questions :

i) Name the parts A, B, C, D, E and G.

ii) While germinating, what is developed from part A?

iii) Do all seeds have part G? What does this part do?



(j) 'Consuming germination seeds is more beneficial than normal dry seeds'. Clarify this statement with logic.

6 Force and Motion

Observe these pictures and discuss the questions given below:

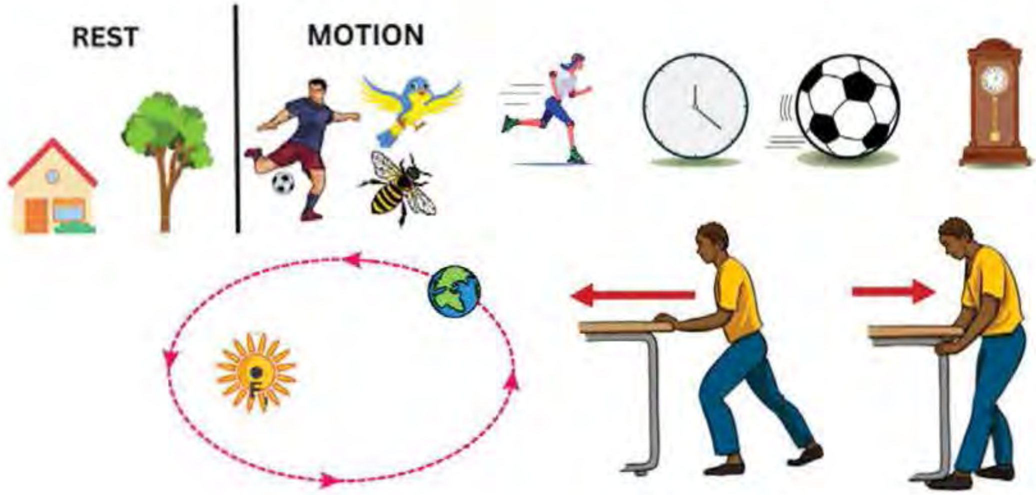


Fig 6.1 Different condition of motion and rest

Questions:

(a) Which objects in the pictures are at rest and which are in motion?

(b) Do all objects have the same types of motion?

(e) What should be done to move the object?

All objects in the universe are either at rest or in motion. To know whether an object is at rest or in motion, it must be compared with a point, place or surrounding environment.A reference point is a point, place or object used to determine whether something is at rest or in motion. Flying birds, moving buses, walking people etc. are in motion compared to the surrounding environment. If an object at rest changes position when a force is applied to it, it is saids to be in motion. Force is required to change the position of an object from rest to motion or motion to rest.

6.1 Motion

The objects which are moving, flying, rolling and flowing around us are said tobe in motion. The buildings and trees in our surroundings are said to be at rest because they do not change their position relative to the surrounding objects. Objects in motion are changing their position relative to surrounding objects. The same object can be considered being at rest or in motion relative to a different point, place or surrounding environment. For example, while travelling on a moving bus, the passengers inside the bus are at rest relative to the bus but they are in motion relative to the surrounding. Therefore,rest and motion are relative terms. In this unit, we will discuss rest and motion, speed, average speed, velocity, relative velocity and acceleration.

Motion: An object is said to be in motion if it changes its position with respect to the reference point or surrounding environment. For example, flying aeroplanes, moving vehicles, walking people, rolling balls etc. are in motion with respect to the surrounding.The motion of objects is categorized as uniform and non-uniform motion. If an object covers equal distances in equal intervals of time then its motion is said to be in uniform motion but if it covers unequal distances in equal intervals of time, then its motion is said to be in non-uniform motion.

Rest: An object is said to be at rest if it does not change its position with respect to a reference point or surrounding environment. For example houses, trees, vehicles in parking areas etc. are at rest relative to the surrounding environment.

Speed and Velocity:

Between a deer and a cheetah, which can run faster? Some objects move faster while others move slowly. If a car moves at 20 m/s means the car moves 20 meters distance in every second. The speed of sound in air is 332 m/s means that sound travels 332 meters distance in one second. Distance travelled by the body in a unit time is called speed. Speed is measured in meters per second (m/s) in S.I. unit.

$$\text{Speed (S)} = \frac{\text{distance travelled (d)}}{\text{time taken (t)}}$$

A fast-moving object has a higher speed than the one that moves slowly. Speed is a scalar quantity because it has magnitude but no direction.

Velocity is defined as the distance travelled by the body in a unit time in the particular direction or the rate of change of displacement. Its S.I. unit is meter per second (m/s). For complete description, velocity requires both magnitude and direction. So, velocity is a vector quantity. Velocity can be expressed in the form ofthe following mathematical equation;

$$\text{Velocity (V)} = \frac{\text{distance travelled in particular direction (s)}}{\text{time taken (t)}}$$

Speed and velocity may be used synoymously in daily life but, in physics, they represent different physical quantities.

6.1.1 Relative velocity

Discuss the following questions:

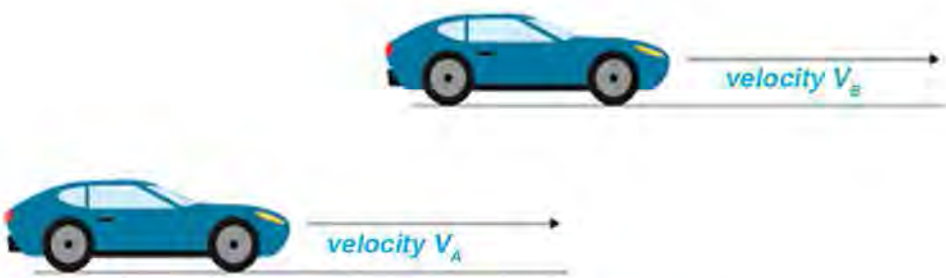


Fig 6.2 Relative Velocity

i. Passengers in a moving bus are at rest or in motion, why?

ii. Why do we feel that our bus is moving slowly when another bus overtakes our bus moving in the same direction?

iii. Why do we feel that the bus is moving faster if another bus passes nearby in opposite direction?

Passengers in a moving bus do not change their position so they are at rest with respect to the bus. These passengers are changing their position with respect to the surrounding place or environment. Therefore,they are in motion with respect to the surrounding. Rest and motion are relative terms.

Any fixed point, line or place from which we compare the motion of an object is a reference point. In Fig 6.3, the line MN is the reference line and 'P' is the reference point for the car 'A' and 'B'. Car 'A' is moving at the speed of 10 m/s in the west direction and car 'B' is moving at the speed of 15 m/s in the east direction. The velocity of a body relative to the reference point or another body is called relative velocity.

Fig 6.3 Objects moving with different speeds in the opposite direction

Finding the relative velocity of a body in different cases:

(a) Both objects are moving atthe same speed in the same direction.

Let us suppose that bus 'A' and bus 'B' are moving in the same direction from the reference line PQ in a parallel road. The velocity of both buses is 22 m/s. Both buses cover 22 meters distance in every second so they lie at an equal distance from the reference line after 1 second. The condition of the buses after 1 second is shown in Fig 6.4. Bus 'A' is at rest relative to the position of bus 'B' and vice-versa.So, the passengers in both buses experience the condition that they are at rest. This is because both the buses are moving with the same speed in the same direction.

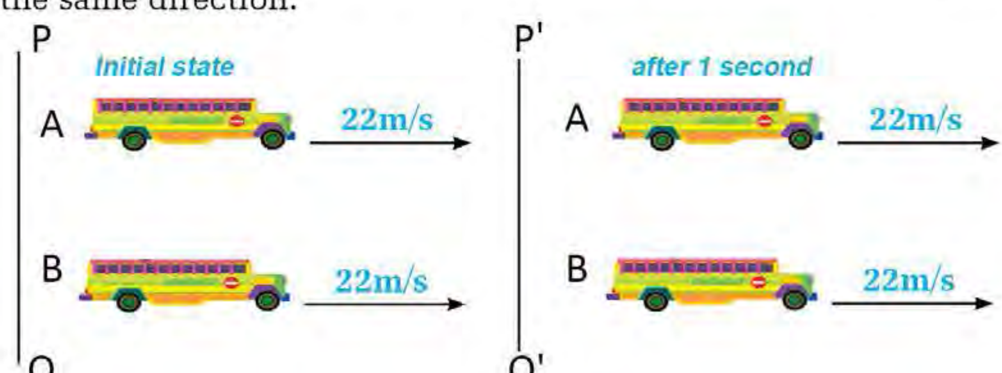


Fig 6.4 Buses moving in the same direction at the same speed

The relative velocity of the bus 'A' with respect to bus 'B' is expressed as,

Relative velocity (vBA) = Velocity of B (vB) – Velocity of B (vA)

$$V_{AB} = V_B - V_A = (22 - 22)\ m/s = 0$$

(a) Both objects are moving in the same direction at different speeds.

Let us suppose that bus 'A' and bus 'B' are moving in the same direction from the reference frame MN in a parallel road. The velocity of bus 'A' is 10 m/s and bus 'B' is 15 m/s. The position of both buses after 1 second is shown on the right side of the given picture where bus 'A' covers 10 m and bus 'B' covers 15 m of distance in 1 second. These buses are 5 meters apart after 1 second. So, the relative velocity of the bus 'A' with respect to bus 'B' is 5 m/s.

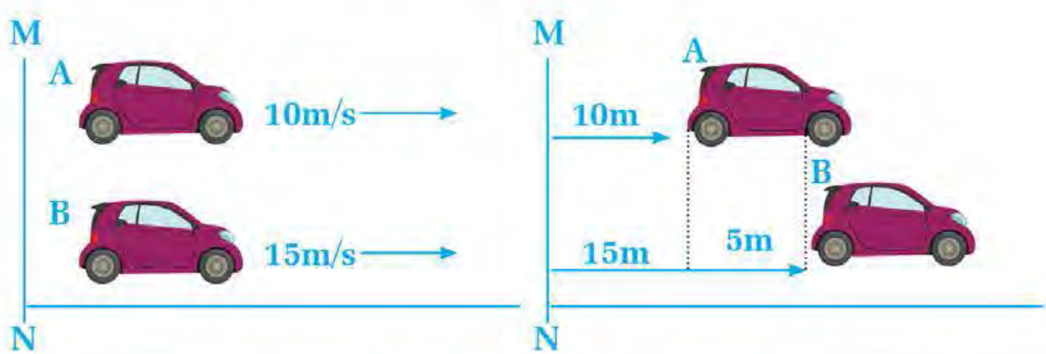


Fig 6.5 Buses moving in the same direction with different speed

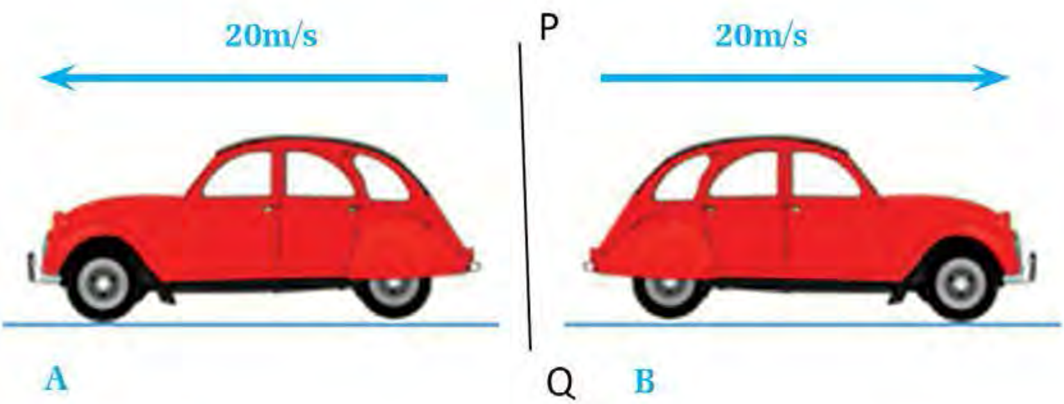


Fig 6.6 buses are moving in opposite direction

(c) Objects moving in a different direction at the same or different speed

The cars 'A' and 'B' moving in the opposite direction from the reference line PQ in Fig 6.6. The cars 'A' and 'B' are moving at the same speed 20 m/s in opposite directions. Therefore, the relative velocity of car 'A' with respect to car 'B' is expressed as,

Relative velocity (V_{AB}) = Velocity of A (V_A) – Velocity of B (V_B)

or, $VAB = V_A - V_B$

or, $VAB = VA - (-_{VB})$

or $VAB = V_A + V_B$

The passengers in both cars experience that they are travelling faster than the speed of their car due to relative velocity in this situation.

Example -1

Two buses 'A' and 'B' are moving in the same direction with the velocity 15 m/s and 10 m/s respectively. Find the relative velocity of the bus 'A' with respect to bus 'B'. What would be their relative velocity if they are moving in the opposite direction? Here,

velocity of bus 'A' (V_A) = 15 m/s

velocity of bus 'B' (V_B) = 10 m/s

relative velocity ofthe bus 'A' with respect to bus 'B' (V_{AB}) = ?

We know that, $(V_{AB}) = V_A - V_B$

or, V_{AB} = 15 m/s – 10 m/s

$\therefore$ VAB = 5 m/s

If they are moving in the opposite direction,$(V_{AB}) = V_A + V_B$

or, (V_{AB}) = 15 m/s + 10 m/s

$\therefore (V_{AB})$ = 25 m/s

Therefore, the relative velocity of the bus 'A' with respect to bus 'B' is 5 m/s if they move in the same direction and 25 m/s if they move in the opposite direction.

6.1.2 Average velocity

Any object in uniform motion has a fixed velocity whereas the velocity of the object in non-uniform motion increases or decreases. In the case of non-uniform motion, the velocity of the body increases or decreases so we need to calculate its average velocity. The total distance travelled by the body in unit time in a particular direction is called average velocity.

$$\text{Average velocity } (v\text{ -}) = \frac{\text{total distance travelled in particular direction (S)}}{\text{total time taken (t)}}$$

$\therefore \bar{v} = s/t$

Here, $\bar{v}$ = average velocity

s = total displacement (total distance travelled in a particular direction) t = total time taken

Example – 2

Find the average velocity if an object covers 10 meters of distance in 3 seconds in a particular direction and another object covers 17 meters of distance in 6 seconds in the same direction.

$$\text{Average velocity} = \frac{\text{total distance travelled in particular direction (s)}}{\text{total time taken (t)}}$$

$$\text{or, Average velocity}(\bar{v}) = \frac{S}{t} \qquad = \frac{(10\text{ m}+17\text{ m})}{(3+6)} = 3\text{m/s}$$

If an object has different velocities at different times, then its average velocity is calculated by the formulae given below by assuming its initial velocity (u) at the beginning and final velocity (v) at the end;

$$\text{Average velocity} = \frac{\text{Initial velocity(u) + Final velocity (v)}}{2}$$

$$\bar{v} = \frac{u+v}{2}$$

Activity 6.1

Gathered all the students of your grade in one place. Find the distance between your home and school by asking your parents or using google maps. Note down the average time required for you to come to the school in the table given below. Find the average velocity based on data.

S.N.	Name of the student's	Total time taken to come to school
	Distance between school and home	
1.		
2.		
.....		
	Average distance =	Average distance =

$$\text{Average distance} = \frac{\text{total distance travelled in particular direction (s)}}{\text{total time taken (t)}}$$

6.1.3 Acceleration

Questions to think about:

(a) What would be the change in velocity of an object if it is released from a certain height or thrown vertically upwards?

> **Things to know:**
> If an object moves from rest then its initial velocity (u) is 0 m/s and if an object is stopped suddenly then its final velocity (v) is 0 m/s.

Generally, a car, motorcycle or bus in motion has non-uniform velocity.Their velocity sometimes increases and sometimes decreases. The velocity of the bicycle increases on a sloppy road. Similarly, if an object is released from a height then its velocity continuously increases. The rate of increase in velocity is called acceleration. The change in velocity of a body in a unit time is called acceleration. It is denoted by 'a' and its S.I. unit is m/s^2.

Let us consider the bicycle is moving with the uniform velocity 'u' and it is accelerated to its final velocity 'v' in time 't', then the change in velocity of the bicycle is (v-u) so, its acceleration is given by,

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{time taken}}$$

$$\text{or, Acceleration} = \frac{\text{Final Velocity} - \text{Initial velocity}}{\text{Time taken}}$$

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

If any object is moving with uniform velocity then the acceleration of the body is zero because there is no change in velocity. If the brake is applied to the moving vehicle then its final velocity is less than the initial velocity so its velocity is decreased. In the case of retardation, the final velocity of a body is less than the initial velocity ($v<u$), so it has negative acceleration ($-a$).The rate of decrease in velocity of the body is called retardation. Negative acceleration is called retardation of a body.

Example – 3

Calculate the acceleration of the bus starting to move from rest and its velocity becomes 25 m/s in 10 seconds.

Solution:

Here,

Initial velocity (u) = 0

Final velocity (v) = 25 m/s

time taken (t) = 10 s

acceleration (a) =?

By using formulae,

$$\therefore \quad a = \frac{(v-u)}{t} = 2.5 \text{ m/s}^2$$

$$\frac{25-0}{10}$$

The acceleration of this bus is 2.5 m/s^2.

Example – 4

Calculate the retardation of the bus which is moving at the speed of 20 m/s and comes to rest in 4 seconds.

Solution:

Here,

Initial velocity (u) = 20 m/s

Final velocity (v) = 0

time taken (t) = 4 s

retardation (-a) =?

By using formulae, $a = \frac{(v-u)}{t}$

or, $a = \frac{0-20}{4}$

or, $a = -5\ m/s^2$

$\therefore$ retardation $(-a) = 5 m/s^2$

The retardation of this bus is $5 m/s^2$

Project work:

Mark two points at a distance of 200 m on a road or playground. Mark another point exactly in the middle between these two points. Call two of your friends and request them to run in the opposite direction from the mid point. Note down the time required for them to cover 100 m of distance. Calculate the velocity and relative velocity of one person with respect to others.

Exercise

1. Choose the best alternative:

(a) What is the condition of an object called if doesn't change its position with respect to the reference frame or surrounding?

(i) motion (ii) velocity

(iii) rest (iv) speed

(b) What is the formula to calculate the relative velocity of two bodies moving in the opposite direction?

(i) $V_{AB} = V_A / V_B$ (ii) $V_{AB} = V_A - V_B$

(iii) $V_{AB} = V_A \times V_B$ (iv) $VAB = V_A + V_B$

(c) What is the shortest distance between any two points in a partcular direction?

(i) speed (ii) displacement

(iii) average velocity (iv) relative velocity

(d) In which condition the average velocity of an object is calculated?

(i)non-uniform motion (ii) uniform motion

(iii) zero acceleration (iv) object at rest

(e) What is the S.I. unit of acceleration?

(i)m/s (ii)m/s^2 (iii)Nm^2/kg^2 (iv)m^2

(f) Which one of the given statements is true?

(i) negative acceleration is produced if an object moves with uniform motion.

(ii) acceleration is not produced if an object is moving with non-uniform motion.

(iii) positive acceleration is called retardation.

(iv) rate of change in the velocity of a body is called acceleration.

2. Differentiate between:

(a) distance and displacement

(b) average velocity and relative velocity

(c) acceleration and retardation

3. Answer the following questions:

(a) Define the reference point.

(b) What is acceleration?

(c) What do you understand by retardation?

(d) What is meant by relative velocity?

(e) Write down the formula to calculate the relative velocity of a body moving in the same and opposite directions with examples.

(f) What is average velocity?

(g) What is the condition in which the average velocity of a body is calculated? Write down formulae to calculate average velocity.

4. Solve these numerical problems.

(a) If a bus covers 4.2 km of distance in 7 minutes, then calculate its average velocity. (Ans: 10 m/s)

(b) If a car starts to move from rest and its velocity becomes 30 m/s in 12 seconds then find its acceleration. (Ans: 2.5 m/s2)

(c) Find the final velocity of the car if it starts to move from rest with the acceleration of 5 m/s^2 in 6 seconds. Calculate the average velocity of the car. (Ans: 15 m/s and 7.5 m/s)

(d) If the brake is applied in a car moving with uniform velocity then the retardation of 2 m/s^2 is produced and the car stops after 4 seconds. Calculate the initial velocity of the car. (Ans: 8 m/s)

(e) If two motorcycles are moving at the speed of 50 km/hr and 60 km/hr in the same direction. Calculate the relative velocity between these motorcycles. If they were moving in opposite directions what would be the relative velocity between them? (Ans: 10 km/hr and 110 km/hr)

6.2 Lever

Observe these pictures and discuss the questions given below.

Fig 6.8 Different machines used in daily life

Questions:

i. What are the uses of these tools shown in the picture?

ii. Is it possible to lift a heavy load by using less effort with these tools?

iii. What are the other similar tools used in daily life?

You might have seen beam balance, *dhiki*, scissors, tongs, wheelbarrows and crowbars used to turn a heavy load. These tools rotate through a fixed point to lift a load and they are called lever. Lever is a rigid bar which can turn through a fixed point called the fulcrum.

Things to know:
"If you give me a lever and a place to stand, I can move the world" This is the famous proverb said by Archimedes. He was invented a lever in 240 BC.

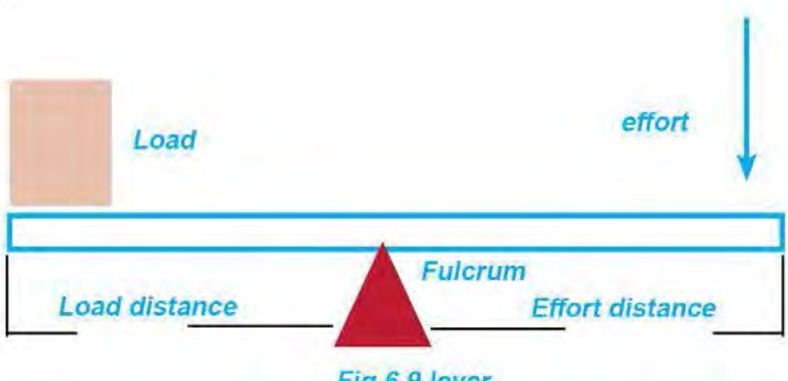


Fig 6.9 lever

The fixed point through which the lever rotates is called fulcrum. The force applied in the lever is called effort (E) and the object which must be lifted by using the lever is called load (L). The distance between the fulcrum and load is called load distance (L.d.) whereas the distance between effort and fulcrum is called effort distance (E.d.). So, any lever has fulcrum, load, effort, load distance and effort distance. The part of the lever between the fulcrum and the load is called the load arm and the part between the fulcrum and effort is called the effort arm.

Types of lever

Levers are classified into three types based onthe position of fulcrum, load and effort.

(a) First-Class Lever:

The lever in which the fulcrum lies between load and effort is called the first-class lever. Effortlies at one end and load at the another end in first-class lever. Beam balance, scissors, dhiki, crowbar etc. are examples of the first-class lever.

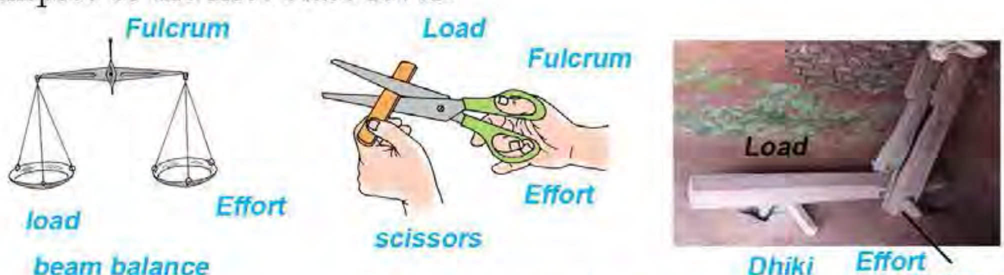


Fig 6.10 First-class lever

(b) Second Class Lever:

The lever in which load lies between the fulcrum and effort is called the second class lever.Fulcrum lies at one end and effort at the another endin second-class lever. Nut-cracker, lemon squeezers, one-wheel barrows etc. are examples of the second-class lever.

Fig 6.11 Third Class Lever

(c) Third Class Lever:

The lever in which effort lies between the fulcrum and load is called the third-class lever. Fulcrum lies at one end and load at the another end in third-class lever. Fire tongs, Shovels and hammers etc. are examples of the third-class lever.

Fig 6.12 Second Class Lever

Activity 6.2

Write down the name of the levers shown in the picture and classify them as a first, second or third-class lever.

S.N.	Name of the lever	Types of lever
1.		
2.		
3.		
4.		

Project work:

Collect the levers used in your daily life or found in surroundings and classify them as a first-class, second-class or third-class lever.

Working principle of lever

Activity 6.3

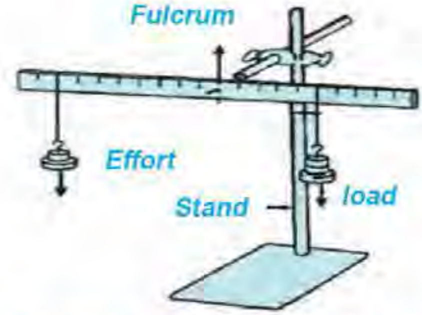


Fig 6.13 Tools based on the Principle of a Lever

Take a 1 m long thick plastic scale. Make a hole exactly in the middle (at a distance of 50cm from the left). Balance the scale by inserting a piece of wire into the hole as shown in the picture. Balance the various masses hanging to the right and left of the scale. Convert mass to the effort. 1 kg mass equals 10 N effort on the earth's surface. Consider the mass on the right as load and the mass on the left as effort. Balance the load by placing mass at different distances from the hole. Measures the load and effort distance from the hole by considering the hole as a reference point. Fill the result obtained from this experiment in the table given below.

S.N	Left side			Right side		
	Effort (N)	E.d.(cm)	E×E.d.	Load (N)	L.d. (cm)	L×L.d.
1.	8N	5	40	4	10	40
2.						

From the above activity we can conclude that;

If the lever is in balanced condition,

Or, Effort × Effort Distance = Load × Load Distance

$\therefore$ E × E. D. = L × L. D.

More effort is required if the effort distance is less and if the load distance is less we need less effort to lift the load. In equilibrium condition, all the levers work on the principle i.e.E × E.D. = L × L.D.

Example 1

The load of 800 N is lifted by using the crowbar in the given picture. Calculate the effort required to lift the load if the distance between the fulcrum and the load is 50 cm and the distance from the fulcrum to the effort is 1.5 m.

Here,

Load (L) = 800 N

Load distance (L.D.) = 50 cm = 50/100 m = 0.5 m

Effort distance (E.D.) = 1.5 m, Effort (E) = ?

According to the principle of the lever,

$E \times E.D. = L \times L.D.$

or, $E \times 1.5 = 800 \times 0.5$

$$\therefore \text{Effort} = \frac{800 \times 0.5\text{m}}{1.5\text{m}} = 266.66\text{N}$$

Mechanical Advantage-MA

Less effort is required to lift the heavy load by using the lever. For a lever, the ratio of load to the effort is called mechanical advantage. Mechanical advantage is calculated to give the number of times to which the applied effort is multiplied while lifting the load.

$$\text{Mechanical advantage (MA)} = \frac{\text{Load (L)}}{\text{Effort (E)}}$$

$$\text{0r,MA} = \frac{L}{E}$$

Mechanical advantage is the ratio of two similar physical quantities of force so it has no units.

For example, if a person requires 150 N of effort to lift a load of 600 N by using alever, thenmechanical advantage of the lever is:

$$(MA) = L / E$$

$$MA = \frac{600N}{50N} = 4$$


Fig 6.14 Use of the Lever

The mechanical advantage of any simple machine is 4, which means that the machine can lift a load which is 4 times heavier than the applied effort. Mechanical advantage is the ratio of two forces so it is affected by friction. Frictional force reduces the mechanical advantage. If the mechanical advantage of a machine is more than 1, then such a machine multiplies the applied effort but if the mechanical advantage of a machine is less than one; then more effortis required than the load to lift.

Velocity Ratio:

Both load and effort cover a certain distance when the load is lifted by using a lever. The distances covered by load and effort are not equal in simple machines. When the heavy load is lifted by using less effort, then the effort covers more distance than the distance covered by the load. So, the velocity of effort is more than the velocity of the load. The ratio of the velocity of effort to the velocity of the load is called the velocity ratio.
Both load and effort cover a certain distance in equal time so,

$$\text{Velocity ratio (VR)} = \frac{\text{distance travelled by effort(E.D.) time(t)}}{\text{distance travelled by load(L.D.) time(t)}}$$

$$= \frac{\text{(distance travelled by effort(E.D.))}}{\text{(distance travelled by load(L.D.)}}$$

$$= \frac{\text{(effort distance(E.D.)}}{\text{(load distance (L.D.)}}$$

The velocity ratio of a simple machine is not affected by friction. Mechanical advantage is affected by friction but not the velocity ratio so, the mechanical advantage is always less than the velocity ratio.

Efficiency

Work done by effort in a simple machine is called input work

Input work (W_i) = Effort (E) × Effort distance (E.D.)

Work done by the machine when the effort is applied to it is called output work. Input work (Wo) = Load (L) × Load distance (L.D.)

The ratio of output work to the input work expressed in percentage is called the efficiency of a machine. It is denoted by the Greek alphabet eta (η).

$$\text{Efficiency}(\eta) = \frac{\text{input work}}{\text{output work}} \times 100\%$$

$$\frac{\text{Load (L) x Load distance(L.D)}}{\text{Effort (E) x Effort distance (E.D.)}} \times 100\%$$

$$\text{Efficiency}(\eta) = \frac{\text{Load (L) x Load distance(L.D)}}{\text{Effort (E) x Effort distance (E.D.)}} \times 100\%$$

$$\text{Efficiency}(\eta) = \frac{\text{mechanical advantage(MA)}}{\text{Velocity ratio(VR)}} \times 100\%$$

Mechanical advantage is always less than the velocity ratio due to friction. Therefore, the efficiency of any machine is always less than 100 %. The imaginary machine having 100 % efficiency is called ideal or perfect machine.

Example-2

An effort of 150 N is required to lift a load of 600 N in the lever. If theeffort covers 7.5 m distance and the load covers 1.5 m distance, then calculate the mechanical advantage, velocity ratio and efficiency of the lever.

Here,

load (L) = 600 N

effort (E) = 150 N

effort distance (E.D.) = 7.5 m

load distance (L.D.) = 1.5 m

mechanical advantage (MA) =?

velocity ratio (VR) =?

efficiency (η) =?

By using formulae,

$$\text{Mechanical Advantage(M.A)} = \frac{\text{Load (L)}}{\text{Effort (E)}} = \frac{600\text{ N}}{150\text{ N}} = 4$$

$$\text{Velocity Ratio (V.R.)} = \frac{\text{Effort distance (E.D.)}}{\text{Load distance (L.D.)}} = \frac{7.5\text{ m}}{1.5\text{m}} = 5$$

$$\text{Efficiency}(\eta) = \frac{\text{mechanical advantage(MA)}}{\text{Velocity ratio(VR)}} \times 100\% = \frac{4}{5} \times 100\%$$

Efficiency(η) = 80%

Therefore, mechanical advantage (MA) = 4, velocity ratio (V.R.) = 5 and efficiency = 80%.

Exercise

1. Choose the best alternative:

(a) Which one of the following simple machines is a second-class lever?

(i) shovel (ii)dhiki

(iii) nut-cracker (iv) hammer

(b) What is the principle of the lever in a balanced condition?

(i) Effort × Effort distance = Load × Load distance

(ii) Effort = Load

(iii) Effort distance = Load distance

(iv) Mechanical advantage = Efficiency

(c) What is the work done by effort called?

(i) input work (ii) output work

(iii) friction (iv) gravitational work

(d) Which one of the following is not affected by friction?

(i) mechanical advantage (ii)velocity ratio

(iii) efficiency (iv)input work

(e) Which of the following given statements is true?

(i) The product of load and effort in the balanced condition of the lever is velocity ratio.

(ii) Effort covers less distance than load while lifting a load heavier than effort.

(iii) Both the mechanical advantage and velocity ratio have their units.

(iv) The ratio of output work to the input work expressed in percentage is called efficiency.

2. Differentiate between:

mechanical advantage and velocity ratio input work and output work

3. Give reasons:

(i) The efficiency of the lever is never 100 %.

(ii) It is easier to push the load in a wheelbarrow while shifting
(iii) the load towards its wheel.

Mechanical advantage is always less than the velocity ratio.

4. Answer the following questions:

(i) How can we lift the heavy load by using a lever?

(ii) Which class lever is a scissor?

(iii) What can be done with a lever whose mechanical advantage is more than 1?

(iv) What are the other advantages of lever besides making our work easier?

(v) What is called the work done by effort in a machine?

5. Solve these numerical problems:

(i) An effort of 75 N is required to lift the load of 300 N. Calculate the effort distance if the distance of the load from the fulcrum is 25 cm. (Ans: 100 cm)

(ii) The weight of Sarad is 550 N and Nirmal is 300 N. Sarad and Nirmal are playing see-saw. How far does the Nirmal sit from the centre to balance the Sarad who sits at a distance of 1.5 m from the center. (Ans: 2.75 m)

(iii) If 300 N effort is applied to lift a load of 900 N by using 2 meters long lever. Calculate the mechanical advantage, velocity ratio and efficiency of the lever if the load lies at a distance of 50 cm from the fulcrum.
(Ans: MA = 3, VR=3, η= 100%)

6.3 Pressure

Activity 6.4

Take a ball pen without refill. Try to apply gentle force on the wrist from the pointed end of the ball pen. Repeat the same with the back side of the ball pen as before. What difference can be experienced between these two activities?

Activity 6.5

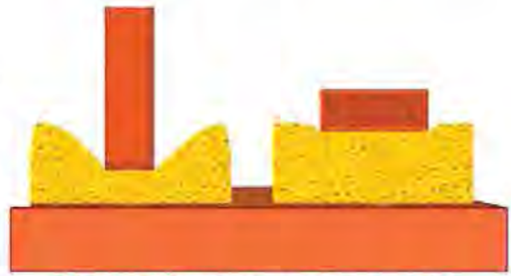


Fig 6.15 Pressure exerted by brick indifferent orientations.

Take a brick and a piece of foam. Place the foam on a plank or table and place the brick on it with a wide surface as shown in the figure. Observe how much the foam is compressed. Again, place the brick on the foam with a narrow surface of the brick in contact with the foam. How much is the foam compressed? Observe the difference in compression of the form while keeping the brick in a different orientation. What conclusions can be drawn from this activity? In activity 6.4, applying force on the wrist from the tip of the non-refillable ball pen hurts more, while it hurts less from the back part of the ball pen, why? Similarly, in the second activity 6.5,the depression in the foam will be more when the narrow surface of the brick is in contact with it.

When we apply force to any object and if the area over which the force is applied is larger, thenthe effect of force will be less. However, if the area is less, the impact of the force will be more. The impact of force on an area is called pressure. Thus, the pressure is defined as the force acting perpendicularly per unit area.

Measurement of Pressure

The pressure exerted by an object at any point depends on the force applied to it. Pressure increases with the increase in force. Similarly, the lesserthe area of the surface of the body the more will be the pressure. Pressure depends on the magnitude of force applied on the surface and thearea ofthe surface over which the force is applied. If 'F' be the force applied at any point on the surface whose surface area is 'A' and 'P' be the pressure exerted on the surface then,

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

or, P = F/A

In the S.I. system, force is measured in Newton (N) and the area is measured in square meter(m^2).Therefore, newton per square meter (N/m^2) is the S.I. unit of pressure. It is also called Pascal (Pa).

1 Pascal pressure: The pressure exerted by the force of 1N acting perpendicularly on an area of 1 m^2 is called 1 Pascal pressure.

$\therefore$ 1 Pa = 1 N/m^2

Example: 1

If 1.5 m2 of anarea is covered by the cupboard of weight 1800 N, calculate the pressure exerted by the cupboard. What would be the pressure exerted by the cupboard if itcovers an area of 3 m2?

Here,

Weight of the cupboard or force (F) = 1800 N

Area covered by cupboard (A) = 1.5 m2

Pressure (P) =?

Pressure (P) = F/A = $1800N/1.5m^2$ = 1200 pa

force (F) = 1800 N

area (A) = 3 m^2

Pressure (P) = F/A = $(1800\ N)/3m^2$ = 600 Pa

Here, more pressure is exerted by the cupboard if it covers less area. Pressure will be reduced to half if its area is doubled.

Applications of Pressure in daily life

Pressure has an important role in different work that we do in our daily life. Sharp plough share made of iron is used to plough the field to make it easier to ploughbecause more pressure will be exerted even while applying less force due to less area of the ploughshare. Similarly, one end of the sickles and knife are made sharper to cut or chop the wood easily.The tip of the iron nail is made sharper to drive the nails easily on the wall.

In some cases, more pressure may make it difficult to work in daily life. In such situations, pressure has to be reduced. For example, the back wheel of a tractor is made big and wide to esure that it does not sink on the ground while digging a field. Similarly, pair of tyres are

Fig 6.16 Application of Pressure

used in the back side of the buses and multiple wheels are used in the back side of heavy trucksso less pressure is exerted on the road.

Questions to think:

(a) Why is the foundation of the house made wider than its walls?

(b) How do the broad feet of the camel help them to walk in the desert?

(c) Why do pencil-hill shoes make a deeper impression than the flat heel shoes on the soft ground?

Pressure of liquid

Activity 6.6

Take a polythene container or a mineral water bottle or a tin can. Make three holes in it at different heights. Fit a short piece of fine pipe in those holes with multipurpose sealant (M-seal) and seal their mouths temporarily with tape and fill the water in the vessel.

Fig 6.17 Variation of Liquid pressure with depth

Now remove the tape simultaneously and observe what happens. In this experiment, the pressure of the water coming out from the bottomhole is the maximum. After that, pressure gradually decreaseson the upper holes.

Why does this happen? Discuss with teachers and friends and present the findings in the class.

Liquid also exerts pressure on the surface of an object like a solid due to its weight. But unlike solids, liquid exerts pressure in all directions. The pressure exerted by the liquid in a unit area of the container is called liquid pressure.

Measurement of prersure of liquid

Let us consider the liquid of density 'd' is filled in the container of height 'h' having cross-section area 'A'. The acceleration due to gravity at this place is 'g'. The volume of liquid in the container is given by, $V = A \times h$.

The force exerted by the liquid at the bottom of the container is called the weight of that liquid.

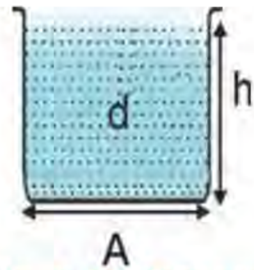


Fig 6.18 Pressure exerted by a liquid

The pressure exerted by the liquid column at its bottom is the force acting normally per unit area of the body.

Therefore,

$$\text{Pressure (P)} = \frac{\text{weight of liquid column(W)}}{\text{cross section area (A)}}$$

$$\text{or, } P = \frac{W}{A} = \frac{\text{mass (m)} \times \text{acceleration due to gravity(g)}}{A} \quad (\because w = mg)$$

$$\frac{\text{density (d) x (volume (V)} \times \text{acceleration due to gravity(g)}}{A} \quad m = d \text{ x } V$$

$$= \frac{d \times V \times g}{A}$$

$$= \frac{d \times A \times h \times g}{A} \quad (V = A \text{ x } h)$$

$$\therefore P = hdg$$

From the above relation, the pressure exerted by a liquid depends on the depth of the liquid column (h), density of the liquid (d) and acceleration due to gravity (g). The pressure exerted by liquid increases with the increase in depth of the liquid column and density of the liquid.

Example: 2

Calculate the pressure exerted by the water tank of a height 2 m at its bottom if it is completely filled with water. (density of water = 1000 kg/m^3)

depth of the water tank (h) = 2 m

density of liquid (d) = 1000 kg/m^3, acceleration due to gravity (g) = 9.8 m/s^2, liquid pressure (P) =?

Liquid pressure (P) = $h \times d \times g$

$$= 2 \times 1000 \times 9.8 = 19600 \text{ Pa.}$$

Example: 3

Calculate the density of liquid if 800N/m^2 of pressure is exerted at the bottom of the tank of height 3 m which is filled with that liquid. ($g = 9.8\ m/s^2$)

depth of the liquid column (h) = 3 m

liquid pressure (P) = 800 N/m^2

acceleration due to gravity (g) = 9.8 m/s^2

density of liquid (d) = ?

We know that, $\underline{P = h \times d \times g}$

$$\text{or } d = \frac{P}{hg} = \frac{800}{3 \times 9.8} = 27.21\ kg/m^3$$

$\therefore d = 27.21\ kg/m^3$

The density of the liquid in the container is 27.21 kg/m^3.

Questions to think:

(a) Why is the blood pressure in our body more towards the feet than towards the head?

(b) Why is itmore difficult for the fish that lives in a river to survive in the ocean?

Application of Liquid Pressure in daily life:

Liquid has weight and it exerts pressure. The pressure exerted by liquid increases with the increase in depth of the liquid column so it has various applications in our daily life. Some applications of liquid pressure in daily life are given below;

(a) The bottom of the dam is made thicker than its walls and the bottom of the water tank is made thicker.

(b) Deep sea driver wears special custume to go deep into the sea.

(c) A water tank is kept at the maximum height in the house.

(d) The bottom of the bottle used for holding mercury is made thicker than the bottles made for holding other liquids.

Air Pressure

Have you filled the air in the ball with an air pump? Have you seen the air filled in the tubes of bicycles, motorcycles and other vehicles? You must have seen that the oxygen cylinder is filled with oxygen gas. Air can be compressed while filling in balls, tubes, cylinders, etc. The pressure of compressed air is greater than the atmospheric pressure. The volume of air is reduced with the help of a compressor. When the air is compressed, heat is produced due to compression and the air pressure increases.

Fig 6.19 Pressure gauge

Compressed air is considered an important medium for the transfer of energy in industrial processes. It is used in power-generating equipment like air hammers, drills, wrenches etc. It isused to operate automatic air cylinders and drive vehicles. The braking system due to compressed air in large trains helps to stop them safely. Compressed air brakes are used in large vehicles running on highways. use of compressed air is increasing in high-level cleaning equipment and air rifles. The pressure exerted by compressed air is measured withthe pressure gauge. It is measured in millibar units. The unit of standard atmospheric pressurein mmHg.

Atmospheric pressure

Activity 6.7

Fig 6.20 Demonstration of Atmospheric Pressure

Take a glass and fill it with water. Cover the top of the glass tightly with cardboard or a piece of thick paper so that it becomes air tight. Now keep the glass in inverted position by keeping your palm of one hand on the cardboard and holding the glass by another hand as shown in the figure. Now remove the hand holding the cardboardslowly. Observe what will happen.

Activity 6.8

Fig 6.20 Demonstration of the effect of atmospheric pressure

Take a small tin can with its lids. Open the lid of the can and fill some water in it and boil the water. When the water boils and starts to evaporate, close the lid of the cantightly. Cut off the source of heat and keep the can under tap water. What happens when the cold water is circulated on the outer surface of the heated can? Observe it.

Caution: Use thick cotton clothes or tongs to hold the heated can and keep your hands away from steam.

The cardboard placed in the mouth of the glass in Activity 6.7 does not fall. How can it hold the water? Discuss with friends. In activity 6.8, the tin can starts to be crushed. Why does this happen?

In Activity 6.7, the air pressure exerted from the bottom keeps the cardboard from falling. Similarly, in activity 6.8, the air pressure inside and outside the can is different and the can is crushed. Before the canis heated, the pressure inside and outside was equal therefore there was no impact on the surface of the tin can.When the can is filled with water and heated, then the air was pushed up by the steam produced inside it and the air pressure inside the can is reduced on cooling therefore can is crushed.

The earth is surrounded by atmospheric air. The area around the earth covered by air is called the atmosphere. Air also has weight. Due to the weight of the air, it exerts pressure on the ground. The pressure exerted by atmospheric air is called atmospheric pressure. Atmospheric pressure is the air pressure exerted per unit area of the earth's surface. The air pressure is maximum at the sea level and as you go higher the atmospheric pressure decreases. The atmospheric pressure at sea level is 760 mmHg. It is also called atmospheric pressure which is equivalentto 105 Pascals. Barometer is used to measure atmospheric pressure. Air flows from one place to another due to changes in the atmospheric pressure on the earth's surface.

Air pressure is controlled in aeroplanes that fly at very high altitudes. Due to controlled conditions, the pressure inside the aeroplanes is just equal to the appropriate pressure required for the human body. So, we can breathe easilyduring a flight. Atmospheric pressure influences all objects and living beings on Earth.

Questions to think about:

Why does a balloon burst if more air is filled inside it?

Manometer or pressure gauge

The pressure exerted by fluids (liquid and gas) is measured by a manometer or pressure gauge. Out of various types, U- shaped manometer is used to measure the pressure exerted by liquid. The level of liquid in both limbs of the U-shaped manometer is equal. When the pressure is applied in one limb by liquid or gas, the level of liquid in another limb increases. The pressure exerted by a liquid in the manometer is measured by the difference in height of the liquid column in the two limbs.

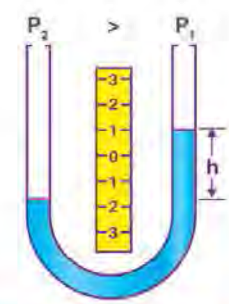


Fig 6.22 Manometer

Activity 6.9

Measure the pressure of the lungs ofall students by blowing air in the manometer one by one. Compare the pressure exerted by theirlungs while blowing air into the manometer to your friends.

Activity 6.10

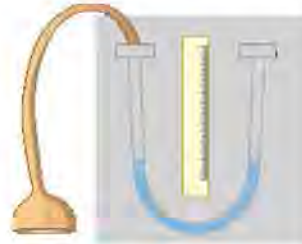


Fig. 6.23

Take a funnel, balloon, level pipe, plywood or plank of wood, scale, pins or small iron nails and a glue stick. Connect one end of the levelpipe to the narrow end of the funnel. Covers the larger end of the funnel by stretching the balloon over it. Fix the level pipe in the U-shaped on the plywood by using pins or iron nails as shown in the figure. Fill the U-shaped level pipe by using water horizontally and mix some colour in it. Fix the scale or measuring tape parallel to the right side of the U-shaped tube by using glue sticks or pins. Now dip the funnel in water or push it with your thumb and observe the change in the level of water in the U-shaped tube.

Application of Atmospheric Pressure

We cando various activities like; filling ink in fountain pens, filling injections in a syringe and filling the air in the tube of a bicycle etc. due to atmospheric pressure. All these instruments are based on atmospheric pressure. When the piston is pulled out in these instruments then the pressure inside the piston decreases and liquid and gas can be pushed inside the piston due to atmospheric pressure. We cannot use these instruments without atmospheric pressure. Therefore, atmospheric pressure has great importance in our daily life.

Fig 6.24 Instruments Based on Atmospheric Pressure

Project work

Make a list of instruments that make use of the atmospheric pressure. Write down the function of these instruments in our daily life.

Exercise

1. Choose the best alternative:

(a) What is the S.I. unit of pressure?

(i) Nm (ii) N/m^2 (iii) m/s^2 (iv) Nm^2/kg^2

(b) Which of the following statement is true?

(i) More pressure is exerted if the area is less.

(ii) Pressure of an object is not affected by area.

(iii) Pressure increases with the increase in the area of the body.

(iv) Pressure remains the same although the force varies.

(c) What is the value of atmospheric pressure at sea level?

(i) 760 mmHg (ii) 700 mmHg

(iii) 1000 mmHg (iv) 750 mmHg

(d) What is the pressure exerted by the water at the depth of 60 m where the value of acceleration due to gravity is 9.8 m/s^2? (density of water is 1000 kg/m^3)

(i) 588 Pa. (ii) 5880 Pa.

(iii) 58800 Pa. (iv) 588000 Pa.

(e) What is the name of the instrument used to measure atmospheric pressure?

(i) thermometer (ii) barometer

(iii) manometer (iv)lactometer

(f) Which of the following given instrument is used to measure the pressure exerted by compressed air?

(i) pressure gauge (ii) rain gauge

(iii) manometer (iv)barometer

(g) What is the principle on which the air braking system is based?

(i) atmospheric pressure (ii) compressed air

(iii) liquid pressure (iv) pressure

2. Give reasons:

a) Football shoes have studs on their soles.

b) Ploughshare is made sharper to plough the field.

c) The bottom of the dam is made wider than its walls.

d) The bucket is filled faster on the ground floor than on the upstairs

3. Answer the following questions:

(a) What is pressure? Write down any three applications of pressure in daily life.

(b) How can we tell that liquid exerts pressure?

(c) Write down any two applications of liquid pressure in daily life?

(d) What is atmospheric pressure? Mention it's any two importance.

(e) Prove that the pressure exerted by the liquid is $P = h\ d\ g$. Where the symbols have their usual meaning.

(f) Draw a neat and labelled diagram of a manometer.

(g) What is atmospheric pressure? Explains with examples.

7 Energy in Daily Life

Observe the pictures and discuss the questions given below:





Fig 7.1 Source ofa different form of energy

i. What types of energy do you see in the picture?

ii. Is it possible to use the same type of energy to do all the work?

iii. What are the sources of different types of energy?

We do various activities in our daily lifesuch as; reading, writing, carrying heavy loads, working in the fields, etc. We cannot do such work without having food for a long time. Similarly, vehicles cannot be operated without burning fuel. Electrical equipment does not operate without access to electricity. We get energy from food. Vehicles are powered by diesel, petrol or other fuels, whereas electrical appliances are powered by electricity. It is the energy that makes all the above-mentioned equipment of appliances run accordingly. Therefore, the capacity of doing work is called energy. Energy is measured in Joule (J) in the S.I unit. A calorie is widely used to measure energy which is a C.G.S unit of energy. One calorie is equal to 4.2 joules.

Different types of energy are required to do different work in daily life. Mechanical energy, heat energy, light energy, sound energy, magnetic energy, electric energy, chemical energy, nuclear energy, etc. are different forms of energy. Those sourcesfrom which we get these different forms of energy are called sources of energy.

The energy which cannot be immediately replaced once they are depleted is called non-renewable energy. Examples of non-renewable energy include coal, petroleum product and nuclear energy. The energy which cannot be exhausted even after continuous consumptionis termed renewable energy. Examples of renewable energy are solar energy, wind energy and tidal energy.

7.1 Heat

Observe the picture and discuss the questions given below:

Fig 7.2 Transmission of heat on different objects

Questions:

i. How is the heat transmitted in the given picture?

ii. Is the mode of transmission of heat similar in all objects?

Heat is a form of energy that gives us warmth. We can feel the heat. We can identify hot and cold objects by touching them. When we touch any object hotter than our body, heat transfers from the hot object to our skin whereas touching an object cooler than our body, heat transfers from the skin to the cold object.

While cooking, we burn fire at the bottom of the pot. Why does the pot's handle or exterior surface heat up during cooking? Why does the glass tumbler heat up when you pour hot water into it? Why does touching hot water make us feel hot and touching ice make us feel cold?

Heat transfers from the hotter body to the colder body. Heat flows from the body at a higher temperature to the body at a lower temperature. When we touch hot objects, heat is transferred from these objects to our skin, causing us to feel heated. Similarly, we feel cold while touching cold objects because heat transfersfrom our bodies to the colder objects. The process of transfer of heat energy from one object to another is called transmission of heat. The introduction of the conduction, convection, and radiation processes of heat transfer, as well as their use in daily life, will be covered in this chapter.

7.1.1 Transfer of heat by the method of conduction

Activity 7.1

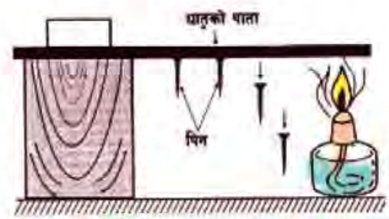


Fig 7.3 Transmission of heat in solid

Take a small metal plate or rod about 20 cm long. Put a drop of wax on it and stick the pin as shown in the figure. To make the pin turn downward, fasten the metal rod or plate to one side of the table as indicated in the illustration. Use a heat source such as a spirit lamp to heat one end of the rod. What did you seeafter a while? Observe it. Are these pins stick to the rod or start to fall on heating? Did all these pins fall at once or did they fall in sequence one after another? Note down the learning from this activity in copy.

In the above activity, when the metal rod is heated, the pin on the heated side starts to fall. Then the pins on the other side of the rod fall in sequence. This proves that the heat is transmitted from one end of the rod to anotherend. Heat is transferred by conduction in a solid. When a solid object is heated, molecules vibrate from their mean position without changing their actual position.Molecules do not move from one place to another during the transmission of heat but they are vibrating about their positions. When a metal rod is heated, a nearby molecule heats the adjacent molecules. It warms a subsequent molecule in the chain once the neighbouring molecule has already been heated. In this way heat transfers from one end to the other end of the rod. The process of heat transmission of heat in a solid without actual movement of the molecules is called conduction.

Project work 7.1

Make a group of friends and stand at an equal distance from each other in a line. Provide a stone or brick to the students standing at one end of the line and tell them to hand over it to the person standing by him/her and the process continues till the stone or book reaches another end. In this activity, all the students remainin their position without moving but the stone reaches from one end to another end of the line. Do solids transmit heat similarly? Discuss it with your teacher in class.

Conductor and Insulator

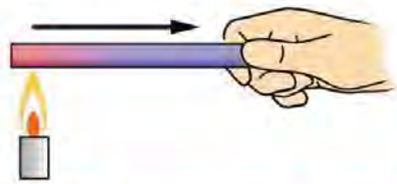


Fig 7.4 Conduction of heat in metals

Take a candle and a matchstick box. Light the candle and heat the objects including a pencil, wooden piece, plastic pipe, etc. one at a time in the lamp. When one end is kept on the flame of a lamp, does the other end become hot? Under the supervision of your teacher, handle these things with caution and safety first. Record your findings in the table below.

Objects	Conduct or doesn't conduct heat	Conclusion

In the above activity, steel spoons, aluminium ladles and iron nail conduct heat but a pencil, wooden piece, and plastic pipe do not conduct heat and rather start to burn themselves. Generally, heat flows in metals but not in non-metals.

Materials that allow heat to pass through them easily are called good conductors of heat. For example; iron, copper, aluminium, gold, etc. are good conductors of heat. Materials that do not allow heat to pass through them are called insulators of heat. For example; wood and plastic are insulators of heat.

Questionto think:

Why non-stick vessels and pressure cooker handles are made of plastic-like materials?

The Conductivity of Various Objects

Conductivityis an intrinsic property of an object that conducts heat. Thermal conductivity refers to how quickly or slowly a material conducts heat. Objects with high conductivity conduct heat faster than objects with low conductivity. Most of the metals have high thermal conductivity. Therefore, when metals arebrought near the source of heat theyare heated very quickly. Due to this property of metal, they are used for making cooking utensils. On the other hand, materials like plastic, cotton and rubber have very low thermal conductivity. However, low conductivity of heat can also have several advantages. For example; warm clothing made of cotton/wool prevents escaping of heat into the atmosphere.

The conductivity of different metals is not uniform. The thermal conductivity of a material depends on the molecular properties of the material and its temperature. Even though diamond is a non-metalit hashigher thermal conductivity than metals. Graphite is a conductive non-metal.

Application of Conductionin daily life

Why the cooking utensils made of copper, steel, iron or aluminium metals but their handles are made of wood or thermosetting plastic? Why is it warm when you wear a jacket? Why is the house made up of mud cool in summer and warm in winter? Why do birds seem fat on very cold days? The answers to these questions are related to the transmission of heat. Some applications of the conduction of heat in daily life can be mentioned as follows:

1. Metals are used to make cooking utensils like pans and kettles because it easily transfers heat from the source to food.
2. The handle of the tea kettle is made of plastic because plastic is a poor conductor of heat, so it does not allow heat to reach the hands.
3. Woolen clothes or blankets are used to keep our bodies warm in winter because wool prevents body heat from escaping. The air that lies between the layer of heavy wool clothing, acts as a heat insulator. So, woolen clothes and blankets keep the body warm in a more efficient manner.

4. Teacupsand coffee mugs are made of porcelain because porcelain is an insulator of heat.

Project work 7.2

Make a list of the materials you use daily that depend on heat conduction. Write down the applications of these materials based on your observation.

Transfer of Heat by Convection method

Activity 7.3

Take two beakers and fill two-thirds of the water in both beakers. Put a few drops of red ink in both beakers.Consider heating a beaker by placing it on a tripod stand and keeping the other beaker at room temperature. Write the differences you notice in these two beakers after close observation of them.

Fig 7.5 Convection of heat in liquids

It can be observed that the coloured water kept in the hot beaker steadily heats up and rises, while the cold water at the top descends to occupy the space. This process of transmission of heat due to the movement of water molecules inside the beaker is called convection. After some time,water in the beaker is heated due to convection. However, there is no heat transfer by convection in the next beaker at room temperature, so the colour disperses slowly in the water. Convection also occurs in air molecules just as in water. Heat is transferred in the atmosphere by moving hot air molecules from one place to another. The hot air molecules go up and cold air molecules fall which causes the movement of air molecules(wind) in the atmosphere. The process of transmission of heat in liquid and gas due to the actual movement of moleculesis called convection.

During the day time,the earth's surface is heated due to solar radiation. When the air close to the earth's surface is heated, hot air becomes lighter and rises, leaving a vacuum or an empty space in its place. Cold air comes from nearby regionsto fill this space. In this way, the movement of air takes place due to convection and it is called wind. Convection is the main cause of wind.

Fig 7.6 Convection of heat in a day and night

Examples of convection

Convection is the process of transfer of heat in liquid and gas due to the actual movement of the molecules. The density of the heated layer of a liquid or gas decreases as the liquid or gas is heated. A less dense heated layer goes up and creates an empty space that is filled by the downward displacement of the denser cold layer at its bottom. This process continues until the whole liquid or gas is heated. Therefore, the transmission of heat in liquid and gas takes place by convection.

Sea breeze

Sea breeze occurs during the daytime. During the day, solar radiation heats both the surface of the water and the land. Due to the significantly higher specific heat capacity, the water in the sea is heated more slowly than the land. Because of this, the temperature above the ground surface rises, which causes the air molecules around the earth's surface to be heated. Less dense warm air expands, resulting in a low-pressure region over the ground. At the same time, a high-pressure region

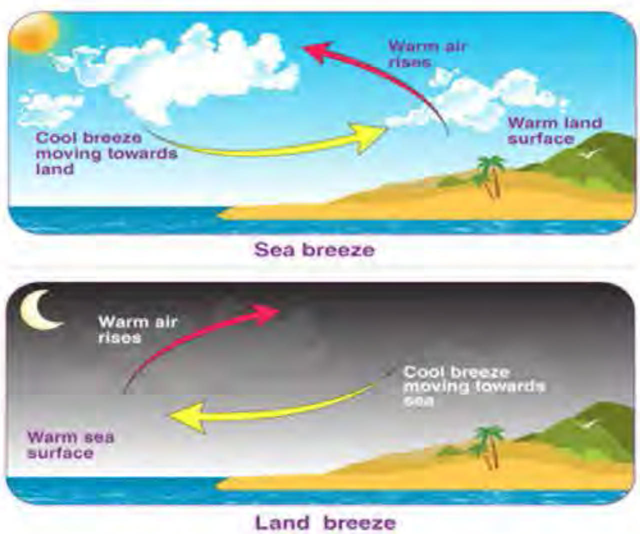


Fig 7.7 Sea Breeze and Land Breeze

develops over the sea's surface. Due to thepressure difference, air flows from the high pressure over the sea to the low pressure over the land. The name "sea breeze" refers to the flow of cold air from the ocean to the landduring the daytime.

Land breeze

The above-mentioned process of the sea breeze is then reversed and continues throughout the night. As soon as the sun sets, both the land and the water begin to cool down. The land cools down quickly because it has a less specific heat capacity than the water. Because the sea is warmer than the land at night, there is a low-pressure condition over the sea. As a result, the cold air flows from the land to the sea at night which is termed the land breeze.

Types of convection

Natural and external convection are the types of convection and are explained below:

I. Free or natural convection: Heat transfers from a hotter body to a colder body. The temperature of the air molecules adjacent to the hot object is higher, thus its density is less. As a result, the hot air rises. The natural convection current is used to describe this air movement. The cyclic movement of boiling water in a pot is an example of natural convection. Warm water from the bottom rises to the top, expands, cools, and then falls to the bottom again. Sea breeze, land breeze and rainfall occur due to the natural convection of heat.

II. Forced convection:When heat is transferred through liquids and gases because of external energy such as heat, chemical energy, electricity, etc. is called forced convection. Rotating electric fans, electric water heaters or gas geysers, etc. are examples of forced convection.

Activity 7.4

How does rainfall occur due to the natural convection of heat? Discussed with your friends and present the result in your classroom.

Questions to think:

a) Why do we feel more warmth directly above the burning fire or lamp but less at its side?

b) Why does the flame of the burning candle go upward?

Convectional Current and Weather

The convection process is used to explain the weather phenomenon in meteorology.

It helps to forecast the weather. In general, heat transfers from a hotter region to a colder region due to convection.The convection process starts after solar radiation heats the ground in the morning. As the temperature of the earth's surface rises, the air layer above the ground is directly heated. Barren surfaces on the ground such as sand, rocks, and pavements heat up faster than water or vegetated ground.So, the air above the surface of the earth and the surrounding are heated unevenly. The air around the barren surfaces like the desert is less dense than the cold air and it begins to rise. Currents set up due to rising hot airis called "thermal current". As the wind rises, heat and moisture move vertically upward in the atmosphere. The higher the ground temperature, the more convection of air takes place in the atmosphere. Therefore, convection is likely to occur on veryhot days. As the heated air moves upwards, the air begins to cool at a high altitude. If there is too much moisture in the air, it forms clouds. The flash of lightning, thunder and heavy rain are also related to convection. In addition to the weather phenomena mentioned above, convection removes excess heat from the surface of the earth. The average air temperature on the Earth's surface would be roughly 125°F if convection did not exist in nature, which is significantly higher than the current average global temperature of 59°F.

Applications of Convection of Heat in daily life:

Have you ever seen a hot air balloon rising into the air? Have you ever seen the steam coming from a cup of tea or coffee? Convection refers to the process of transmission of heat from a body at a higher temperature to a body at a lower temperature through a liquid or gas medium. When the temperature of the molecules in a liquid or gas increases, the vibration of the molecules increases and the molecules move farapart from each other. If we look at the surrounding, we can see that convection plays an important role in our daily life. Some of these uses are as follows:

1. Convection occurs while boiling water and other liquids.
2. In warm-blooded mammals, the circulation of blood is carried by convection.
3. Electric fans and air conditioners (AC)used in summer arebased on the principle of convection.
4. Convection is also used in radiators, refrigerators, etc.
5. Convection also plays an important role in rainfall, thunderstorms, cloud formation and lightning.

Project work 7.3

Make a group of friends in your class. Take a balloon by each memberof a group.Inflate the balloon by blowing air into and tie its mouth with thread. Hot air is filled in one of the balloons.Release this balloon in the surroundings and observe whether it goes up or not in the atmosphere.Is the balloon propelled into the air by the convection principle? Discuss with your friends and present the finding of this activity in your class.

7.1.3 Transfer of Heat by Radiation

Why do we feel warmth or hot when we sit in the sun or by a heater?How does the heat transmit to Earth from the sun although there is a space between the sun and the Earth? There is no solid material medium between the sun and earth beyond the earth's atmosphere so the heat cannot transmit by conduction. If it is assumed that the heat transmits by convection, then the heated air molecule goes upwards. Therefore, heat does not transmit from the sun to Earth by the process of conduction or convection. In the above-mentioned process, heat transmits without any material medium. Transmission of heat without any medium is called radiation. So, we feel the warmth from the sun or heater through the process of radiation

Heat and light energy are emitted by the sun. Heat and light energy are transmitted in the form of waves. These waves do not require any material medium so the heat from the sun reaches the earth's surface without any material medium. The process of transmission of heat without any material medium is called radiation. In a vacuum, heat is transmitted by radiation.

Fig 7.8 Transmission of Heat by Radiation

7.1.4 Waves

Activity 7.5

What would happen if you were to throw a stone into a pond, frozen lake, or the ice and stagnant water in your surroundings? Observe it.

Ripples of water are formed while throwing stones into the surface of the lake and these ripples move towards the edge of the pond. It is called a water wave.

These waves are formed when the molecules of water raise up and down regularly and spread in all directions from the point of disturbance. Water waves spread from the point of disturbance to the extremities of the pond but the water molecules remain in their position. Like in water, a wave is produced in a rope when we jerkits one end. Therefore,waves are produced due to the vibration of molecules.

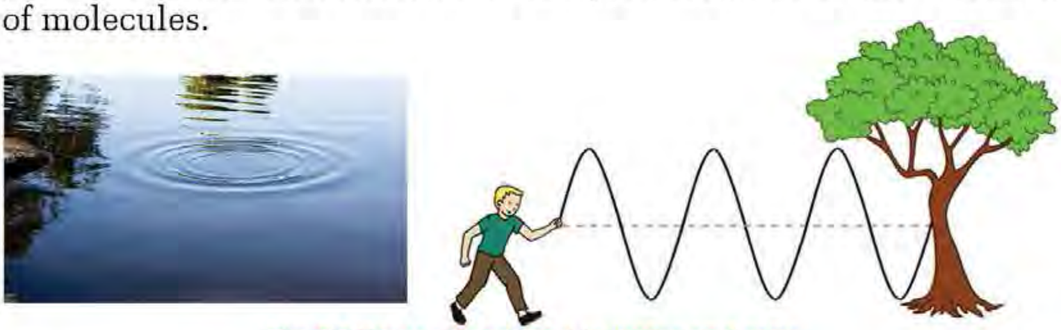


Fig 7.9 Waves Produced in water and rope

Mechanical and Electromagnetic Wave

Some waves require a medium for transmission, while others do not. Those waves which require a material medium for propagation are called mechanical waves, and waves that do not require a medium for propagation are called electromagnetic waves. A sound wave is an example of a mechanical wave and propagation of energy takes place through the vibration of molecules. The material which vibrates during the propagation of the wave is called the medium. The mechanical wave's energy decreases throughout wave propagation as part of it is absorbed by the medium. Therefore, the transmission of mechanical waves is limited to a certain range depending on the nature of the medium. The speed of mechanical waves is different in different mediums. The speed of sound in air, water and iron is 332m/s, 1481m/s and 5120m/s respectively in normal conditions.

The light coming from the sun and other stars reaches the earth through a vacuum. The infrared radiation that carries heat cannot be seen by our eyes. Radiation is the process of transmission of energy in the form of electromagnetic waves without any materials medium. When these waves are transmitted without a material medium, energy in the wave is conserved.

Electromagnetic waves can travel at the speed of light up to large distances without any loss of energy. For example, heat and light energy emitted by the sun travel in the form of a wave at the speed of light 3×108 m/s and it takes around 8 minutes and 20 seconds to reach the Earth.

Transmission of Heat and ElectromagneticWaves by Radiation

Thermal radiation is the process of transmission of heat in the form of electromagnetic radiation. Infrared radiation in the electromagnetic spectrum transmits heat throughradiation. Heat energy is received by the earth from the sun by radiation and it doesn't require any material medium because it can travel even through a vacuum at the speed of light.

Effects of the Colour of an object in theradiation of heat

Activity 7.6

Take three equal-sized boxes with lids in white, black, and golden colours as indicated in the illustration. Make a hole in them the same size as the thermometer's probe, then insert the thermometer in the holes. Keep these containers in the sun for an equal duration of time. Which colour box has the highest temperature recorded on the thermometer? Observe and record it.

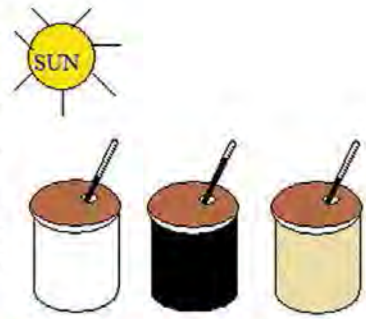


Fig 7.10 Radiation of Heat in different colour materials

White or pale-coloured things have poor heat-absorbing and heat-emitting capabilities compared to black-coloured items. Therefore, dark-coloured hot objects emitmore radiation, whereas white or pale-coloured objects emit and absorb less radiation. White-coloured clothes are usually preferred and worn in summer and hot places, whereas black or dark-coloured clothes are suitable in winter and cold places. Therefore, the inner surface of the solar heater is painted with black colour to absorb more radiation coming from the sun. In order to absorb more heat, cook food more quickly, and conserve fuel, the exterior surface of cooking tools is frequently coated with black materials.

Question to think:

Why are buildings in the Terai region or other hot regions painted white on the exterior walls?

Applications of Radiation of Heat in daily life

Why do hot drinks like tea and prepared foods eventually become colder? When the temperature of an object is higher than the temperature of its surroundings, it gives off heat by the process of radiation. As a result, its temperature decreases until the condition of thermal equilibrium is achieved. If the temperature of an object is lower than its surroundings,it absorbs heat radiation from its surrounding so its temperature increases. Some applicationsof radiation of heat in daily life are given below.

1. When we sit near the fire, our body receives heat from the fire by the process of radiation.

2. The heat radiations from the sun heat the surface of the planet.

3. The radiator at the back of the refrigerator throws heat into the surrounding by the process of radiation.

4. White or light-colored clothes are worn in the summer season because they absorb less heat.

7.1.5 Structure and Function of Thermos Flask

Activity 7.7

Take the thermos at your home and observe its interior by opening its lid. What is the inner part of the thermos made up of? Is its surface thick or thin? Does it transfer heat or not? How does it work? Answer these above questions by looking at the structure of the thermos and find the information related to the thermos with the help of the internet.Collect thenecessary information from the internet and present it in class.

Thermos flasks keep hot liquids hot and cold liquids cold for a long time. It consists of a glass vessel with double walls. The glass vessel is enclosed by a metal or plastic cover for protection against damage. The space between the walls is a vacuum which reduces the loss of heat due to conduction and convection. The outer surface of the inner wall and the inner surface of the outer wall are silvered (shining). The shining surfaces reduce the loss of heat due to radiation. An insulating stopper (cork) is used to close the mouth of the vessel. The vessel is kept over an insulating (cork) pad. It is therefore thermally insulated. Heat does not escape or enter easily in the thermos, so, hot liquids remain hot and cold liquids remain cold inside the flask.

Fig 7.11 Thermos Flask

4.1.6 Greenhouse

Have you heard about artificial greenhouses? What is the importance of the greenhouse in our daily life? What would happen if greenhouse gases were absent from the atmosphere of the earth? Discuss.

Fig 7.12Artificial Greenhouse

A greenhouse is a house made of glass or plastic on a metallic frame. It is mainly used to grow off-seasonal plants and vegetables. In the greenhouse, the glass and plastic allow short waves from the sun to come in but do not let the longer waves radiated by the soil and plants go out.The heat trapped inside can't escape and warms the greenhouse which is essential for the growth of the plants. Favourable condition like temperature, light, moisture, etc.for the growth of the plant ismaintained inside the greenhouse. The roof of the greenhouse is made slanted so that maximum solar energy enters through it.

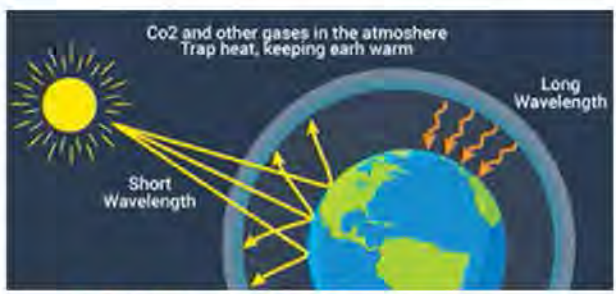


Fig 7.13Natural Greenhouse

The same is the case in the earth's atmosphere.During the day, the sun warms the Earth's surface and its atmosphere. The heat is reflected into the space as the sun sets. In this process, some of the heat is absorbed and radiated towards the surface by the greenhouse gases present in the earth's atmosphere. Because of this, the earth's surface remains somewhat warmer, which enables life to exist on the planet. Carbon dioxide, chlorofluoro carbons, methane, water vapour, nitrous oxide, etc. are greenhouse gases. They are emitted mainly by factories, automobiles and deforestation are the major emitters of greenhouse gases.

The mechanism through which solar radiation is absorbed by greenhouse gases rather than being transmitted into space is known as the greenhouse effect. This insulates the surface of the earth and prevents it from freezing. The increased number of factories and automobiles increases the amount of these gases in the atmosphere. The increased greenhouse gases trap more heat and increase the surface temperature of the earth. This leads to global warming.However, due to the increased levels of greenhouse gases, the temperature of the earth has increased considerably. This has led to several disasters.

Activity 7.8

Making a model of an artificial greenhouse

Objective: To show that temperature is increased inside the artificial greenhouse.

Materials required: Transparent glass or plastic pieces (four pieces of glass or plastic in A4 size), small pins or nails, small wooden or bamboo sticks for frame-work, a square-shaped plank of wood, laboratory thermometer)

Procedure:

1. Take a square-shaped plank of wood and fix the wooden or bamboo stick vertically around its all sides as per necessity. Fix these sticks with glue or small iron pins.

2. Fix three sticks in a row in the centre of the plywood which is longer than that used at its sides. Fixed one wooden stick at the top of these sticks with iron pins. Now make a slanting surface by keeping sticks horizontally from the centre position to the sides of the plywood.

3. The slanting surface and its vertical walls are covered by sheets of transparent glass or plastic materials. The prepared model of the greenhouse looks similar toa tunnel made for off-seasonal vegetable farming or the nursery bed.

4. Take a laboratory thermometer and note down the temperature of the surroundings. Make a small hole in the slanting roof of the artificial greenhouse to fix the thermometer in it and keep the bulb of the thermometer inside the greenhouse. Keep the model of the greenhouse outside on a sunny day for some time. What

is the difference in temperature between the inside and outside of the greenhouse?Observe it and note down the difference in the temperature.

Observation and conclusion:Short-wave radiationof the sun can enter the greenhouse from its transparent roof and walls. These radiations are partly absorbed, partly reflected and the remaining transmitted to the inside of the greenhouse. Some portion of reflected radiation changes into long-wave radiation and istrapped inside the greenhouse. This is responsible for increasing the temperature inside the greenhouse. The roof of the greenhouse is made slanted to enter more solar radiation.

Question to think:

Why do we feel warmer on a cloudy day/night rather than on a clear day/night?

Impacts of the Greenhouse Effect

a) It increases the average global temperature.

b) It changesthe pattern of the water cycle.

c) It brings negative impacts on human health.

d) It decreases the agricultural production and productivity of the land.

e) Melting of snow in the mountain causes the risk of glacier lakes outburst flood (GLOF).

f) Due to the increase in the level of water in the ocean nearby lowland areas are at high risk ofbeing submerged underwater.

g) It reduces biodiversity.

h) It causes desertification.

i) It causes an imbalance in the ecosystem.

Applications of Greenhouse Effects

It is essential to have a natural greenhouse effect on the Earth. Greenhouse effects are crucial to keeping our planet's temperature suitable for the survival of life. Without the natural greenhouse effect, the heat radiated by the Earth's surface would simply escape into space, resulting in an average temperature of -20°C. Due to this, the existence of life on Earth will be merely impossible. Off-season vegetables can be grown inside the greenhouse due to the increase in temperature inside it. Farmers can make a good source of income from off-season vegetables. Some plants that have lost their existence in cold temperatures can be saved in an artificial greenhouse. In addition, plants growing in hot places can be protected even in very cold countries. If the greenhouse effect is more, it would have many negative effects on the environment.

Project work 7.4

Go to the agricultural farm near your home or school and observe the tunnels (artificial greenhouses) built there. Build a small greenhouse in your school premisesin a group by using materials like those used in the tunnel.

Exercise

1. Choose the best alternatives:

(a) What is the process of transmission of heat due to the actual movement of molecules?

(i) conduction (ii) convection

(iii) radiation (iv) temperature

(b) What is the name of the process of transmission of heat in liquid and gas?

(i) conduction (ii) convection

(iii) radiation (iv) evaporation

(c) How does the heat transmit in a vacuum?

(i) by conduction (ii) by convection

(iii)by radiation (iv) by transpiration

(d) In which of the following activities is heat transmitted by the radiation process?

(i) spoon kept in sunlight is heated

(ii) spoon immersed in a cup of tea is heated

(iii) spoon kept above the spirit lamp is heated

(iv) water gets heated when the hot iron rod is kept in cold water

(e) What is the average global temperature on the surface of the earth?

(i) 70oF (ii) 59oF (iii) 40oF (iv) 125oF

(f) Which one of the following is an example of a mechanical wave?

(i) radio wave (ii) gamma-ray

(iii) sound wave (iv) X- ray

2. Differentiate between

a) conductor and insulator of heat

b) conduction and insulation

c) mechanical waves and electromagnetic wave

d) sea breeze and land breeze

3. Give reasons:

a) The mud houses are cooler in summer and warmer in winter.

b) A teacup is usually made of porcelain.

c) We prefer light-coloured clothing in summer.

d) Ventilation is kept at the upper part of the wall or door.

e) Transparent plastic is used to cover the roof and walls of an artificial greenhouse.

4. Answer the following questions:

a) What is the transmission of heat?

b) What is meant by the conduction of heat?

c) How does the wind blow? Explain the process.

d) What is the convection process? Write down the applications of convection in daily life.

e) What is the radiation process? Write down the applications of radiation in daily life.

f) What is an electromagnetic wave? Give any three examples of electromagnetic waves.

g) Draw the neat and labeled diagram of athermos flask and label its parts.

h) What is the greenhouse effect? Write down the applications of greenhouse effects.

7.2 Light

Look at the picture below and discuss the question:

Fig7.14 Different Sources of Light and Reflection

(a) What type of sources of light are shown in the picture?

(b) What is the reflection of light? Do all objects reflect light in the sameway?

(e) What types of mirrors do you see in the picture?

We can see the objects around us with the help of the light coming from the sunduring the day. We are unable to view the surroundings at night. We can see everything around us at night if we switch on the light. Light is a form of energy that gives the sensation of vision or enable us to see objects around us. When the rays of light fall on any object then the part of the light is absorbed, some part is reflected and the remaining istransmitted (passed) through it. The phenomenon of returning light after striking a surface is called the reflection of light. The object appears shiny if they reflect alarge amount of light falling on them. An object that scatters light falling on it looks dull. Flat and smooth surfaces glow when the reflection occurs on them, while rough surfaces do not.

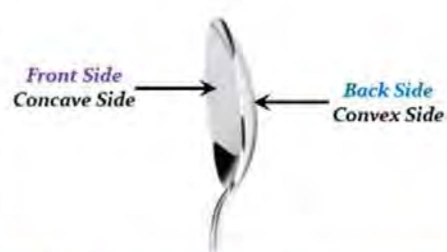


Fig 7.15 Concave and Convex surface

When an object is placed in front of the mirror, then the image of that object is formed due to the reflection of light fromthe mirror.

A mirror is a device that reflects the rays of light coming from an object and forms the image of that object at the point of intersection of two reflected rays. Mirrors are mainly of two types i.e. plane mirrors and spherical mirrors. In this lesson, we will discuss the nature of concave and convex (spherical) mirrors, the reflection of light from the mand the differences between real images and virtual images.

5.2.1 Introduction of Concave and Convex Mirror

Take a steel spoon.What can you see if you look at the front side of the spoon? Again, look at the back surface of the spoon. The middle part of the spoon is depressed while looking at the front side and raised while looking at its back surface. Identify the difference between the middle part and the edge of the spoon while looking from the front and back and discuss it with your friends in the classroom.

While observing the front surface of the spoon, the middle part of the spoon is depressed and its edge is raised. So, the surface which is depressed in the middle and raised at its edge is called a concave surface. Similarly, when the spoon is looked at its back surface the middle part of the spoon is raised and its edge is depressed. The surface which is raised in the middle and depressed at its edge is called a convex surface.Spherical mirrors are of two types: concave and convex.

1. Concave Mirror:

The mirror in which the middle part is depressed and its edge is continuously raised is called a concave mirror. When the rays of light

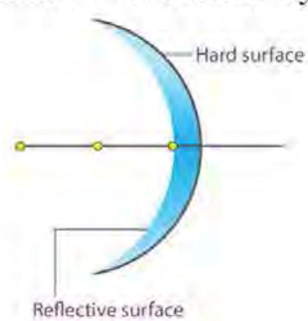


Fig 7.36 Concave mirror

parallel to the principal axis fall on the concave mirror, they meet at a point on the principal axis after reflection. The point is called the principal focus of the mirror. A concave mirror converges the rays of light falling on it to the principal axis, so it is also called a converging mirror. Generally,a concave mirror forms an enlarged image of the object if it is kept very close (within focal range) to the concave mirror.

Questions to think:

Why the bulb is placed at the centre of the concave mirror in a torch light?

Activities7.10

Take a flash light or search light and switch it on. How far does the light travel due to the concave mirror used in it? Observe it.

2. Convex mirror

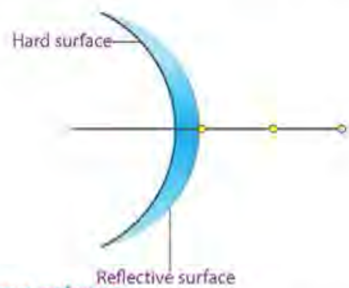


Fig 7.17 Convex mirror

A mirrorin which the outer surface is polished and bulgedout is called a convex mirror.In this mirror, Edge is compressed and the middle part is raised. A Convex mirror diverges the rays of light after reflection, soit is also calleda diverging mirror. In general, a convex mirror forms an erect and diminished (smaller) image of an object. The convex mirror forms a diminished image of the larger object lying far from the mirror, so it has a wide field of view.

Question to think about:

Why does a driver use a convex mirror as a side mirror to observe the traffic behind the vehicle?

Project work 7.5

Observe the street lights in the evening and find out which mirrors are used to scatter street lights into wide regions.

Spherical mirror

Some important terms related to the spherical mirror

a. Pole of the mirror: The geometrical centre of the reflecting surface of the spherical mirror is called the pole of the mirror. It is denoted by the symbol 'P'. All distances are measured from the pole of the mirror.

b. Centre of curvature: Spherical mirrors can be considered as part of the spherical glass sphere. The centre of the sphere from which the mirror is made is called the centre of curvature. It is denoted by the symbol 'C'.

c. Radius of curvature: The radius of the sphere from which the spherical mirror is made is called the radius of curvature. It is the distance between the centre of curvature and the pole of the mirror. It is denoted by the symbol 'R'.

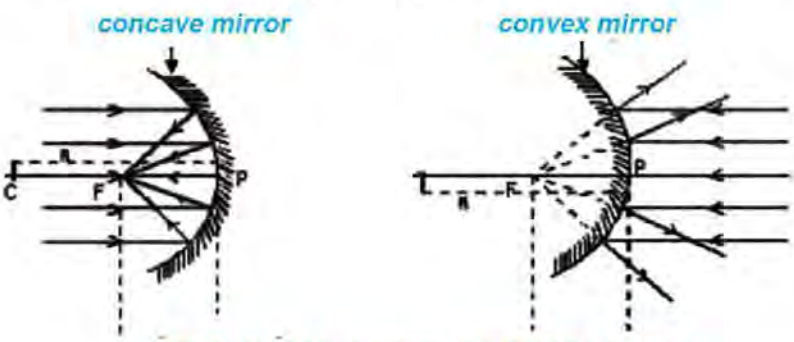


Fig 7.18 Various terms in spherical mirror

d. Principal axis:The imaginary straight line of infinite length that passes through the pole of the mirror (P) and centre of curvature (C) is called the Principal axis.

e. Principal focus: When the rays of light parallel to the principal axis fall on the concave or convex mirror then after reflection they pass or appear to pass through the fixed point on the principal axis, which is called focus or principal focus. The focus of the concave mirror lies in front of the mirror and that of the convex mirror lies behind the mirror. So, the focus of the concave mirror is real and the convex mirror is virtual. It is denoted by the symbol 'F'. The focus lies exactly between the pole of the mirror (P) and the centre of curvature (C).

f. Focal length: The distance between the pole of the mirror (P) and the principal focus (F) is called the focal length of the mirror. Its SI unit is meter (m) and is represented by the symbol 'f'.

Reflection from Concave and Convex Mirror

When the rays of light parallel to the principal axis fall on the concave mirror it converges at a fixed point called principal focus(F). In a convex mirror the rays of light appear to diverge through the fixed point (principal focus) behind the mirror. Therefore, the focusof the concave mirror lies infront of the mirror and the focus of the convex mirror lies behind the mirror. The reflection of light through a concave and convex mirroris shown in the figure below:

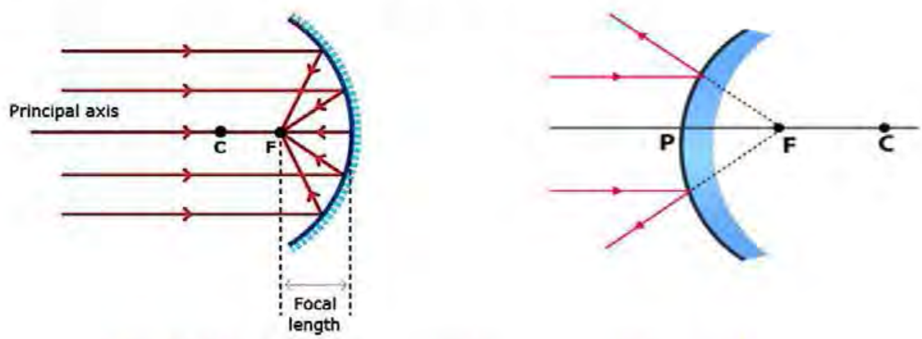


Fig 7.19 Reflection through Concave and Convex Mirror

Rules of reflection for concave mirror

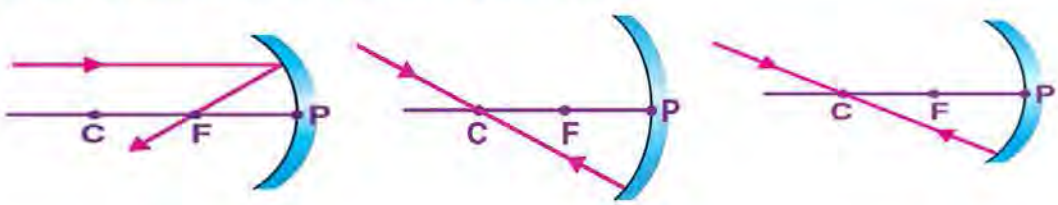


Fig 7.20 Reflection of light through aconcave mirror

1. Rays of light parallel to the principal axis, pass through the principal focus after reflection.
2. The rays of light coming from the principal focus passes parallel to the principal axis after reflection.
3. The ray of light coming from the centre of curvature returns through the same path.

Rules of reflection for convex mirror

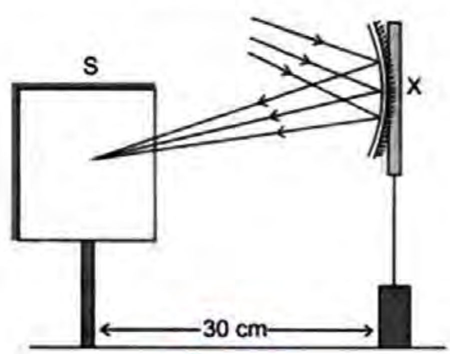
Fig 7.20 Reflection of Light through a Convex Mirror

1. Rays of light parallel to the principal axis, after reflection from a convex mirror, appear to diverge through the fixed point called the focus.
2. Rays of light coming through the principal focus reflect parallel to the principal axis
3. The rays of light coming from the centre of curvature of the mirror reflect along the same path.

Real and Virtual images

Activity 7.11

Take a concave mirror and keep it facing towards the window. Put a plain white sheet of thick paper in front of the mirror with in a distance of 20 cm to 30 cm. Try to make thelight rays reflected from the mirror fall on the plane of the paper. Adjust the distance between the mirror and the plane of paper to produce asharp image on the paper. The distance between the mirror and the plane of paper when the sharp image is formed on the paper is called the focal length



चित्र 7.21

of that concave mirror. The process of changing the distance between the concave mirror and the screen to producea clear image on the paper is called focusing. The image formed by the concave mirror can be obtained on the screen, so it is a real image.

Now replace the concave mirror with a convex mirror and aplane mirror in turn, and repeat the above-mentioned steps. Can a convex or plane mirror produce any image on the screen? Observe it.

If an image can be obtained on the screen, such images are called real images. Real images are formed by the actual intersection of the reflected rays from the mirror. If the images cannot be obtained on the screen, such images are called virtual images. The virtual image is formed at the point where the reflected rays appear to meet. For virtual images, the reflected rays do not meet actually at any point. In general, a concave mirror forms a real image whereas a plane and convex mirror forms a virtual image.

Difference between Real image and virtual image

Real Image		Virtual Image	
1.	It is formed in front of the mirror	1.	It is formed behind the mirror.
2.	It can be obtained on the screen.	2.	It cannot be obtained on the screen.
3.	It is formed at the point where the reflected rays meet.	3.	It is formed when the reflected rays appear to meet at the back of the mirror.
4.	The real image is inverted.	4.	The virtual image is erect.

Procedure to draw a Ray Diagram for a Concave mirror

Activities 7.12

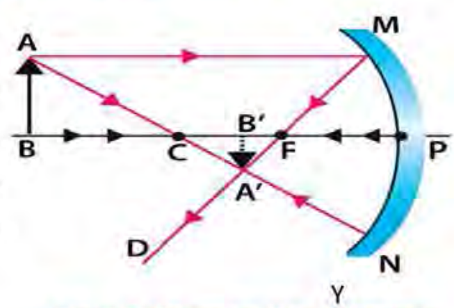


Fig 7.22Drawing Ray Diagram in a Concave Mirror

1. Draw a circular arc XY with the help of a compass.
2. Mark 'C' at the point where the compass needle remains while drawing an arc.
3. Mark the midpoint of arc XY at point 'P'.
4. Drawa straight line to pass through the point P and C.
5. Shade on the exterior surface of XY by pencil.
6. Find the middle point of the line CP and mark it'F'.

7. Place an object at a point on the principal axis. For example, place an object AB beyond 'C' on the principal axis and draw the image A'B' formed by the mirror following the 'rules of the ray diagram' as shown in the picture.

Now use the essential rules to draw the ray diagram for the concave mirror:

1. Draw line AM parallel to the principal axis from point 'A'.
2. Join these points 'M' and 'F' and draw another straight-line MD.
3. Draw line ANpassing from 'A' to 'C' which meets the mirror at N.Line AN is the incident ray passing through the centre of curvature (C). These rays again reflect in the same path from 'N' to 'A' through 'C'.
4. Now, these two reflected rays MD and NA intersect at point A'.
5. Draw the perpendicular A'B' to the principal axis from the point of intersection A'. Now,A'B' is the image of the object AB. Note the position and measure the size of image A'B'.

The image is diminished, inverted and real. This image lies between 'F' and 'C'.

An image formed by a concave mirror:

The image formed by a concave mirror depends on the size, location and distance of the object from the mirror. So, the images formed by the concave mirror when the object is kept at different position sare given in the picture drawn along side. We can find the nature of the image concerning the object by comparing the image formed to the object.

1. Objectis at infinity: When the object is kept at infinity(too far) from the concave mirror, then the image is formed at the principal focus (F). The nature of this image is real, inverted and highly diminished (extremely small).

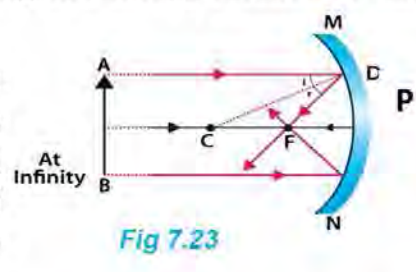


Fig 7.23

2. Objectis kept beyond 'C': When the object is kept beyond 'C' of the concave mirror, the image is formed between 'F' and 'C'. The image is real, inverted and diminished.

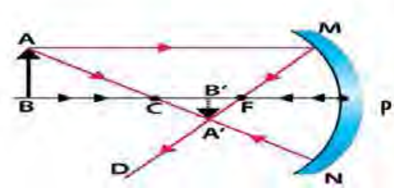


Fig 7.24

3. Object is kept at 'C': When the object is kept at 'C' of the concave mirror, the image is formed exactly at 'C'. The image is real, inverted and the same size as that of the object.

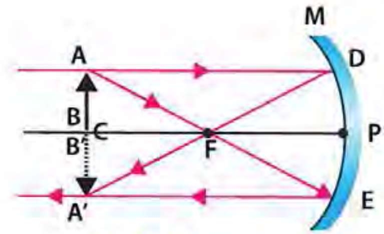


Fig 7.25

4. Objectis kept between 'F' and 'C': When the object is kept between 'F' and 'C' of the concave mirror, the image is formed beyond 'C'. The image is real, inverted and magnified.

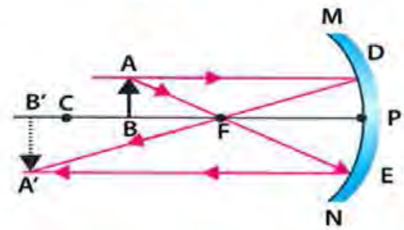


Fig 7.26

5. An object is kept at 'F': When the object is kept at 'F' of the concave mirror, the image is formed at infinity. The image is real, inverted and highly magnified.

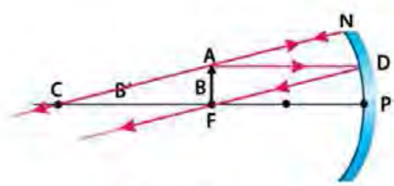


Fig 7.27

6. Object is kept between 'F' and 'P': When the object is kept between 'F' and 'P' of the concave mirror, the image is formed behind the mirror. The image is virtual, erect and magnified.

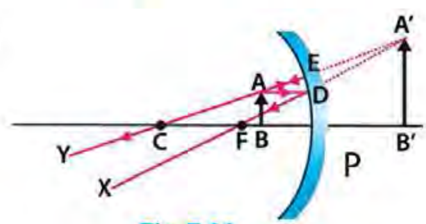


Fig 7.28

The image formed by convex mirror:

When an object is kept at any position in front of the convex mirror,the virtual image is formed behind the mirror. The convex mirror always forms a virtual, erect and diminished image of the object.

1. An object is at infinity: When the object is kept at infinity (too far away) from the convex mirror, a point image is formed at the principal focus (F) behind the mirror. The nature of this image is virtual, erect and highly diminished (extremely small).

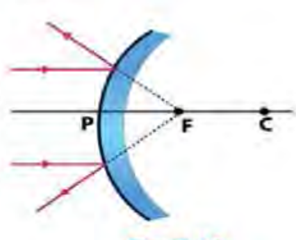


Fig 7.29

2. An object is kept between infinity and 'P': When the object is kept between infinity and 'P' of the convex mirror, a virtual, erect and diminished image is formed behind the mirror within the principal focus (F).

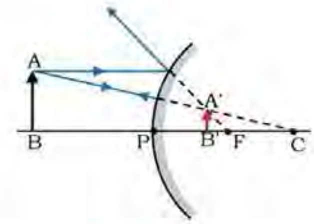


Fig 7.30

Uses of the spherical mirror:

(A) Usesof a concave mirror

1. Concave mirrors are used in the torchlight, searchlight and headlight of the vehicle to reflect the light nearly parallel upto a long distance.
2. It is used by medical doctors to obtain an enlarged view of the organ in the nose, ear, mouth, neck, etc.
3. It is used as a savings or make-up mirror to see the enlarged face of the person.
4. It is used in an astronomical telescope to reflect light.
5. Since it is a converging mirror, it is used in a solar cooker to converge solar radiation to cook food.

(B) Uses of a convex mirror

1. It is used as a looking mirror to get the rearview, i.e. to look at the traffic behind the vehicle.
2. Since it is diverging mirror, it is used to scatter the light into a wide region in the street light.

Project work 7.6

Make a list of devices having concave or convex mirrors in and around your house or school. What is the application of these devices? Make a list and discuss it in the classroom.

Exercise

1. Choose the best alternative:

(a) Which type of mirror is used to look at our faces in daily life?

(i) plane mirror (ii) concave mirror

(iii) convex mirror (iv) spherical mirror

(b) Which mirror can make a real image of an object?

(i) plane mirror (ii) concave mirror

(iii) convex mirror (iv) spherical mirror

(c) What type of image is called a real image?

(i) image that cannot be obtained on the screen

(ii) image that can be obtained on the screen

(iii) an erect image

(iv) an inverted image

(d) What kind of mirror is called a concave mirror?

(i) plane mirror (ii) diverging mirror

(iii) converging mirror (iv) simple mirror

(e) The ray of light coming from the centre of curvature in the concave mirror

(i) passes through the focus.

(ii) reflect along the same path.

(iii) passes parallel to the principal axis.

(iv) diverges from the mirror.

2. Differentiate between:

(a) Concave mirror and convex mirror

(b) Real and Virtual images.

3. **Define the following vocabulary:**

a) Principal axis
b) Focus
c) Centre of curvature
d) Focal length

4. **Give reason:**

(a) Concave mirror is also called a converging mirror.

(b) Concave mirror is used in solar stoves.

(c) Convex mirrors are used as looking glass in vehicles.

(d) Convex mirrors and plane mirrors cannot producethe real image.

5. **Answer the following questions given below:**

(a) What is meant by the reflection of light?

(b) Which mirror is called a spherical mirror?

(c) Write down the factors on which the image formed by the concave mirror depends.

(d) Which mirror is suitable to use while shaving a beard and doing make-up, and why?

(e) What could be the reason for using a convex mirror in street lamps?

(f) Draw the ray diagram of the image formed by a concave mirror when the object is kept

i. beyond 'C'
ii. at infinity
iii. between 'C' and 'F'

Sound

Fig 7.31 Different Sources of Sound and Waves

We hear sounds from people, birds, bells, different instruments, cars, television, radio, etc. These objects which produce sound are called the sources of sound.Sound produces the sensation of hearing in our ears. A sound is a form of energy that is produced due to the vibration of objects. The sound produced from different objects propagates through material mediums such as solid, liquid or gaseous mediums. Sound waves cannot travel through the vacuum or in the absence of a material medium.

The sound produced by a guitar is sharper than that produced by a drum set.Some sounds are louder and some are fainter; some are sharper and some are flat. This lesson will cover the introduction of sound waves, measurement of sound intensity, calculation srelated to the speed of sound, audible sound, infrasound, ultrasound, and causes of sound pollution and the strategies for reducing it.

Production of Sound Waves

Activity 7:13

Take a tuning fork and strike its prong onarubber pad. Do you hear the sound while bringing its prong nearer to your ear or not? Touch the tuning fork and feel the vibrations produced by the tuning fork. How do you feel? Share your experience with your friends in the class.

Fig 7.32

When an object is struck, the molecules of that object vibrate back and forth, creating sound. Sound waves originate from a vibrating object and propagate through the molecules in the medium. Sound waves require a material medium for their propagation so it is a mechanical wave. The molecules of a material medium vibrate in to and fro motion while propagating sound waves. The wave in which molecules in a medium vibrate in the direction of propagation of the wave is called a longitudinal wave. Sound waves are mechanical wave because it requires a material medium (like solid, liquid or gas) for their propagation and they cannot travel through a vacuum.

Characteristics of Sound Wave

Frequency:

The total number of waves generated or produced in a unit of time is called frequency. It is denoted by 'f' and measured in Hertz (Hz) in the S.I. unit. Kilohertz (kHz), megahertz (MHz) and gigahertz (GHz) are the bigger units of frequency of sound.

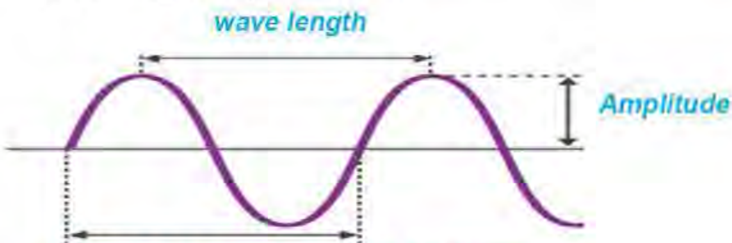


Figure 7.33 Characteristics of Waves

Period:

The time taken by the body to makeone complete wave is called the period. It is denoted by 'T' and its S.I. unit is second (s). If 'f' complete waves are formed in 1 second then1 complete wave is formed in 1/f seconds.

$$\therefore \text{ time period} = \frac{1}{\text{frequency}} \text{ or } \frac{T}{F} = 1$$

Wavelength:

The distance travelled by a sound wave in one complete vibration is called wavelength. It is also defined as the distance between any two consecutive crests or troughs or compressions or rarefactions in the wave. It is denoted by the Greek Letter Lambda 'λ' and its S.I. unit is meter (m).

Amplitude:

The maximum displacement of particles of the medium above or below the mean position in a wave is called the amplitude of the wave. It is denoted by 'A' and its S.I. unit is meter (m).

Speed of Sound Wave

The speed of sound is different in different media but it is constant in a particular medium. For example, the speed of sound in the air is 332 m/s. The distance travelled by the sound in a unit time (or 1s) is called the speed of the sound wave.

Mathematically,

Speed of sound wave (v) = Frequency (f) $\times$Wave length (λ)

Wavelength is measured in meters and frequency is measured in hertz (per second), therefore speed of sound is measured in m/s. In any medium, the speed of a sound wave remains constant even if the wavelength and frequency of sound vary. Wavelength and frequency are in the form of product, so if the wavelength is increased then thefrequency decreases and vice-versa.

Example 1

Find the speed of a sound wave whose frequency is 66 Hz and wavelength is 5m.

Solution:

Here,

Frequency of sound (f) = 66 Hz

Wavelength (λ) = 5 m

Speed of sound (v) =?

We know that,

Speed of sound wave (v) = Frequency (f) $\times$Wave length (λ)

or, $v = 66 \times 5$

or, v = 330 m/s

Therefore, the speed of sound in air is 330 m/s.

Example 2:

If the speed of sound at 0°C is 332 m/s and its frequency is 40 Hz then calculate its wavelength.

Solution:

Here,

Speed of sound (v) = 332 m/s

Frequency of sound (f) = 40 Hz

Wavelength (λ) =?

We know that,

= ×Frequency (f)

$$\text{Speed of sound wave (v)} = \frac{\text{Frequency (f)}}{\text{Frequency (f)}} = \frac{332}{40} = 8.3\text{m}$$

Therefore, the wavelength of sound is 8.3 m.

Different types of sound

The frequency of sound varies according to the source of the sound. Even within the same medium, the frequency of the sound produced by different sources varies. The frequency of sound waves ranges from 1 Hz to 108 Hz. Since the frequency of the voice of children and girls is higher, so their voice is heard sharper. After reaching physical maturity, the sharp sound of boys changes to flat (dhodro). A male voice has a frequency of about 60-180 Hz, whereas a female has a frequency of about 160-300 Hz. We cannot hearall frequencies of sound. Humans can only hear frequency ranges from 20 Hz to 20 kHz (20,000 Hz). Based on frequency, sounds are classified into three types,i.e. infrasonic, audible and ultrasound.

(a) InfrasonicSound

Sound with a frequency less than 20 Hz is called infrasound or subsonic sound. This sound cannot be heard by humans but can be felt by the sensation of touch. Infrasound is produced during Earthquakes, volcanic eruptions, etc. Animals like camels and elephants can produce infrasound. Rhinos can also produce infrasound with a frequency of less than 5 Hz.

(b) Audible Sound:

The sound whose frequency lies within the range of 20 Hz to 20 kHz. This sound can be perceived by the human ears. The sound produced while tuning a guitar, singing a song, tuning a radio, etc.is an exampleof audible sound.

(c) Ultrasonic Sound:

The sound which has a frequency of more than 20000 Hz (20 kHz) is called ultrasonic sound. It is also called ultrasound. This sound cannot be heard by human ears. Some animals like; bats, rats, birds and insects can produce and hear ultrasound. Due to its higher frequency, ultrasound has a large amount of energy. In the medical field, ultrasound is used to scan and evaluate the interior organs of the human body.

Application of Ultrasound:

Sound which has a frequency of more than 20 kHz is called ultrasound. The wavelength of ultrasound is minimum so this sound wave can propagate from one place to another without bending or losing energy. Ultrasound is used in USG (Ultrasonography) to find the growth conditionof the baby inside the mother's womb, to perform bloodless operations, to kill bacteria, to find out the position oftumors and identify diseases in the internal parts of the human body.

SONAR is used to measure the depth of the sea. In SONAR, the ultrasound wave is sent from the surface of the sea to its bottom and the receiver receives the wave reflected from the bottom of the sea. Additionally, the time it takes for ultrasound waves to travel to the surface and return is also noted, and the depth is determined using the formulas of the speed of the sound,

Project work 7.7

Go to the nearest hospital or health institution to observe the ultrasonography (USG) machine. Ask the medical staff in the hospital for a list of diseases that can be detected by an ultrasound scan.

Intensity of Sound

Sound waves carry sound energy. The amount of energy emitted by the sound wave from the source per second per unit area is called the intensity of the sound. The louder sound has more intensity. The loudness of sound is measured in decibel(dB) units. If anyone cannothear theintensity of soundbetween 45dB and 60 dB, he or she has lost the sensation of hearing partially. The state of not hearing even sound up to 80 dB is called deafness. The high-intensity sound may damagethe sensation of hearing. The intensities of sounds produced during different activities are given below:

Activities of producing sound	The intensity of sound (dB)
Whispering	0 – 20 dB
Environment in library	20 – 40 dB
Normal conversation	40 – 60 dB
busy traffic	60 – 70 dB
Machinesin press	70 – 80 dB
Railway station	85 – 110 dB
The sound produced by vehicles	110 – 120 dB
Threshold of pain	120 – 140 dB
Mechnical Problem	140 – 160 dB

Measurement of intensity of sound

The intensity of sound at any point is the rate at which sound energy is passing through the unit area perpendicular to the direction of propagation of the sound wave. It is denoted by 'I' and its S.I. unit is W/m2 (Watt / square meter). The intensity of sound is measured by using the formula given below,

$$I = \frac{P}{A}$$

Here,

P = Power of sound (P)

A = Area (A)

Examples: 3

Calculate the intensity of sound in an area of 5 m^2 whistling by the children of power 2×10^{-4}W.

Solution:

Here, Power of sound(P) = 2×10^{-4} W, Area (A) = 5 m^2

The intensity of sound(I) = $= \frac{p}{A}$ $\frac{2 \times 10\text{-}4 \text{ W}}{5 \text{ m}^2} = 0.4 \times 10^{-4}$ W /m^2

Factors affecting the intensity of sound

Amplitude:

The intensity of sound is directly proportional to the square of its amplitude. ($I \propto a2$)

Distance of the listener from the source: The intensity of the sound is higher near the source of sound and decreases as the listener moves away from the source. When sound is transmitted in the air, some of the energy is absorbed by the air molecules, some energy is reflected and the remaining energy is transmitted. Thus, as the distance of the listener from the source increases, the intensity of the sound decreases.

The density of medium: The intensity of sound in the gaseous medium is directly proportional to the density of that medium. Since the density of cold air is more than the density of hot air, the intensity of sound is more in cold air than in hot air.

Area of vibrating body: The greater the area of the vibrating surfacethe greater will be the intensity of the sound. For example, the large temple bell or a big drum produces a more intense sound.

Frequency: The intensity of sound is directly proportional to the frequency of sound. A sharper or shriller sound has more intensity than a flat sound.

Activity 7.8

Determine whether an animal's sound intensity is higher or lower by listening to or recording the sounds of several animals. Give proper justification for your observation. If you are blind folded and placed in a room, how would you distinguish whether the room is fully furnished or empty?

Sound Pollution:

Sound pollution is unwanted or excessive sound that has negative effects on human health, wildlife, and environmental quality.The unnecessary sound produced due to various activities is considered sound pollution. Noise is an unwanted sound that is considered unpleasant, loud or disruptive to hearing. Noise causes sound pollution in the environment.

Cause of Sound Pollution:

Louder or unnecessary sounds are produced in the market, densely populated regions, heavy traffic, machinery, etc.

The sound produced at the site of construction causes sound pollution.

Watching television, tuning the radio or other musical instrument in a loud voice cause sound pollution.

Sound pollution occurs in factories when unwanted noise is generated by running machinery.

Sound pollution is caused by the noise of people in the market and broadcasting through speakers loudly etc.

Effects of Sound Pollution:

Several effects on human health may arise due to sound pollution. Some of the major effects of sound pollution are listed below:

The weakening ofsensation of hearing.

The blood pressure of a person increases.

Loud noise can cause eardrum rupture and deafness.

Health problems like difficultyin hearing, and a problem in the digestive system may arise due to noise pollution.

Difficult to concentrate on reading, writing or doing any other work.

Ways of Reducing Noise Pollution:

Afforestation along the side of the road and near industrial zones can reduce noise pollution.

Noise pollution can be minimized by using silencers in vehicles.

Do not disturb other people, while tuning an instrument, watching television, or listening to music.

We can minimize the effects of sound pollution by running public awareness programmes in the community.

Project work 7.9

What is the condition of noise pollution in your place? If there is noise pollution, what are its causes? What can you contribute to minimizing the noise pollution there? Make a list of things you can do to minimize sound pollution.

Exercise

1. Choose the best alternatives:

(a) Which is the time the number of sound waves produced is called wave?

(i) 1 second (ii) 2 seconds

(iii) 3 seconds (iv) 4 seconds

(b) What is the range of frequency of audible sound?

(i) 2 Hz to 20 Hz (ii) 2 Hz to 20 kHz

(iii) 2 Hz to 200 kHz (iv) 2 Hz to 200 Hz

(c) What is the range of intensity of audible sound?

(i) 2 Hz to 20 dB (ii) 2 Hz to 40 dB

(iii) 2 Hz to 200 dB (iv) 2 Hz to 200 dB

(d) What is the intensity of sound having a higher amplitude?

(i) more (ii) Less

(iii) remainsthe same (iv) more or less

(e) What is the threshold of hearing for deafness?

(i)90 dB (ii)80 dB

(iii)60 dB (iv)55 dB

(f) Which of the following animal can produce and hear ultrasound?

(i) elephant (ii) bat

(iii) crocodile (iv) whale

2. Differentiate between:

(a) wavelength and amplitude (c) infrasound and ultrasound

(b) infrasound and audible sound

3. Answer the following questions given below:

a. The speed of sound remains the same on changing the frequency or wavelength of sound, why?

b. Write the range of frequency of sound that can be heard by human beings.

c. What is the relationship betweenthe wavelength, frequency and speed of the sound wave?

d. Draw a neat and clean diagram of the sound wave.

e. What is an ultrasonic wave? Write down the name of any two animals that can produce and hear ultrasound.

f. Write down any three applications of ultrasound.

g. The sound is heard fainter when the listener is moving away from the source of the sound, why?

h. Write down any two effects of sound pollution and any two ways to minimize its effect.

4. Solve these numerical problems:

a. Calculate the wavelength of the sound wave if the speed of sound in air is 332 m/s and its frequency is 10 Hz. (Ans: 33.3 m)

b. Calculate the speed of the sound wave if the wavelength is 22 m and its frequency is 10 Hz. (Ans: 330 m/s)

c. If the speed of sound in air is 332m/s then calculate the wavelength of the shortest and longest wave that can be heard by human beings. (Ans: 0.0166 m and 16.6 m)

d. If the 2×10-5 W/m^2 intensity of sound spreads out in an area of 6 m2 in 1 second, then calculate the energy carried by the sound wave. (Ans: 1.2×10^{-4} J)

8 Electricity and Magnetism

Read the given passage and discuss the questions given below.

Sumnima is doing experiments onthe properties of magnets in the laboratory. She is surprised while seeing the attraction between the N-pole of one and the S-poles of another magnet and the repulsion between the N-N poles and S-S poles of two magnets. In the course of the experiment, a bar magnet fell into the floor andbroke into pieces. She carefully picked up the broken pieces of magnet and repeats the above activity by using them. When the ends of these magnets are brought close together, the attraction between some pieces and repulsion between the other pieces occurred. On seeing this incident, curiosity arose in her mind. Meanwhile,the electricity was cut off and the laboratory became dark. Sumnima was about to come out of the lab after closing the door, the science teacher came into the lab and said "MCB trips, there may be some problem in the electric circuit."

(a) Why does a magnet attract another magnet or magnetic substance?

(b) Does the magnet retain its magnetic properties even if it is crushed into small pieces?

(c) Why did the electrical line cut off in the laboratory?

(d) What is the function of MCB in an electric circuit?

A magnet is a substance that attracts unlike poles, repels like poles, and produces a magnetic field around it. Magnets are widely used invarious equipment including generators that generate electricity. Electricity is the one form of energy. Electricity has been used in most modern appliances to run them. Therefore, various devices operated by using electricity and magnets have made our life easier.

8.1 Magnet

Read the given passage and discuss the questions given below.

It has been many days since the television doesn't function properly in Samprit's house. One day, amechanic was called to his house for repairing the televisions. The mechanic tried to find the problem by opening its cover. There wasa lot of dust inside the television. He started cleaning the dust by using a brush. When the screws were kept on a round object inside the TVs they were pulled by that object. While cleaning, them echanic found that a connecting wire was broken inside the TV. As soon as it was reconnected, the television started functioning properly and everyone was happy. Samprit who was closely watching all those activities wondered why these screws stuck onto the round device inside the TV.

(a) Why are these screws pulled by the round object inside the TV?

(b) What would happen if you put small pieces of wood instead of screws in the round object inside the TV?

Magnet is a substance that attracts some metals like iron, cobalt and nickel. Objects which are attracted by magnets are called magnetic materials. Iron, cobalt and nickel are examples of magnetic materials. A magnet can attract only those magnetic materials kept inside the magnetic field. A magnet has a north pole (N-pole) and a south pole (S-pole). The property of attracting opposite poles and repelling similar poles of the magnet is called magnetic property.

Activity 8.1 Study the properties of magnets (By using bar magnets).

Objective: To study the magnetic properties of magnets.

Materials required: Two bar magnets,pins or small iron nails and cotton thread.

Procedure

(a) Tie the bar magnet with the cotton threadin the middle and suspend it onthe stand.

(b) Bring the north and south poles of another magnet alternately to any pole of the suspended magnet.

(c) Bring pins or iron nails near the suspended magnet.

Observation and discussion

Fill in the observed properties of the magnetin the given table and discuss them with your friends.

Activities	Response in the magnet
In which direction are the poles of the magnet pointing when the bar magnet is at rest after suspending freely?	
What happens when the pins are brought closer to the magnet?	
What happens when the north pole of the bar magnet is brought closer to the north pole of the suspended magnet?	
What happens when the south pole of the bar magnet is brought closer to the north pole of the suspended magnet or vice-versa?	
What are the conclusions that can be drawn from the above activities?	

Natural and artificial magnet

Natural Magnet

Fig 8.1 Loadstone

Those objects which contain magnetic properties naturally are called natural magnets. They are found on the surface of the earth's crust. Loadstone is an example of a natural magnet. Loadstone is a magnetite mineral that contains an excessive amount of iron in them. Loadstone possesses magnetic properties naturally. Two poles (N and S)existin a natural magnet too. The magnetic strength possessed by the loadstone cannot be altered.

Project work 8.1

Collect various metals and non-metals found in your surroundings. Classify them based on whether they are attracted by a magnet or not. Write down the name of the objects attracted by the magnet and the ones not attracted by the magnet in separate columns on chart paper and present itin your class.

B. Artificial magnet

Magnetic substances in which magnetic properties are developed as per need are called artificial magnets. The artificial magnets may be temporary or permanent. The strength of the artificial magnets can be easily altered as required. Artificial magnets can be made by passing electricity or by various other methods. The artificial magnet formed by passing electricity through magnetic material is called an electromagnet.

Fig 8.2 Different Types of Artificial Magnet

Activity 8.2

Objective: To make an electromagnet.

Required materials: 1.5-volt cell, enamel-coated insulated copper wire, switch, pliers, pins and small iron nails.

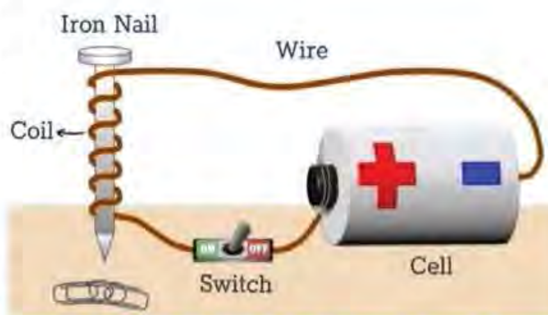


Fig 8.3 Making an Electromagnet

Procedure

Cut 50 cm long insulated copper wire with the help of pliers.

Make a spiral formation of insulated copper wire around the iron nail as shown in the picture. The spiral formation of wire is called a solenoid.

Connect the two ends of the wire to the opposite terminals of the cell. Keep the switch in the path of electrical circuits.

Observation and discussion

Bring the pins or iron nails near the electromagnet and observe the difference in activity while turning the switch ON and OFF continuously. Demonstrate this electromagnet in your class.

Uses of magnet

a. Magnets are used in radio, television, fan, refrigerator, induction cooker, electric bells, generators, etc.

b. It is also used in computers, sensors, headphones, hard disks, tape recorders, etc.

c. Magnet are used in medical imaging equipment like MRIs (Magnetic Resonance Imagers).

d. In factories and ports, huge iron plates and rods are loaded and unloaded using electromagnets.

e. The magnetic compass is used for navigation purposes.

f. Electromagnets are used in the lock of doors and windows.

8.1.2 Molecular Theory of Magnetism

The molecular theory of magnetism was first discovered by the German scientist Weber. It was later modified by James Alfred Ewing. The principles of the molecular theory of magnetism are explained below:

a. Magnet and magnetic substances are made up of magnetic molecules. Each magnetic molecule has North and South poles.

b. In magnets and magnetic materials, molecular magnets are organised as open or closed chains, as shown in Figure 8.4. As a result, magnet and magnetic materials exhibit magnetic behaviour.

c. When the magnetic molecules are lined up or arranged in a certain pattern, magnetic material becomes magnetised.

d. The intensity of magnetization in magnetic materials is maximum when all the molecular magnet gets aligned or arranged in an open chain. This condition is called magnetic saturation. The north and south poles of all the molecular magnets are arranged at the extremities of the bar magnet in magnetic saturation.

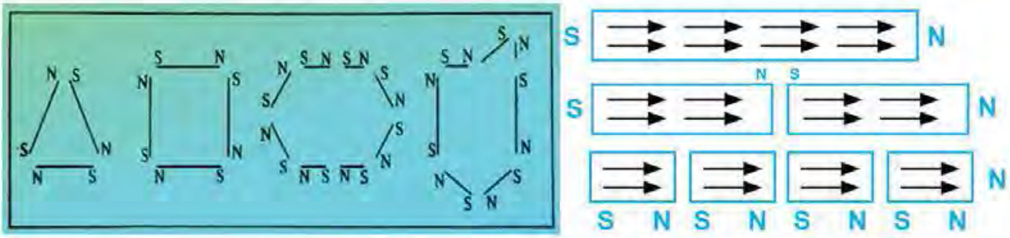


Fig 8.4 (i) molecular magnet in magnetic substance (ii) magnetic molecules in magnet.

Project work 8.2

Make a picture illustrating the principle of molecular magnets on chart paper. Briefly explain the principle of molecular magnet on the chart and present it in your class in the presence of your subject teacher.

8.1.3 Demagnetization

The process of losing the magnetic properties or behaviour of a magnet is called demagnetization. Magnets lose their magnetic properties when molecular magnets aligned in a particular direction are oriented in a random direction or closed chains.The causes of demagnetization are given below:

- Heating the magnet
- Hammering the magnet
- Passing alternating current ina magnet
- Keeping like poles together forcefully for a long time
- Natural loss

a. Heating the magnet

If the permanent magnet is heated, the magnetic molecules in the magnet vibrate and their patternis disturbed. Magnet gets demagnetized when the parallel alignment of the molecular magnet in the magnet is disturbed and its open chains of the molecular magnets are changed into closed chains.

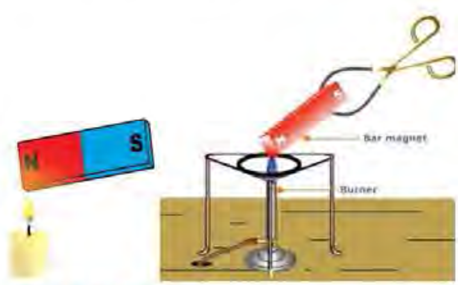


Fig 8.5 Demagnetization by heating.

b. Hammering the magnet

If the permanent magnet is hammered or struck on a hard surface, the configuration of the molecular magnets and their parallel alignment gets disturbed and scattered in random directions. If this process continues then the magnet loses its magnetic behaviour, i.e. gets demagnetized.

Fig 8.6 Demagnetization by heating

c. Passing electricity in a magnet

If the alternating current (a.c.) is passed through a magnet it gets demagnetized. The negative and positive terminals (polarity) of alternating current change continuously which produces vibration in molecular magnets. Due to the vibration in molecular magnets, the alignment of the magnetic molecules is disturbed and the magnet is demagnetized.

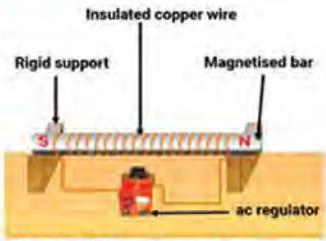


Fig 8.7 Demagnetization by passing alternating current

Keeping like poles together

Like poles repel each other. If like poles of two magnets are kept together forcefully for a long time then the repulsion disturbs the parallel arrangement of the molecular magnets and the magnets get demagnetized.

d. Natural loss

If the permanent or bar magnet is kept in an open place or without a keeper for a long time, it gets demagnetized. The magnetic intensity of anold magnet slowly decreases. If this process would be continuing for a long time, the magnet may lose its magnetic properties.

Activity 8.3

Objective: To study the demagnetization of the permanent magnet

Materials required: Bar magnet, insulated copper wire, low voltage A.C. current, switch, pins or iron nails and pliers.

Procedure

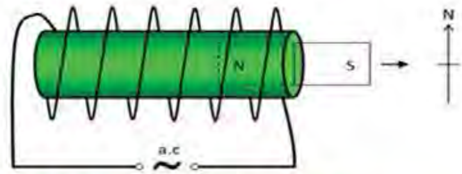


Fig 8.8 Demagnetization of the magnet

a. Cut 1m long insulated copper wire by using the pliers. Make the spiral adjustment of this insulated wire around the cylindrical object to make a solenoid.

b. Join the two ends of the solenoid wire to the source of low voltage alternating current and keep the switch in the wire to turn the circuit ON or OFF.

c. Keep the bar magnet inside the solenoid and switched it ON.

d. Hold the bar magnet by pliers and move itinward and outward continuously.

Observation and discussion

Turn OFF the switch and remove the bar magnet from the solenoid with the pliers. Bring some pins or tiny iron nails close to the bar magnet now and observe what happens.

Conservation of magnetic property

Fig 8.9 Bar Magnet in its keeper

a. Do not heat the magnet.

b. Do not hammer or drop the magnet on the hard floor.

c. Do not keep a current-carrying wire near the magnet.

d. Keep the bar magnet always in its keeper if it is not in use.

Geomagnetism

Earth also possesses a magnetic property and it is considered a huge magnet. Magnetic properties associated with the earth are called geomagnetism or terrestrial magnetism. The geomagnetic North Pole and South Pole exist in terrestrial magnets too. Terrestrial magnetism is generated by convection currents of molten iron and nickel in the earth's outer coreover the inner core. The poles of the terrestrial magnet are located opposite to the geographic poles and they are gradually changing their position very slowly.

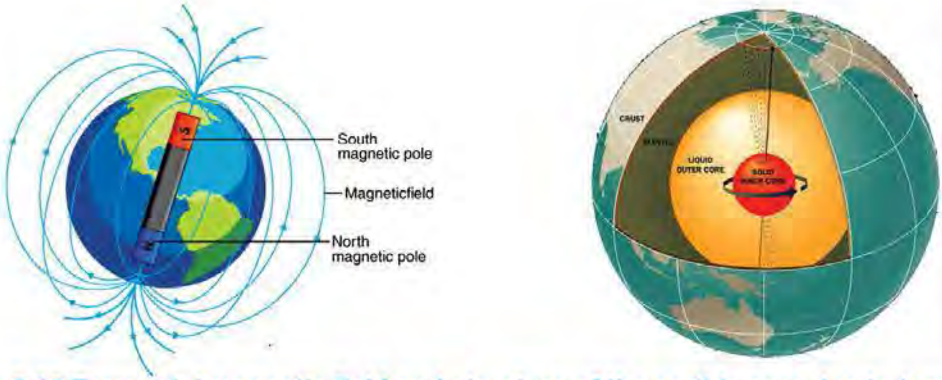


Fig 8.10 Terrestrial magnetic field and structure of the earth's core due to terrestrial magnetism.

Evidence for the existence of terrestrial magnetism.

a. If the iron rod is buried under the earth's crust in the north-south direction, it shows magnetic properties due to the influence of terrestrial magnetism.

b. A freely suspended magnet always rests in a geographical north-south direction.

c. The existence of a neutral point is the combined effects of terrestrial and other magnetic fields.

d. The occurrence of natural magnets on Earth is due to terrestrial magnetism.

Applications of terrestrial magnetism

a. Charged particles in the solar wind are reflected by the earth's magnetic field towards the north and south poles to be discharged safely. In this way, terrestrial magnetism has saved the Earth from the direct hit of harmful charged particles from the sun.

b. The age of the rocks is estimated by the magnetic materials found in the igneous rock. It helps to identify the new ores of metal.

c. A magnetic compass is based on terrestrial magnetism which is used to show the directions in submarines, ships and aeroplanes.

Elements of Terrestrial Magnetism

Magnetic Declination

The plane which connects the geographical North Pole and the South

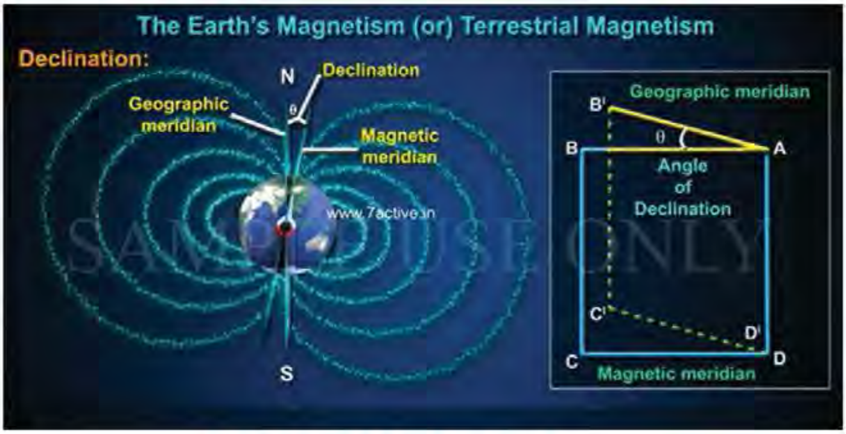


Fig 8.11 Angle of declination

Pole is called the geographical meridian. The plane which connects the North Pole and the South Pole of a terrestrial magnet is called the geomagnetic meridian.

The angle between the geographical meridian and geomagnetic meridian at any place on the earth's surface is called magnetic declination. In the above figure, 'BAB' is the angle of declination and it is measured in degrees. The value of the angle of declination varies from 0^0 to 90^0. The value of the angle of declination at the geomagnetic poles is 90^0 whereas its value is 0^0 at the geomagnetic equator. The value of the angle of declination is determined by using a declinometer, declination calculator or declination chart table. Nowadays the angle of declination is also calculated by aeronautical maps or computer software.The angle of declination is mainly used in aeroplanes, ships or submarines for navigation purposes.

Activity 8.4

Objective: Navigating by using the magnetic compass

Materials required: Magnetic compass

Procedure: Place the magnetic compass on the table or a horizontal surface.

Fig 8.12 Magnetic Compass

Observation and discussion

Observe the direction shown by the needle of the compass and compare it to the known geographical direction of your place. Identify the geographic direction indicated by the compass needle, and then locate others' directions by using this direction as a reference.

Project work 8.3

Use the compass in a mobile application or other software to find the directions of various locations. Complete the data in the table below, then present it to the class.

Place	Name of the instrument	Object pointing in the north direction	Remarks
Playground in school	Compass in mobile phone		

Magnetic inclination or angle of dip

The magnetic inclination is also calledthe angle of dip. The angle made by the needle of the freely suspended magnet with the horizonat any place is called the angle of dip.The magnetic inclination is measured by the dip needle of the dip circle. Its value varies from place to place on the earth. The angle of dip at the magnetic equator is 0^0 because the needle of the dip circle rests horizontally on the magnetic equator but the angle of dip at the magnetic poles is 90^0. The angle of dip in the capital of Nepal (i.e. Kathmandu) is 42^0. The angle of the dip is used for geographical and geological mapping.

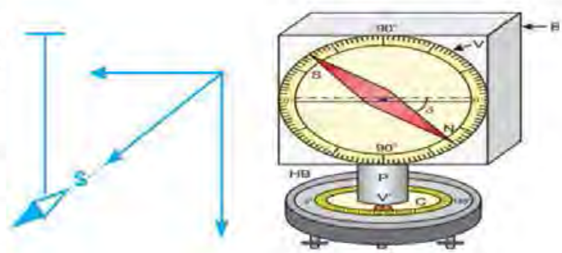


Fig 8.13 Magnetic Inclination and Dip Circle

8.2 Electricity

8.2.1 Household Electrification

The use of electronic devices has made our life easier to perform various activities. Electrical devices require electricity to operate them. The process of bringing the electricity generated from the powerhouse to the people's houses through the transmission line is called household electrification. High-voltage electricity sent from the powerhouse in the transmission line or national grid is reduced to the appropriate 220 V in the substation transformer before sending for domestic purposes. To run the various electrical equipment in the house, an electrical cable made up of copper is used to provide electricity access everywhere in the house. Wiring done in domestic premises (houses), for providing electrical power for the lamps, fans and domestic appliances with all the safety precautions followed is called domestic wiring. Various electrical equipmentor loads are connected in series, parallel or mixed combinations.

Fig 8.14 Transmission line and domestic electrification

Devices used in Domestic Wiring

Main switch

Fig 8.15 Main switch

The main switch is kept between the main meter box and the distribution board in household electrification. The current coming from the transmission line reaches the electrical loads through the main switchboard and distribution box. The main switch controls the current supplied by the transmission line to 15 A or 30 A which is appropriate for domestic wiring. The main switch is also known as the master switch. It is always connected in series in combination with the electrical loads.

Electric Meter

The electric meter is the device that measures the energy consumed by the electrical equipment or loads. The electric meter is kept inside a plastic or wooden box which is called an electric meter box. It is kept in a series combination with the main switch. The electrical energy consumption is recorded in digital form on an electric meter. The commercial unit of electrical energy consumption is a kilowatt hour (kWh) or unit. One unit of electrical energy consumption is equivalent to a 1-kilowatt hour. One unit of electricity is consumed while using any electrical device of power 1000 W for 1 hour. Based on this information, monthly energy consumption is recorded in the form of units and we can calculate the monthly charge for electricity. For example, if the electric meter shows 40 units of electrical energy consumed in a month and the cost of electricity consumption is Rs. 8 per unit. We should pay Rs 320 to the electricity authority for the consumption of electricity in that month. We can use the following formulae to calculate the electricity bill.

Fig 8.16 Electric meter

Let us consider,

Energy consumed = E.C. (kWh or unit)

Power of electrical device = P (kW)

Time = t (hr)

Number of devices = N

Then the formula to calculate the energy consumption is given below,

$E.C. = P \times N \times t$

By using the above formula, we can calculate the electrical energy consumed by total electrical equipment and the bill amount that must be paid to the electricity authority.

Numerical problem

If there are 4 electric bulbs each of power 60 W in a house used for 3.5 hrs in a day. Calculate the electricity bill for the month if the cost of a unit of electricity is Rs 8.50

Solution:

Here,

Power of the bulb (P) = 60 W = 60/1000kW = 0.06 kW

Number of the bulb (N) = 4

Time (t) = 3.5 hrs.

Electricity consumption per day (E.C.) =?

By using the formula,

$E.C. = P \times N \times t$

or, $E.C. = 0.06 \times 4 \times 3.5$

or, E.C. = 0.84 kWh

Total electricity consumed in a month (E.C.') = 0.84×30

= 25.2 kWh = 25.2 units.

Rate of electricity (R) = Rs. 8.50

Now,

Electricity bill for a month = total energy consumption (E.C.') × Rate (R)

= 25.2×8.50

= Rs. 214.20

Therefore, the total electricity bill for the month of that house is Rs. 214.20.

Distribution Board

Fig 8.17 Distribution board

The distribution board sends the current coming from the transmission line to the domestic electrification.It does so by distributing electrical current to different electrical equipment.

Miniature Circuit Breaker (MCB)

Fig 8.18 MCB.

MCB is connected near the electric meter in the distribution board. It is kept inside a plastic box. It is also called the main fuse. MCB is an automatic switch that opens when excessive current flows through the circuit. It can be closed again without replacing any part. MCB trips and shuts down the system when anelectrical load draws more current than the maximum current allowed in the domestic wiring.It avoids accidents caused due to short circuits.

Fuse

A fuse is a safety device used in domestic wiring. It is a thin wire made up of tin and lead which is kept in a small ceramic box. It has high resistance and a low melting point. It is connected in a series with loads in the domestic circuit. When more than the required current flows in the electric circuit due to some disturbance, the fuse melts and protects the other electrical equipment from being damaged. In general, 5 A to 30 A capacity fuses are used in domestic wiring.

Fig 8.19 fuse

Switch

The switch is a device that is used to flow or cut off the current in an electric circuit. It is connected in series with the electrical load in domestic wiring. The switch is always connected in phase or live wire. The switch is turned ON to operate the electrical equipment whenever needed. Usually, different switches are used to control different devices separately although we can run various devices at a time by using a single switch.

Fig 8.20switch

Plug and socket

Plugs and sockets are used to distribute the electric current from one place to another place in domestic electrification. Plug and socket are fixed on the wall and electrical devices are connected tothe plug and socket to operate them. In the same socket, we can insert one or many plugs. The sockets are either 2-pin or 3-pin sockets. Plug and socket are used to distribute the electric current safely and to minimize the risk of electric shock in domestic wiring.

Fig 8.21 Plug and socket

Electric Bulb

An electric bulb converts electrical energy into light energy. Bulbs are connected in parallel combination in domestic wiring but they are connected in series combination in disco lights. The bulb is made of transparent glass. A tungsten filament is kept inside the bulb to convert electrical energy into light energy. Filament lamps, fluorescent lamps, compact fluorescent lamp (CFL) bulbs and light emitting diode (LED) are some common types of bulbs. We should be very careful while disposingof the broken bulb because the broken pieces of glass are sharp and harmful chemicals may have been used inside the bulb.

Project work 8.4

Identify the various electrical devices used in your school premises. Make a report by including the condition of these devices and their application. Present your reportin the classroom.

8.2.2 Electric Wire

Conducting wire is used to distribute the electric current in domestic electrification. We cannot make an electric circuit without conducting wires. Electric current flows through the path provided by the wire. Three types of wires are used in domestic electrification; i.e. Phase or live wire,neutral wire and earth wire.

Phase or Live Wire

The wire containing a higher potential current is called phase wire or live wire. It gives the electric shock while touching because a high potential current flows through our body. So, we should be very careful. Switches and fuses are used in phase or live wire so that the high potential current doesn't flow through the circuit when the switch is OFF. Generally, red or dark-red coloured wires are used for making phase or live wire.

Neutral Wire

An electric current of zero potential flows in a neutral wire. Electric current flows through the electric equipment due to the difference in potential between a phase and a neutral wire. Generally, blue or black coloured wires are used for making neutral wire. Although it has zero potential, we must not touch it.

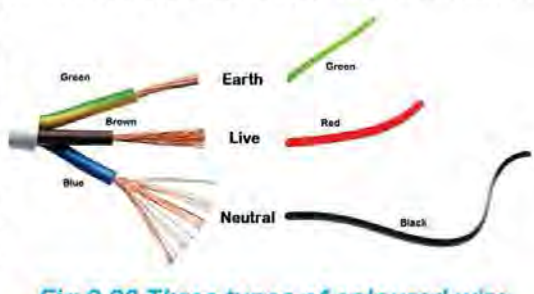


Fig 8.22 Three types of coloured wire

Earth Wire

In domestic wiring, an earth wire is connected to each appliance and is buried in the ground through the distribution box and electric meter. Earthing is the process of instantaneous discharge of electrical energy by transferring charges directly to the earth through low resistance wire. In a three-pin socket, the pin for connecting the earthwire is at the top. Earthing protects the electrical equipment from leakage currents by sending itto the ground and hence preventing electrical fires. Generally, green or yellow coloured wire is used for making the earth wire. By using different coloured wires for phase, neutral and earth, the damaged wire and its location can be identified easily if there is any problem in the electric circuit. This helps in maintenance.

Project work 8.5

Observe the wiring in each room of your house or your classroom in the school and identify the live, neutral and earth wires. Prepare a report on whether the wires of the appropriate colour are used and whether the appliances in the room are earthed or not and show it to the teacher.

8.2.3 Wiring in Plug and Socket

Plugs and sockets are the most commonly used devices in household circuits. Sometimes the wires inside them become loose and need to be repaired. In the same way, new plugs and sockets should be wired and connected to the circuit. The plug and socket should be wired in the following manner:

a. Open the cover of the plug or socket with a screwdriver.

b. Using a knife or pliers, cut off about 1.5 inches of the insulation around the electrical cable and take out the three smaller cables inside it.

c. Identify the live, neutral and earth wires and remove the insulation around them by using pliers as mentioned in previous steps.

d. Twist the naked wires inside each cable and bend the upper end of the twisted wire slightly.

e. Loosen the screw on the right-hand pin (usually it has a fuse connected in this pin) with the screwdriver and insert the twisted bare tip of the live (red or dark-red coloured) wire into the pinhole and tighten the screw.

f. Unscrew the pin on the left and insert the twisted bare tip of the neutral (black or blue wire) into the hole and tighten the screw.

g. Now unscrew the upper pin in the socket and put the twisted bare end of the earth wire in the hole and tighten the screw.

h. Clamp the cord with several grippers and tighten the screws so that the power cord does not come out of the plug even with a slight pull.

i. Finally, put the cover of the plug and tighten the screw.

j. Wires can be connected to sockets in the same way.

Fig 8.23 Wiring in the plug

Caution: Electric shock may kill a person, so turn OFF the main switch before performing any electrical activities with the real domestic electric circuit. You must carry out such activities only in the presence of parents or teachers.

Activity 8.5

Objective: To connect the wire to a plug

Materials required: Screwdriver, tester, pliers, knife and conducting wires.

Procedure

a. Take a plug and unscrew its cover witha screwdriver.

b. Take a cable connected to a piece of electric equipment at one end.

c. Identify the live, neutral and earth wires at the free end of the cable and remove about 1.5 cm of insulation from the tip of each of these wireswith the help of pliers or a knife.

d. Twist the naked wires in each cable with the help of pliers and bend them slightly.

e. Connect the live, neutral and earth wires to their respective pins.

f. Put the cover of the plug back and tighten the screw. Check the current in the socket by the tester and insert the plug into the socket.

Observation and conclusion

When the plug is inserted into the socket, observe the condition of electrical equipment when switched ON and switched OFF.

8.2.4 Electric Circuit of light bulbs

Electric light bulbs are connected in parallel combination in household electrification. We can use a separate switch to control each bulb when they are connected in such a combination. Every light bulb gives equal brightness (for the same power) in a parallel connection. Light bulbs are installed in every room inthe house. We should use a separate switch for each bulb.

Fig 8.24 Connection of the bulbs in household electrification

Activity 8.6

Objective: To construct the electric circuit of lamps

Materials required: Wooden electric board, holder, cable, wire, switch, multiplug, screwdriver, screws, pliers, knife, insulation tape, and a tester.

Procedure

a. Sketch the graph of the parallel connection of three lamps on the electric board with the help of the teacher.

b. Tighten the holder of the bulb with its screw at the marked place on the sketch.

c. In the same way, connect the switch and wire to the specified place of the electric board. Cover all the naked wires using insulated (PVC) tape.

d. Fix the lamp to the holder,and connect the wiring board to the multiplug.

Fig 8.25 Connecting bulb to the electric circuit

e. Check the access of electricity in the socket by the tester and connect the multiplug to the socket.

f. Turn ON the switch of the socket board.

Observations and conclusions

Observe whetherthe bulb glows or notwhen the switch is switched ON and OFF.

Glossary

Crust	:	The outer layer of the earth
Imaging equipment	:	Advanced medical equipment is used to make a three-dimensional image of a human organ using electro magnetic radiation.
Transformer	:	a device used to increase or decrease the voltage of alternating current.

Exercise

1. Choose the correct alternatives:

(a) Whichof the following is a natural magnet?

(i) limestone (ii) nickel

(iii) loadstone (iv) electromagnet

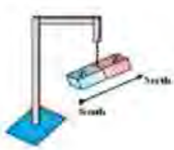
(b) To which wire in a home's electrification system is the switch connected?

(i) neutral wire (ii) earth wire

(iii) fuse wire (iv) live wire

(c) Which one of the following figures gives evidence of geomagnetism?

(I) (II) (III) (IV)




(i) I (ii) II (iii) III (iv) IV

(d) "Earthing prevents the electrical equipment from being damaged or destroyed." How is the earthing done in household wiring?

(i) A wire is buried in the earth.

(ii) A green-coloured wire is buried in the earth.

(iii) A wire is taken from the plug and connected to the earth.

(iv) Earth wire is taken from every electrical equipment and buried in the earth.

2. Differentiate between:

a. natural magnet and artificial magnet

b. plug and socket

c. live wire and neutral wire

3. Give reasons:

a. The magnet gets demagnetized while hammering.

b. The angle of inclination or the angle of dip at the geomagnetic poles is 90^0.

c. Different coloured wires are used in domestic wiring.

d. The fuse is always connected in phase or live wire in domestic wiring.

4. Answer the following questions:

a. What are the conditions for the demagnetization of a magnet? Explain any one of them in brief.

b. Explain, with a diagram, the molecular theory of magnetism.

c. Write down any three applications of the magnet.

d. What is terrestrial magnetism?

e. Write any three applications of terrestrial magnetism.

f. What is household electrification? Write down the characteristics of neutral and phase wires used in household electrification.

g. "Magnetization of magnetic materials in nature is the effect of terrestrial magnetism." Justify this statement with examples.

h. Write down the steps of wiring a plug.

i. What is earthing? Why is earthing necessary in domestic wiring?

j. "The orientation of magnetic molecules determines the condition of magnet and magnetic substance." Are the magnetic and non-magnetic propertiesof a substance interchangeable according to the above statement? Justify.

k. Is there a connection between magnets and electricity? Explain their connection with any activity.

5. Solve the following numerical problems:

a. The electric meter in Bhawana's house records 15 units of consumption of electricity in 15 days. Calculate the average monthly electricity bill of Bhawana's house if the cost of electricity is Rs. 9.5 per unit. (Ans: Rs 1425)

b. If 8 bulbs each of power 25 W are installed in a house used for 4 hours 40 minutes daily, calculate the total electricity consumption, in units, in a day. (Ans: 0.0932 units)

c. The sub-meter in Sharmila's room records 8.5 units of electricity in a month. If there is only one electric bulb of power 65 W in her room, calculate the average duration for which theelectric bulb is used in a day. (Ans: 4.353 hrs.)

d. In a certain place, the municipality installed 14 street lights each rated 1500 W. These street lights are used for 6.5 hours daily on average. If the municipality has to pay the electricity bill at the rate of Rs 12.50, calculate the monthly bill paid by the municipality to the electricity authority for using these street lights. (Ans: Rs 51187.50)

9 Matter

There are various types of objects around us, such as bags, books, pens, pencils, desks, benches, water, air etc. All these objects have mass and volume. Similar to this, observe the items that have mass and volume around you and those that do not. Based on that, complete the given table below and discuss it in class.

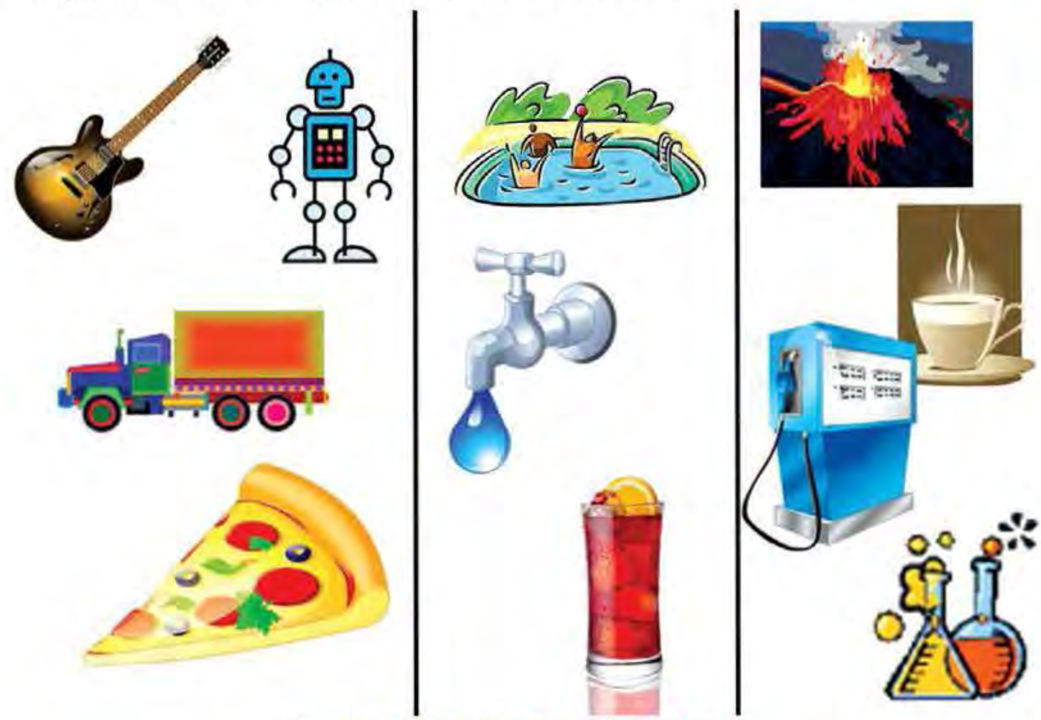


Fig. 9.1 Different types of substances

Objects with mass and volume	Objects without mass and volume

In contrast to heat, light, shadow etc. which do not have mass and volume, the objects around us such as books, copies, desks, benches, houses, and trees all have these properties.

All objects which have mass and volume are called matter. The matter is made up of the same or different types of atoms. The matteris categorized into pure and impure substances. Elements and compounds are pure substances whereas mixtures are impure substances. In addition, the substances around us are found in solid, liquid and gaseous states.

Atom

Activity: 9.1

Match the symbol and atomic number of the given element.

Element	Atomic Number
H	13
Li	15
N	1
Al	10
P	3
Ne	7
	9

Activity9.2

Look at the picture and discuss the questions given below.

a. What is called the central part of an atom?

b. What are the sub-atomic particles of an atom?

c. Which sub-atomic particles remain in the central part of the atom?

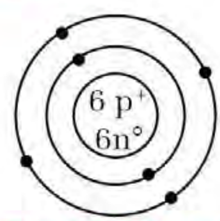


Figure 9.2: Atomic structure

d. What is the sub-atomic particle that revolves around the nucleus?

e. Atomic structure of which element is shown in the figure?

The smallest particle of an elementis systematically composed of subatomic particles. An atom may take part in a chemical reaction. An atom is an extremely minute particle of matter that cannot be seen with the naked eye. Elements are made up of the same type of atoms. An atom of an element is different from the atom of other elements.

The structure of an atom determines the physical and chemical behavior of an element.

Structure of an atom

An atom is composed of three subatomic particles. There are two types of sub-atomic particles in the central part of an atom. The central part of an atom is called the nucleus. Another sub-atomic particle revolves around the nucleus in a fixed path. Such a fixed path is called a shell or orbit. Neutrons and protons are the sub-atomic particles in the nucleus whereas the electrons revolve around the nucleus in their shells.

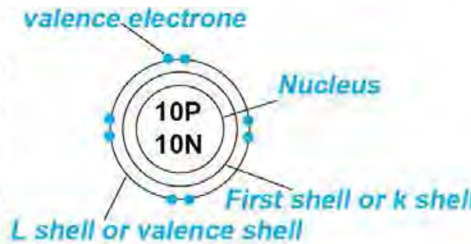


Figure: 9.3 Atomic Structure

Proton

A positively charged sub-atomic particle in the nucleus of an atom is called a proton. It is denoted by p+. The mass of a proton is equal to the mass of a hydrogen atom. The mass of a proton is called 1 atomic mass unit (a.m.u.).

Neutron

The chargeless sub-atomic particles in the nucleus of an atom are called neutrons. It is denoted as n^0. The mass of a neutron is equal to the mass of a proton. Therefore, the mass of a neutron is 1 atomic mass unit (amu).

Electron

A negatively charged sub-atomic particle that revolves around the nucleus of an atom is called an electron. It is denoted as e-. The mass of an electron is very less than that of a proton and neutron. The mass of a proton is equal to the mass of about 1837 electrons or the mass of an electron is equal to 1/1837 amu.

Comparative study of the sub-atomic particles of an atom

Sub-atomic particles	Symbol	Location	Charge	Mass
Proton	p^+	nucleus	positive	1amu
Neutron	n^o	nucleus	chargeless	1amu
Electron	e^-	shells or orbit	negative	1/1837amu

Name of element, symbol and number of sub-atomic particles in an atom

Atomic number	Element	Symbol	Number of protons	Number of neutrons	Number of electrons
1	Hydrogen	H	1	0	1
2	Helium	He	2	2	2
3	Lithium	Li	3	4	3
4	Beryllium	Be	4	5	4
5	Boron	B	5	6	5
6	Carbon	C	6	6	6
7	Nitrogen	N	7	7	7
8	Oxygen	O	8	8	8
9	Fluorine	F	9	10	9
10	Neon	Ne	10	10	10
11	Sodium	Na	11	12	11
12	Magnesium	Mg	12	12	12
13	Aluminium	Al	13	14	13
14	Silicon	Si	14	14	14
15	Phosporous	P	15	16	15
16	Sulphur	S	16	16	16
17	Chlorine	Cl	17	18	17
18	Argon	Ar	18	22	18
19	Potassium	K	19	20	19
20	Calcium	Ca	20	20	20

Nitrogen has seven electrons in its shell. Are these all electrons in the same shells or different shells? The number of electrons in an atom of an element can be found by Bohr and Bury's $2n^2$ Rule.

Bohr and Bury's $2n^2$ Rule

The electrons in the atoms of an element are located in its shells. The innermost shell of an atom is called the K shell and the other shells are called L, M, and N respectively. Shells are also called energy levels. K shell is the first energy level of an atom, while the second, third and fourth energy levels are L, M and N shells respectively.

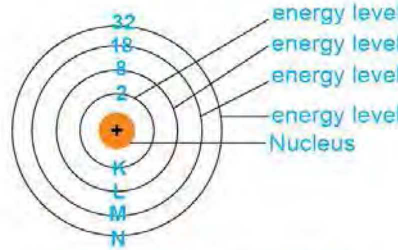


Fig. 9.4 energy of atom

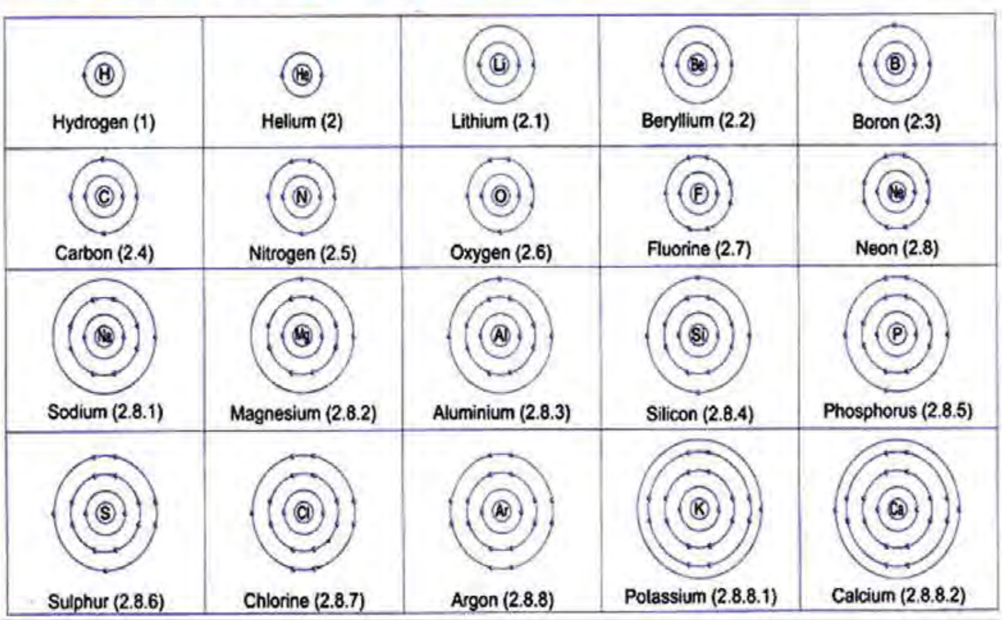
The rule that tells how many electrons are located in the shell of an atom is called the $2n^2$ rule of Bohr and Bury where 'n' is the number of shells. According to this rule, the K shell has 2 electrons. Similarly, L, M and N shells have 8, 18 and 32 electrons respectively.

For example:

For K shell (n=1), the number of electrons that can be accommodated

$= 2n^2 = 2 \times 1^2 = 2.$

Atomic structure of the first 20 elements



Project work 9.1

Prepare an atomic model of any five elements among the first 20 elements by using materials such as different colored threads or iron wire, different colored pulses or any locally available materials and demonstrate it in the class.

Valence shell, Valence electron and Valency

The outermost shell of an atom is called the valence shell. The electrons in the valence shell are called valence electrons. Atom always tries to attain stability by attaining two (elements from atomic number 1 to 5) or 8 electrons in their valence shell. Atoms loose or gain or share electrons to attain stability. An atom of an element with valence electrons 1 to 3 loses electrons, an atom with 4 valence electrons shares electrons and an atom with 5 to 7 valence electrons gains electrons to attain stability. Valency is the number of electrons donated, shared or gained by an atom of an element to attain stability. An atom of an element with valence electron 8 does not donate, share or lose any electron. Therefore, the valency of such elements is 0 and do not take part in the generalchemical reaction.

Activity 9.3

Complete the electronic configuration and valency of the elements in the given table.

Atomic number	Element	Electronic configuration	Valency
1	Hydrogen	1	
2	Helium		
3	Lithium		
4	Beryllium		
5	Boron	2, 3	
6	Carbon		

7	Nitrogen		
8	Oxygen		
9	Fluorine		
10	Neon		
11	Sodium		
12	Magnesium	2, 8, 2	
13	Aluminium		
14	Silicon		
15	Phosphorous		
16	Sulphur		
17	Chlorine	2, 8, 7	
18	Argon		
19	Potassium		
20	Calcium	2, 8, 8, 2	

Molecular formula

The symbolic representation of a molecule of an element or a compound is called molecular formula. Molecules of an element have the same type of atoms while the molecules of the compounds have different types of atoms. While writing the molecular formula of a compound, it is necessary to know the type of elements and their valency involved in the formation of the compound. Then the molecular formula of the compound can be written using the criss-cross method. For this following method should be used serially.

(a) At first, write the name of the compound. Eg: Magnesium oxide

(b) Write the symbol of the elements involved in the molecule of the compound.

Mg O

(c) Write the valency of the elements above their symbol.

2 2

Mg O

(d) Now exchange the valency with the help of arrow symbols.

2 2

Mg O

(e) Write the exchanged valency number as a subscript in the symbol of elements.

Mg_2 O_2

$= MgO$

Valency 1 is not written. If the valency of two elements is divisible by a common number, then divide the number and write the remaining number only.

$Mg_2O_2 = MgO$

Other examples of molecular formulas

(a) Potassium Chloride

Potassium Chloride

1 1

K Cl

K_1 Cl_1

$= KCl$

(b) Calcium Chloride

Calcium Chloride

2 1

Ca Cl_1

Ca_1 Cl_2

$= CaCl_2$

(c) Ammonia

3 1

N H

N_1 H_3

$= NH_3$

(d) Carbon dioxide

4 2

C O

C_2 O_4

$= CO_2$

(f) Water

1 2

H O

H_2 O_1

$= H_2O$

Atomic weight of elements

The sum of the number of protons and neutrons in the nucleus of an atom is called the atomic weight of the element. For example, there are 12 protons and 12 neutrons in the nucleus of a magnesium atom. So the sum of protons and neutrons is 24, which is the atomic weight of magnesium.

Atomic weight of an element = number of protons + number of neutrons

Examples

Find the atomic weight of calcium which has 20 protons and 20 neutrons.

Number of protons of calcium = 20

Number of neutrons of Calcium =20

Atomic weight of Calcium =?

Atomic weight= number of protons + number of neutrons

=20+20

= 40 amu

Question to think about:

Although the sub-atomic particles of elements are protons, neutrons and electrons but the atomic weight of elements is calculated by the sum of protons and neutrons only, why?

Molecular weight of molecule

The molecular weight of any element or compound is the sum of the atomic weights of the elements present in the molecule of the element or compound. For example, the molecular formula of water is H_2O. This means that there are two hydrogen atoms and one oxygen atom in the water molecule. The atomic weight of hydrogen and oxygen are 1 and 16 respectively. So the molecular weight of water is 18 amu.

For examples:

(a) What is the molecular weight of Calcium Carbonate?

Molecular weight of Calcium Carbonate = atomic weight of calcium + atomic weight of Carbon+ 3×atomic weight of oxygen × 3

$= CaCO_3$

$= Ca + C + 3 \times O$

$= 40 \times 1 + 12 \times 1 + 16 \times 3$

$= 100$ amu

(b) What is the molecular weight of Magnesium Chloride?

Molecular weight of Magnesium Chloride =?

Molecular weight of Magnesium Chloride = atomic weight of magnesium+ atomic weight of Chlorine × 2

$= MgCl_2$

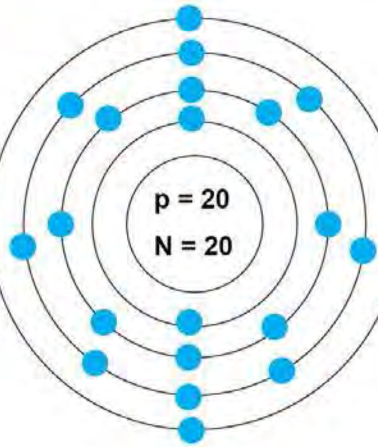
$= Mg + 2 \times Cl$

$= 24 \times 1 + 35 \times 2$

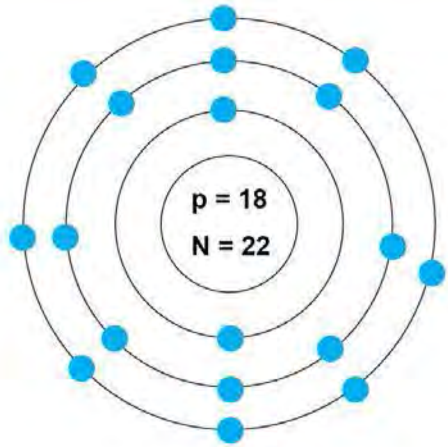
$= 94$ amu

Activity 9.4

Compare the atomic structures of elements and complete the table given below.



Atom A



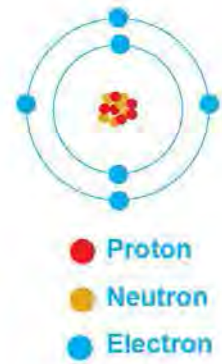
Atom B

	Element name	Atomic number	No. of proton	No. of neutron	No. of electron	Atomic weight	No. of shells	Valence electron	Valency
Atom A									
Atom B									

Exercises

1. Choose the best alternatives:

(a) What is the symbol of the element given in the figure?



(अ) S (आ) Si

(इ) Na (ई) C

(b) Which of the following elements has zero valency?

(i) Hydrogen (ii) Sodium

(iii) Neon (iv) Calcium

(c) What is the atomic weight of Argon?

(i) 40 amu (ii) 42 amu

(iii) 44 amu (iv) 46 amu

(d) Which of the following is the mass of negatively charged subatomic particles of an atom?

(i) 1/1834 amu (ii) 1/1835 amu

(iii) 1/1836 amu (iv) 1/1837 amu

(e) What are the subatomic particles in the nucleus of an atom?

(i) Proton and Electron (ii) Electron and Neutron

(iii) Neutron and proton (iv) Proton, Neutron and Electron

(f) What is the molecular formula of calcium oxide?

(i) CaO (ii) CaO_2

(iii) Ca_2O (iv) $CaCO_3$

(g) The number of protons (p+), electrons (e-) and neutrons (n^0) of various elements are given in the table below.

Element	No. of proton	No. of electron	No. of neutron
Potassium	19	19	20
Carbon	6	6	6
Oxygen	8	8	8
Argon	18	18	22

Which of these has the highest atomic weight?

(i) Potassium (ii) Carbon

(iii) Oxygen (iv) Argon

2. Differentiate between:

(a) Proton and electron (b) K shell and M shell

(c) Valence shell and valence electron

(d) Atomic weight and molecular weight

3. Give reasons:

(a) An atom is electrically neutral.

(b) The valency of Chlorine is 1.

4. Answer the following questions:

(a) What is an atom?

(b) Write the name, symbol and charge of sub-atomic particles in an atom.

(c) Write the molecular formula of the given compound by the crisscross method.

(i) Magnesium oxide (ii) Sodium Chloride

(iii) Potassium oxide (iv) Aluminium Chloride

(v) Ammonia

(d) What is a shell?

(e) What isthe $2n^2$ rule used for?

(f) What is a valence shell? What is called the electron in the valence shell?

(g) What is valency? What are the factors on which the valency of an element depends?

(h) What is meant by the valency of an element being zero?

(i) What will be the valency of an element if the electronic configuration of an element is 2,8,8,1? Write with reasons.

(j) What is the molecular formula? What arethe information required to write the molecular formula of a compound?

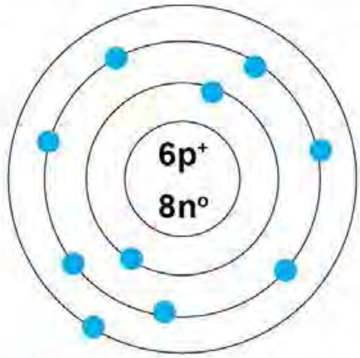
(k) What is the atomic weight of Potassium? Calculate the molecular weight of Calcium Chloride.

(l) Complete the table given below:

Element	Symbol	Atomic number	Atomic mass	No. of proton	No. of neutron	No. of electron
Oxygen			16			
	C			6		
		11			12	
			24			12
Chlorine				17		
	K				20	
		14				14
Argon			40			

(m) Can an atom exist without electrons? Give reasons.

(n) Anju has drawn the atomic structure of Sodium as follows. Find any three mistakes in the atomic structure drawn by her.



(o) What is the element to which the given nucleus of an atom belongs? Draw the atomic structure of an atom of the elements given below. What are the information required to calculate the atomic weight of the elements? Write with reasons.

Proton=19

Neutron=20

(p) Complete the table by the number of atoms in a molecule of Sulphuric acid (H_2SO_4)

Element	Number of atoms
Hydrogen	....
Sulphur	....
Oxygen	....

Classification of elements

Activity 9.5

Write the names of at least 20 objects around us. Try to memorize these items by reading them once or twice. Check how many of them you can remember. Now classify these objects based on similar properties and try to remember them. Discuss whether it was easier to remember the names of objects before or after categorizing them. By classifying the elements in this way, the study of the elements would be easier and faster to memorize for a long time.

Along with the development of science, more and more elements were discovered. It became difficult to study them one by one. Therefore, it is needed to classify the elements based on their similar and dissimilar characteristics. While classifying the elements, they were arranged in a table having rows and columns which is called the periodic table. Along with the development of different types of the periodic table, the modern periodic table was developed which is still in practice.

Modern Periodic Table

While classifying elements, many scientists tried to classify the elements in their own way, but the modern periodic table created by Henry Moseley in 1913 is considered the most scientificclassification. It is accepted all over the world so being used currently in scientific works. Henry Moseley discovered that the properties of the elements repeated at certain intervals while arranging them in increasing order of their atomic number. Elements with similar properties fell inthe same vertical column and different elements with different properties lie in a horizontal row. Henry Mosely put forward the modern periodic law based on the periodic function of the atomic number of elements.

Periodic table of the elements

- Alkali metals
- Alkaline-earth metals
- Transition metals
- Other metals
- Other nonmetals
- Halogens
- Noble gases
- Rare-earth elements (21, 39, 57–71) and lanthanoid elements (57–71 only)
- Actinoid elements

period	group 1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

lanthanoid series 6	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
actinoid series 7	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

*Numbering system adopted by the International Union of Pure and Applied Chemistry (IUPAC).

Modern Periodic Law

"The physical and chemical properties ofelements are the periodic function of their atomic number". The physical and chemical properties of elements change as their atomic number increases and a similar property repeats itself at a certain interval.

Activity 9.6

Make a blank periodic table on a piece of chart paper. Write the symbol of the elements from hydrogen to calcium clearly on separate pieces of paper as big as the room made in the periodic table. Now paste the pieces of paper serially from hydrogen to calcium in the periodic table. Every student should perform this activity and present it in the classroom turn-wise.

Position of Hydrogen in the modern periodic table

Hydrogen has only one electron in its outermost shell. Therefore, it is placed in group 1 of the modern periodic table.But hydrogen does not have metallic properties like other elements of group 1.

Position of metals in the modern periodic table

Elements that donate electrons during a chemical reaction are called metals. Metals are good conductors of heat and electricity. If there are 1 to 3 electrons in the outer shell of an element, the elements show their reactivity by donating electrons. There are metals from groups 1 to 13. Elements in group 1 have one valence electron which they easily donate during a chemical reaction to attain stability. Hence elements of this group are very reactive. They are also called alkali metals. Group 2 elements are called alkaline earth metals.

Position of non-metals in the modern periodic table

Elements that gain electrons during a chemical reaction are called non-metals. Non-metals are poor conductors of heat and electricity. If there are 5 to 7 electrons in the outermost shell of an element, the elements show their reactivity by gaining electrons. Elements in groups 15, 16 and 17 of the modern periodic table have the properties of non-metals.

Since there are seven valence electrons in the outermost shell of an atom of group 17, they attain stability by gaining one electron. Therefore, the elements of this group are called very reactive non-metals. They are also called halogens.

Position of inert gases in the modern periodic table

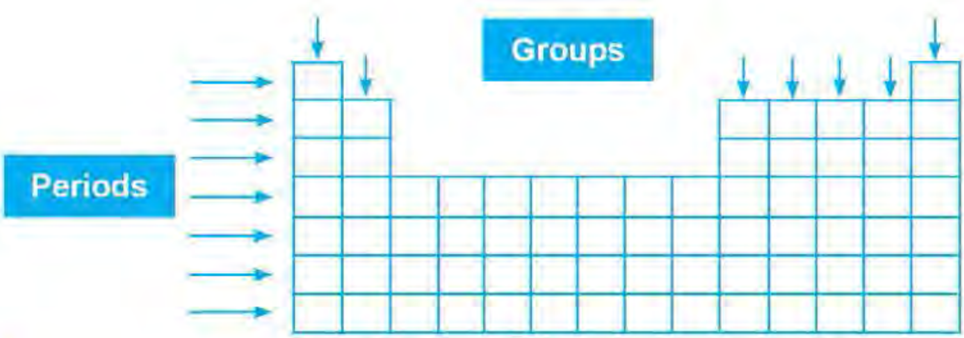
Elements that neither gain nor donate any electrons nor participate in a chemical reaction are called inert gases. If there are two electrons (helium) and 8 electrons (neon, argon) in the outermost shell of an element, these elements do not gain or donate electrons because they have already attained stability. The inert gases are placed in group 18 of the modern periodic table.

Activity 9.7

In the class, students from roll numbers 1 to 20 are given the name hydrogen, helium, lithium ...... calcium respectively according to atomic number. Make a blank periodic table with chalkor lime in the school hall, courtyard or open space. Now, students who are named hydrogen, helium, lithium......... calcium have to occupy their respective places in the empty periodic table one by one. Discuss the reason for falling in group 1 by the students in that group. Similarly, the students in other groups also discuss the reasons for falling into their respective groups.

The concept of groups and periods in the modern periodic table

In the modern periodic table, elements with similar properties are placed in the same vertical columns called groups, where as elements having different properties are placed in horizontal rows called periods. The modern periodic table has 18 groups and 7 periods.



Characteristic of groups in the modern periodic table

Activity 9.8

Make atomic structures of Group 1 elements by using locally available materials such as yarn, cotton, wool, fine metal wire etc.and keep them serially. Study their atomic structure and answers the following questions:

(a) What happens to the atomic sizes of Group 1 elementsas we move from top to bottom?

(b) What change occurs in the number of shells of elements of group 1 on moving from top to bottom?

(c) What change is observed inthe electron-donating capacity of group 1 elements as we move from top to bottom?

(d) Is the valency changed in the elements of group 1 as we move from top to bottom and why?

Characteristics of Groups

1. The physical and chemical properties of elements in the same group are similar.
2. Elements in the same group have different numbers of shells but the number of electrons in the valence shell isthe same. Therefore, their valency is also the same.
3. As we move from top to bottom in any group, the atomic size of the elements increases because the number of shells in their atom increases one by one.
4. When we move fromthe top to the bottom in any group, the electron-donating ability or metallic character of the elements increases whereas the electron-gaining capacity or non-metallic character decreases.

Periods in the modern periodic table

Activity 9.9

Make atomic structures of period 3 elements using locally available materials such as yarn, cotton, wool, fine metal wire, etc. and keep them serially.

Study the atomic structure carefully and answer the following questions:

a) What change occursin the atomic size of the elements in period 3 as we move from left to right?

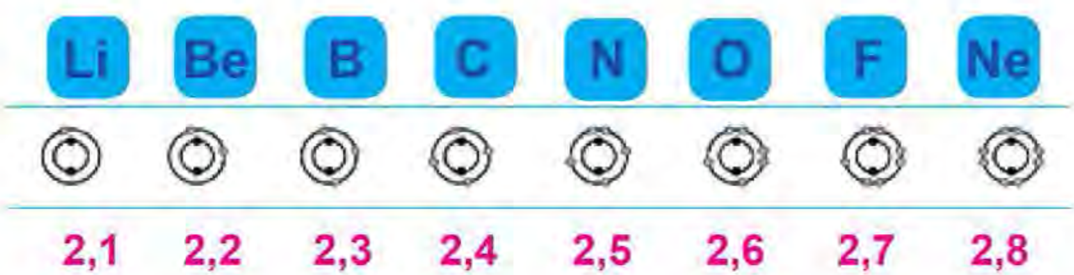
b) What change occurs in the number of shells ofelements as we move from left to right in period 3?

c) What change occurs in the ability of elements of period 3 to accept electrons as we move from left to right?

d) Why is the valency of the element in period 3 changed as we move from left to right?

Properties of Period

1. The physical and chemical properties of the elements gradually change in the same period.



2. Elements in the same period has an equal number of shell, whereas the number of valence electrons is different. Therefore, the valency varies in a period.

3. Atomic size of elements decreases as we go from left to right in any period except inert gas.

4. While moving from left to right in any period, the electron donating capacity of the elements or metallic character decreases, whereas the electron gaining capacity or the non-metallic character increases.

Project work 9.2

Prepare a model of a modern periodic table using locally available materials like wood, thermocol, cardboard etc. and demonstrate it in your class.

Chemical Reaction

Various changes are taking place around us. A change that does not alter the composition of the substance is called a physical change. Physical change can be reversed to its original state. The changes in which the composition of the substance varies and cannot be reversed directly to its original state is called a chemical change. Combination, dissociation and exchange of atoms take place during the chemical change. Thus, the chemical change in which combination, dissociation and exchange of atoms take place to form new substances is called a chemical reaction.

A chemical equation is the symbolic representation of a chemical reaction in the form of symbols and chemical formulas.The substances that take part in a chemical reaction are called the reactants, whereas the new substances formed at the end of the chemical reaction are called the products. While writing a chemical equation, the reactants are written on the left and the products on the right of the arrow symbol.

Chemical Equation

Chemical equations in which reactants and products are expressed in words are called word equations. Likewise, chemical equations in which reactants and products are expressed inmolecular formulae are called formula equations. The number of atoms of every element on the left and right sides of the formula equation must be equal. So the reactants and products are balanced by placing coefficients in front of reactants and products as per necessity.The number of atoms on the left and right sides of the formula equation is equal in a balanced chemical equation. The formulae equation before balancing is called the skeletal equation. Therefore, chemical equations can be expressed as word equations, skeletal and balanced chemical equations

For example, the chemical reaction between sodium and chlorine to form sodium chloride can be expressed into a balanced chemical equation as:

Sodium + Chlorine $\rightarrow$ Sodium chloride

$$2Na + Cl_2 \rightarrow 2NaCl$$

The reaction between nitrogen and hydrogen to form ammonia can be expressed ina balanced chemical equation as:

Nitrogen+ Hydrogen $\rightarrow$ Ammonia

$$N_2 + 3H_2 \rightarrow 2NH_3$$

When calcium carbonate is heated, calcium oxide and carbon dioxide are formed. This chemical reaction can be expressed in the form of a chemical equation as:

Calcium carbonate $\rightarrow$ Calcium oxide + Carbon dioxide

$$CaCO_3 \rightarrow CaO + CO_2$$

The chemical reaction between zinc and dilute hydrochloric acid produces zinc chloride and hydrogen gas which can be expressed in the form of a balanced chemical equation as:

Zinc + Hydrochloric acid $\rightarrow$ Zinc Chloride + Hydrogen

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Exercise

1. Choose the correct alternative:

(a) Who discovered the modern periodic table?

(i) Dmitri Mendeleev (ii) Henry Moseley

(iii) John Dalton (iv) Bohr

(b) On which basis are the elementsarranged in the modern periodic table?

(i) atomic weight (ii) atomic mass

(iii) molecular mass (iv) atomic number

(c) Which of the following statements is true regarding the characteristics of the group?

(i) Elements in the same group have different chemical and physical properties.

(ii) Atomic size of elements decreases from top to bottom of the group.

(iii) Elements in the same group have the same valency.

(iv) The non-metallic properties of the elements increase from top to bottom of the group.

(d) Which metal is found in the liquid state at normal room temperature?

(i) Sodium (ii) Magnesium

(iii) Aluminum (iv) Mercury

(e) Which of the following elements belongs to group 18 of the modern periodic table?

(a) Sodium (ii) Magnesium

(iii) Phosphorus (iv) Argon

(f) What are the similarities between argon and chlorine?

(i) Both elements are inert gases.

(ii) Both elements belong to the same period.

(iii) Chemical reactivity of both elements isthe same.

(iv) Both elements lie in the same column

(g) Which of the following statements is correct about the characteristics of groups in the periodic table?

(i) The physical properties of the elements are different in the same group.

(ii) Elements belonging to the same group have the same chemical properties.

(iii) Elements belonging to the same group have the different physical and chemical properties.

(iv) Elements belonging to the same group have the same physical properties but different chemical properties.

2. Differentiate between:

(a) Group and period

(b) Metals and non-metals

(c) Group 1 and Group 17 elements

(d) Word equation and formula equation

(e) Reactants and products

3. Give reason:

(a) Classification of elements is necessary.

(b) Sodium and Chlorine belong to different groups but they have valency 1.

(c) The study of elements becomes easier using a periodic table.

(d) The products are different from the reactants.

(e) Metals and non-metal sare kept separately in the periodic table.

4. Answer the following questions:

(a) What is periodic table?

(b) Write the modern periodic law.

(c) Explain the position of metals in the modern periodic table.

(d) What change in the metallic properties of the elements occurs while moving from top to bottom in any group of the modern periodic table?

(e) What change in metallic properties of elements occurs while moving from left to right in any period of the modern periodic table?

(f) What is a chemical reaction?

(g) What is a chemical equation?

(h) How can we balance the formula equation? Write with examples.

(i) Express the given chemical reaction into a balanced chemical equation:

(i) Magnesium oxide + Hydrogen → Magnesium + water

(ii) Calcium carbonate + Hydrochloric acid → CalciumChloride + Water + Carbon dioxide

(iii) Potassium + Chlorine → Potassium chloride

(iv) Sodium + Oxygen → Sodium oxide

(vi) Hydrogen + Oxygen → Water

(j) The chemical equation for the chemical reaction between Zinc and hydrochloric acid is given below:

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

Write the chemical equation if sulfuric acid is used instead of hydrochloric acid.

(k) Part of a group of the periodic table is given below:

Be
Mg
Ca

Write any four characteristics of this group.

10 Materials Used in Daily Life

Observe the given figure below and discuss:

Figure no. 10.1

Questions:

(i) Which objects are shown in the figure?

(ii) Which of the items shown in the figure have you used?

(iii) What items have you used other than those shown in the figure?

(iv) Which of the substances shown in the figure have acidic, alkaline and salt properties?

We use different types of substances in our daily life. Among them, some are acids, some alkalis and some salts. Fruits, vegetables, soaps, shampoos, conditioners, sanitizers, and cleansing agents contain different kinds of acids, alkalis or salts.

Acid

Activity 10.1

Make a list of the sour foods that you have eaten. Discuss why these foods are sour.

Activity 10.2

Match the given acids with figures.

Formic acid

Oxalic acid

Citric acid

Hydrochloric acid

Acetic acid

Lactic acid

Carbonic acid

Discuss which organic acids are found in the foods based on the above matching exercise.

The sour substances around us are acids. Acids are soluble in water and give hydrogen ions (H+) when dissolved. Therefore, the substances that give hydrogen ions when dissolved in water are called acids. All the acids are not edible. Generally, acids found in plants and animals are edible but the acids made in the laboratory are not edible. Thus the acids can be divided into two types based on sources. They are organic and inorganic acids. Acids that are found in plants and animals naturally are called organic acids. For example, acids found in fruits, animals etc. Those acids which are prepared in the laboratory by using minerals are called inorganic acids. For example hydrochloric acid, sulphuric acid, nitric acid etc. Similarly, acids are divided into two types i.e. hard acids and soft acids depending upon the liberation of hydrogen ions when dissolved in water. Those acids which give more hydrogen ions when dissolved in water are called strong acids whereas those acids which giveless hydrogen ions are called weak acids. Mostly, inorganic acids are called strong acids and organic acids are weak acids.

Questions to think:

Hydrochloric acids are found in the stomach of our body. Is hydrochloric acid organic or inorganic? Why?

Physical properties of an acid

Activity 10.3

Take a lemon and complete the table by doing the following activity.

Activities	Experience/ Observation
Taste a little lemon juice.	
Dissolve lemon juice in water.	
Dip red litmus in lemon juice.	
Dip blue litmus in lemon juice.	
Mix lemon juice with a little methyl orange.	
Mix lemon juice with a little phenolphthalein.	

Based on the above activity, write the physical properties of the acids on chart paper and paste it into the classroom.

Physical properties of acids

a. The taste of acid is sour.

b. Acids are soluble in water.

c. Acids turn blue litmus to red but do not change colour to red litmus.

d. Acids turn methyl orange into red colour.

e. Phenolphthalein remains colourless in acids.

Chemical properties of acids

(a) Ionization when dissolved in water

Acids give hydrogen ions when dissolve in water.

Hydrochloric acid $\rightleftharpoons$ Hydrogen ion + Chloride ion

$$HCl \rightleftharpoons H^+ + Cl^-$$

Activity 10.4

Observation of chemical reaction between metal and dilute acid.

Objective: To observe the chemical reaction between acid and metal.

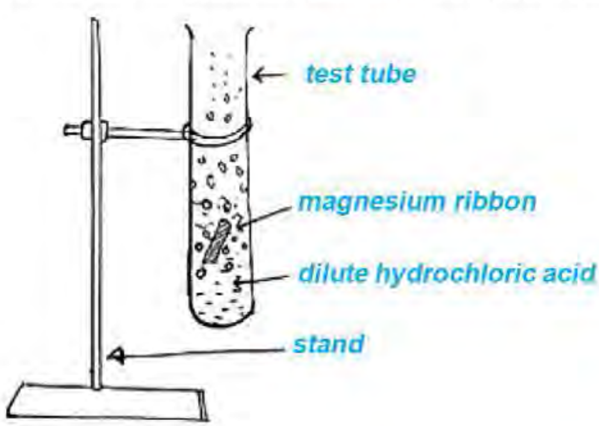


Fig 10.2

Materials required: Magnesium ribbon, dilute hydrochloric acid, match stick.

Method

Take a little dilute hydrochloric acid in a test tube and keep a small piece of magnesium ribbon on it. What happens? Observe it. Bring a burning matchstick close to the mouth of the test tube after bubbles appear in the test tube. Is the 'pop' sound produced or not?

Write a conclusion based on the activity.

(b) Chemical Reaction with metals

Acids react chemically with metals to form metallic salt and hydrogen gas.

Magnesium + Hydrochloric acid $\rightarrow$ Magnesium chloride + Hydrogen

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Activity 10.5

The chemical reactionbetween acids and metallic carbonates.

Objective: To observe the chemical reaction between acids and metallic carbonate.

Materials required: Calcium carbonate, dilute hydrochloric acid, lime water.

Fig 10.3

Method: Take some pieces of calcium carbonate in a test tube. Now put some dilute hydrochloric acid in it. What happens? Observe it. Why did bubbles appear in the test tube? Observe, what happens when that colourless gas is passed intoclean lime water.

Conclusion:

(c) Chemical reaction of dilute acids with metallic carbonate

Acids react chemically with metallic carbonates to form metallic salts, water and carbon dioxide gas.

Calcium carbonate + Hydrochloric acid $\rightarrow$ Calcium chloride + Carbon dioxide +Water

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Activity 10.6

The chemical reaction between acids and bases.

Objective: To observe the chemical reaction between acid and base.

Fig. 10.4

Material Required: Dilute hydrochloric acid, a few pellets of sodium hydroxide, a test tube, a porcelain basin, a sprint lamp or bunsen burner, a spatula, a glass rod, a tripod stand, and wire gauzes.

Method: Take a half-test tube of dilute hydrochloric acid and pour a few drops of phenolphthalein. Make the aqueous solution of sodium hydroxide in another test tube. Now mix the sodium hydroxide solution drop by drop in the test tube containing acids. When the colour of the mixture becomes faint pink, stop mixing. Now pour the solution into a porcelain basin and evaporate it. Observe what is left after heating for some time.

Conclusion:

(d) A chemical reaction between an acid and a base Salt and water are formed when a chemical reaction occurs between an acid and a base. This is also known as the neutralization reaction.

Hydrochloric acid + Sodium hydroxide$\rightarrow$ sodium chloride + water

$$HCl + NaOH \rightarrow NaCl + H_2O$$

Uses of acids

Activity 10.7

Cut radish or carrot into small pieces. Now divide those radishes or carrots into two parts and put them in two glass bottles. Do not put anything in one bottle whereas put vinegar in the other bottle making all the radishes or carrots sink. Within a week to two weeks, observe both bottles and discuss the changes that have occurred with reasons.

Acids	Uses
Organic acids	
Citric acid	To preserve food for a long time. To make food sour.
Ascorbic acid	To make medicine for various diseases as a source of vitamin C.
Acetic acid	To make pickles.
Tartaric acid	To make baking powder.
Inorganic acids	
Hydrochloric acid	Hydrochloric acid produced in the human body help to digest food, clean bathrooms and make polyvinyl chloride.
Nitric acid	To make nitrogenous fertilizer, explosive materials.
Sulphuric acid	To use in batteries, make chemical fertilizers, dyes, detergent, artificial silk, manufacture hydrochloric acid.

Base

Metallic oxides and hydroxides are called bases. Sodium oxide, sodium hydroxide, potassium oxide, potassium hydroxide, magnesium oxide etc. are examples of bases. Some metallic oxides are soluble in water whereas some are not soluble. Bases that dissolve in water are called alkalis. Bases give hydroxide ions when dissolved in water such as sodium hydroxide, potassium hydroxide etc. Bases are divided into hard and soft based on the number of hydroxide ions they give when dissolved in water.

Strong bases give more hydroxide ions whereas weak bases give less hydroxide ions when dissolved in water. Sodium hydroxide and potassium hydroxide are strong basesand ammonium hydroxide is a weak base.

Activity 10.8

Take little amount of ashes. Perform the following activities and fill in the observations in the given table.

Activities	Experiences / Observations
Taste a little ash water.	
Dissolve little ash in water and filter.	
Touch the ash water with your hand.	
Dip red litmus paper in ash water.	
Dip the blue litmus in the ash water.	
Mix the ash water with a little methyl orange.	
Mix the ash water with a little phenolphthalein.	

Share your experiences or observations of the above activities with your friends. Then, write the physical properties of bases on the sample chart paper and paste it into the classroom.

Sample Chart

a. Bases turn red litmus paper to blue.

b. Most of the bases are bitter.

c. Most of the bases are slippery like soapy water.

d. Bases change methyl orange to yellow colour.

e. Bases change phenolphthalein to pink colour.

Chemical properties of bases

(a) Bases ionize in water and give hydroxide ions(OH^-).

Sodium hydroxide $\rightleftharpoons$ Sodium ion + Hydroxide ion

$$NaOH \rightleftharpoons Na^+ + OH^-$$

Activity 10.9

Objective: To observe the chemical reaction between base and ammonium salt.

Materials required: Sodium hydroxide, ammonium sulphate, test tube and litmus paper.

Method: Take a little amount of ammonium sulphate in a test tube. Now mix a little amount of sodium hydroxide solution in it. What happens? Observe it. Then after, bring a moist red litmus paper near the mouth of the test tube. What happens? Observe it.

Conclusion:............

(b) Chemical reaction with an ammonium salt.

Ammonia gas is produced when ammonium salt reacts with a base.

Ammonium sulphate + Sodium hydroxide → Sodium sulphate+ Ammonia + Water

$$(NH_4)_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2NH_3 + H_2O$$

(c) Chemical reaction with acids

Bases react with acids to give salt and water. This is called an acid-base reaction or a neutralization reaction.

Sulphuric acid + Potassium hydroxide → Potassium sulphate + Water

$$H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$$

Uses of base

Bases	Uses
Calcium hydroxide	To makebleaching powder, use it as a white primer before painting the house (to whitewash), to reduce the acidity of the soil.
Magnesium hydroxide	As an antacid to neutralize hyperacidity (gastric).
Sodium hydroxide	As an antacid to neutralize hyperacidity (gastric).
Ammonium hydroxide	To manufacture soap, clothes, and paper. For processing petroleum products.
	As a laboratory reagent, to manufacture chemical fertilizer, rayon cloth, plastic and dyes.

Salt

A neutral compound formed after the chemical reaction between an acid and a base is called a salt. According to the nature of acids and bases, salts can be acidic, basic or neutral. Salts are mainly of three types which are as follows:

(a) Neutral Salts

Salts formed after the chemical reaction between a strong acid and a strong base or a weak acid and a weak base are called neutral salts. For example:

sodium chloride ($NaCl$) is a neutral salt.

(b) Acidic Salts

Salts formed after the chemical reaction betweena strong acid and a weak base is called acidic salts. Ammonium chloride (NH_4Cl) is an example of an acidic salt.

(c) Basic Salts

Salts formed after the chemical reaction between astrong base and a weak acid are called basic salts. Sodium carbonate (Na_2CO_3) is an example of basic salt.

Activity 10.10

Take a little amount of table salt or copper sulphate. Perform the following activities and fill in the observations in the table given below:

Activities	Observations
Taste the table salt or examine copper sulphate properly.	
Dissolve a little table salt or copper sulphate in water.	
Dip red litmus paper in table salt or copper sulphate solution	
Dip blue litmus in table salt or copper sulphate.	
Mix a little amount of methyl orange in table salt or copper sulphate.	
Mix a little amount of phenolphthalein in table salt or copper sulphate solution.	

Write the physical properties of salts on a chart paper based on the above activities and paste it in the classroom.

Sample:

Although table salt is salty, most salts are tasteless and some are bitter.

Most salts are soluble in water.

They are colourless or white and some are colourful.

Neutral salts do not react with indicators.

The boiling and melting points of salts are high.

Chemical properties of salt

(a) Ionization when dissolve in water

When salts dissolve in water, they produce positive ions of metals and negative ions of non- metals.

Sodium chloride $\rightleftharpoons$ Sodium ion + Chloride ion

$$NaCl \rightleftharpoons Na^{+} + Cl^{-}$$

(b) Chemical reaction with acids

Sometimes salts react chemically with acids to form new salts and acids.

Sulfuric acid + Sodium chloride → Sodium sulfate + Hydrochloric acid.

$$H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + HCl$$

(c) Chemical reaction with bases

Sometimes salts react chemically with bases to form new salts and bases.

Ammonium chloride + Calcium hydroxide → Calcium chloride + Ammonia + Water

$$2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + 2H_2O$$

Activity 10.11

Objective: To observe the chemical reaction wherea more reactive metal displaces a less reactive metal of a salt.

Materials Required: Test tube, Copper sulphate, iron powder.

Method: Take a half test tube of copper sulphate solution. Now keep some iron powder in it. What happens after some time?
Observe and write a conclusion based on the activity.

(c) Displacement reaction

The more active metal displaces the less active metal of salt and forms a new salt.

Iron + Copper sulphate → Ferrous Sulphate + Copper

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$

Uses of salt

Salt	Uses
Table salt or Sodium Chloride	To make food tasty. To use as a food preservative. To manufacture sodium hydroxide, sodium carbonate, soap, baking soda etc.
Sodium carbonate or washing soda	For cleansing action. To remove the permanent hardness of the water. For industrial production of glass, paper, and soap.
Sodium bicarbonate or Baking soda	To make baking powder. To make antacid. To use in fire extinguishers.

10.2 Acid rain

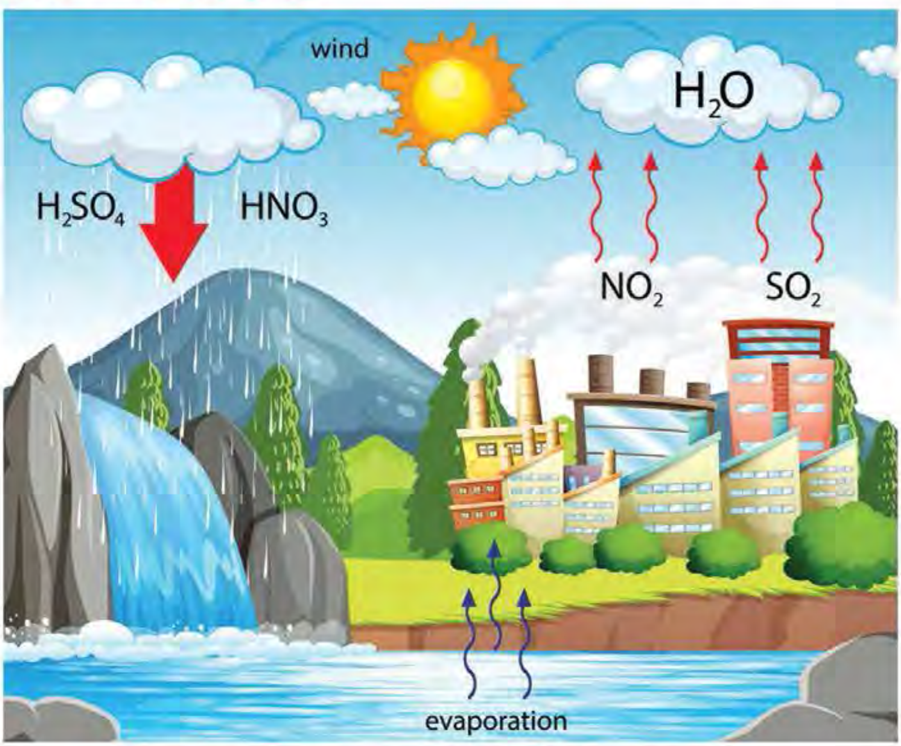


Fig 10.5

Study the picture and discuss it in the classroom based on the given questions:

Questions

i. What is coming out from the factories and industries in the given figure?

ii. How are the sulphuric acid and nitric acid formed as shown in the figure?

iii. What is called when these acids fall with rain water?

iv. What is the effect of these acids when they are mixed with rainwater?

v. How is acid rain prevented?

The rain that has become acidic by mixing various acids formed in the atmosphere is called acid rain. Generally, rainwater is acidic because carbonic acid is formed by the chemical reaction of carbon dioxide and water in the atmosphere. It will reach the earth's surface with rainwater. The pH value of this water is around 6 which is not very harmful. In addition to this, strong acids come with rainwater of low pH value is harmful to animals and plants. Acids are formed in the atmosphere in two ways.

(a) By natural means

Natural events such as the decay of animals and plants, volcanic eruptions, and the mixing of oxides of nitrogen and sulphur inthe atmosphere, chemically react with water to form acids such as sulphuric acid and nitric acid. These acids mix with rainwater and fall on the earth's surface in the form of acid rain.

(b) Byartificial means

Mostly acid rain is caused by human activities. Oxides of nitrogen and sulphur are present in the atmosphere by burning fossil fuels, use of unnecessary vehicles and harmful chemicals produced by factories and industries. These harmful chemicals are mixed into the atmosphere and react with the water to form acids such as sulphuric acid, nitric acid, and carbonic acid reach the surface of the earth along with rainwater.

Activity 10.12

Take rainwater and find out whether it is acidic, basic or neutral with the help of litmus paper or any other indicator. Discuss the result in the classroom.

Effects of Acid Rain on the Environment

Rainwater is a major component of the environment. Living beings need water to survive. Rainwater is the main source of water recharge on Earth. Water mixed with acid reaches the surface of the ground and affects living organisms as well as other environmental elements. Some of the effects are given below.

1. Acid rain will make water sources such as rivers, lakes, and ponds acidic which is harmful to aquatic life.
2. Acid rain damages the leaves of plants and also reduces the quality of the soil.
3. The forest will be destroyed if the acid rain exists for a long time.
4. Acid rain also destroys temples, monuments and idols of archaeological importance.

Measures to prevent acid rain

1. Reducing the use of fossil fuels.
2. Reducing air pollution by using renewable sources of energy like hydroelectricity, solar energy etc.
3. Establishing industries and factories away from residential areas.

Project work

Create a poster which indicates them easures that can be taken to prevent acid rain artistically and paste it on the notice board of the school.

Exercises

1. Choose the correct alternatives.

(a) Which of the following is a property of an acid?

(i) Bitter (ii) Slippery

(iii) Sour (iv) Colorless

(b) Which of the following turns red litmus blue?

(i) Curd (ii) Tomato

(iii) Coca- Cola (iv) Shampoo

(c) Which of the following liquid will be in the test tube if bubbles come out as soon as zinc pieces are placed?

(i) Water (ii) Acid

(iii) Base (iv) Salt

(d) What is the reason for using ash to reduce soil acidity?

(i) Ash is cheap (ii) Ash is available at home

(iii) Ash is alkaline (iv) Ash is salt

(e) Which salt is used in fire extinguishers?

(i) Sodium carbonate (ii) Potassium carbonate

(iii) Sodium bicarbonate (iv) Potassium sulphate

2. Differentiate between:

(a) Organic acid and inorganic acid.

(b) Strong acid and weak acid.

(c) Bases and alkalis.

3. Givea reason :

a. Generally, rainwater is acidic.

b. Ammonium chloride is an acidic salt.

c. Both lemon juice and sulfuric acid are acidic, sulfuric acid corrodes cloth but lemon does not.

d. Gastritis patients are cured by consuming magnesium hydroxide.

4. Answer the following questions:

a) What is an acid?

b) Show in a table the reaction of an acid with indicators.

c) Define bases.

d) Make a table to show the reaction of a base with indicators.

e) What is salt?

f) Make a table to show the reactions of salts with indicators.

g) List out the reasons for acid rain.

h) How do you know that acid rain is harmful?

i) What can be done to prevent acid rain?

j) What suggestion do you give to improve the declining agricultural production due to acid rain?

k) Results obtained by reacting two samples with a different indicator are shown in the table below:

Sample	Methyl orange	Litmus paper	Phenolphthalein
A	Red	Red	X
B	Y	Blue	Pink

(i) Which colour do X and Y represent?

(ii) Among A and B, which will produce carbon dioxide gas when reacts with calcium carbonate?

10.3 Hardness of water

Activity 10.13

Collect water from different sources and keep it in a different beaker. Write down the name in the beaker from where the water is collected. Now put two drops of liquid soap on all the water samples and stir them. Observe which beaker water produces more lather and less lather. Discuss the results obtained in the classroom.

The water that gives more lather with soap is called soft water and that gives less lather is called hard water. Mostly, surface water is soft while groundwater is hard. In this way, water can be divided into two types i.e. soft water and hard water based onthe formation of lather.

Soft water

Water which does not contain soluble salts of calcium and magnesium is called soft water. Soap gives more lather in soft water and more water is needed to wash clothes. Rainwater, boiled water and surface water are some examples of soft water.

Hard water

Water which contains soluble salts of calcium and magnesium is called hard water. Hard water contains sulphate, chloride and bicarbonate of calcium and magnesium which produces less lather with. Clothes washed in hard water will gradually get dull and whitish matter accumulates in the pipes and boilers. Generally, groundwater is hard. There are two types of hardness of the water.

Temporary hardness of water

The water which contains dissolved bicarbonate salts of calcium and magnesium is called temporary hardness of the water. The temporary hardness of water can be removed by boiling or using calcium hydroxide (lime).

Method for removing temporary hardness of water

(a) By Boiling Method

The temporary hardness of water can be removed by boiling. The calcium and magnesium bicarbonate salts dissolved in the water are converted into insoluble carbonates after boiling and it settles. The remaining water becomes soft.

(b) Clark method

The method of removing the temporary hardness of water using calcium hydroxide is called the Clark method. In this method, calcium hydroxide is added to the required amount of water. Calcium hydroxide converts the bicarbonate salts of calcium and magnesium into insoluble carbonates. It gets precipitate at the bottom of the crucible and can be separated by filtration.

Activity 10.14

Objective: To remove the temporary hardness of water

Materials Required: Well water, beaker, test tube, bunsen burner or spirit lamp, calcium hydroxide, soap etc.

Method

a) Place the sample of well water in three test tubes.

b) Put a small amount of liquid soap powder in the first test tube and stir it.

c) Boil the water in the second tube and adda few drops of liquid soap and stir it.

d) Pour a small amount of calcium hydroxide into the third test tube and add a few drops of liquid soap with stirring.

e) Now, which of the following three test tubes of water produces more lather? Conclude by observing.

Permanent hardness of water

The water that contains sulphate and chloride salts of calcium and magnesium is called permanent hardness of the water. The permanent hardness of water cannot be removed by boiling but can be removed by using washing soda or zeolite (crystalline solids of aluminium silicate)

Method for removing permanent hardness of water

(a) Using washing soda

Washing soda converts calcium and magnesium sulfate and chloride salts dissolved in water into insoluble carbonates, which are separated by filtration.

(b) By permutit method

The method of removing the permanent hardness of water using zeolite is called the permutit method. In this method, layers of small stones, sand and sodium zeolite are placed together as shown in the figure. When hard water is passed, the sodium in sodium zeolite is replaced by calcium or magnesium ions. Hence the hardness of the water is removed and soft water is obtained.

Read the following story and discuss the questions given below:

Ramila went to the jewellery with her mother. Mother wanted to make a gold bangle. In the jewellery, she chose the design which she liked and started discussing with the goldsmith about the carats and tolas of gold required. Mother told her plan to the goldsmith to make two tolas of 24 carats. The goldsmith asked whether she would wear bangles daily or occasionally. Mother said that she would wear it daily. Then the goldsmith advised her to make a 22-carat gold bangle instead of a 24-carat.

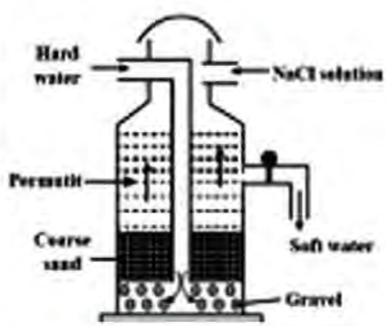


Fig: 10.6 Permutit method

Questions

(i) Which gold among 24-carat and 22-carat is pure and mixed?

(ii) Why did the goldsmith advice Ramila's mother to make a bangle 22-carat for daily use?

A homogenous substance formed by the combination of metals with metals or with non-metals is called an alloy. In our daily life, we use alloys instead of pure metals due to various reasons. Making alloys from metals further improves the properties of the metal and increases its utility. Aluminium is a light metal and is used to make the body of aeroplanes but to make it strong it is mixed with copper, manganese and magnesium which is duralumin.

Properties of Alloys

1. Alloys are harder than metals from which it is made up. They are less ductile and malleable.
2. Alloys do not rust easily.
3. An alloy has a melting temperature lower or higher than that of the pure metals it is composed of.
4. An alloy has a different colour than the metals it is composed of. For example, silver and zinc both are white but an alloy made of these two metals is pink in colour.
5. The properties of alloys are improved than the properties of the constituent metals.

Some Alloys used in daily life

Activity 10.15

Make a list of materials made of pure metals and alloys in your kitchen and discuss them in the classroom.

(a) Steel

Figure No. 10.7

A homogenous mixture of carbon and iron is called steel. Pure iron is very soft when heated and is difficult to work with. So a little carbon is added to it which makes it hard. Similarly, pure iron rusts, but an alloy made up of iron, chromium and nickel (stainless steel) does not rust easily. Therefore, steel and stainless steel are used more than pure iron these days. Steel is used to make buildings, bridges, railings, etc. Similarly, stainless steel is used to make kitchen utensils and surgical instruments in hospitals.

Brass

A homogenous mixture of copper and zinc is called brass. It is used to make various materials used in daily life like pooja items, gagri, idols etc and is also used to make different nuts, bolts plumbing and machinery items.

Figure No. 10.8

(c) Bronze

A homogenous mixture of copper and tin is called bronze. Bronze is used to make dinner plates, bowls, tumblers etc. In addition, bronze is also used to make medals, coins, ships, and statues.

Figure No. 10.9

Activity 10.16

Prepare a list of the names and uses of items made of steel, brass and bronze available at your home and present them to the class.

Exercise

1. Choose the correct alternatives.

(a) Hard water contains which of the following salts?

(i) Magnesium sulphate (ii) Magnesium oxide

(iii) Magnesium nitrate (iv) Magnesium sulphide

(b) Which method should be used to remove the permanent hardness of water?

(i) By boiling (ii) Clark's method

(iii) Permutit method (iv) Using calcium hydroxide

(c) Which of the following water has the lowest hardness?

(i) Rain water (ii) Well water

(iii) Tube bell water (iv) River water

(d) What is the reason for the increment in the use of alloys instead of pure metals?

(i) Alloys are cheaper.

(ii) The properties of metals are improved in the alloy.

(iii) Alloys are easily available in the market

(iv) The use of alloy is good for health.

(e) Which metals are mixed to make brass?

(i) Copper and zinc (ii) Copper and tin

(iii) Copper and carbon (iv) Copper and nickel

(f) Which property of iron is lost when carbon is mixed with iron?

(i) Becomes black after ageing (ii) Becoming heavy

(iii) Rusting properties (iv) Shining properties

(g) Which alloy is formed when copper is mixed with tin?

(i) Steel (ii) Stainless steel

(iii) Brass (iii) Bronze

(h) Which of the following sentences is true?

(i) An alloy is harder than the metal it is made of.

(ii) An alloy is more flexible than its constituents metal.

(iii) An alloy is dull than the metal it is made up of.

(iv) The alloy is more ductile than the metal it is made of.

(2) Differentiate:

(a) Soft water and hard water

(b) Temporary hardness of water and permanent hardness of the water.

(c) Clark's method and Permutit method

(d) Pure metals and alloys

(e) Steel and stainless steel

(3) Give reasons:

(a) Steel is used more than iron in making household kitchen utensils.

(b) rainwater produces more lather with soap while washing clothes.

(c) Well water is hard.

(d) The use of alloys is increasing day by day than pure metals.

4. Answer the following questions:

(a) Define the hardness of the water.

(b) What are the causes of the hardness of water?

(c) Roshan took out water from the well to wash his school uniform on Saturday. Sufficient lather is not produced while applying soap to it. What would you suggest to produce sufficient lather even in well water?

(d) Riya always washes her clothes in tubewell water. White clothes became dull instead of shiny. What is the reason for this dullness of white clothes? What do you suggest to her to solve this problem?

(e) How can the hardness of water be removed by the permutit method? Describe with the necessary diagram.

(f) What is an alloy?

(g) Whichmetals are mixed in the following alloys?

(i) Steel	(ii) Stainless steel
(iii) Brass	(iv) Bronze

(h) What are the causes for the increasing popularity of alloys? Prepare a list.

(i) Rama won a bronze medal in a competition. Which metals are mixed to make the medal she has received?

11 The Earth and Universe

Observe the diagrams and discuss the given questions :

Fig 11.1

(a) What is the surface of the earth shown in Figure A made of up?

(b) How are the masses shown in Figure B formed in your opinion?

(c) Are all living beings shown in Figure C evolved at the same time?

All heavenly bodies including Earth are part of the universe. The universe is made of nebulas, stars, planets, asteroids, meteors etc. Although there are different hypotheses about the origin of the universe, the most acceptable one is the Big Bang theory which is based on scientific facts and evidence.

In the beginning, the earth was too hot for living beings, but later on, it gradually cooled to normal temperature and the living beings started evolving one after another.

The surface of the earth is composed of rock, soil, stones, sand, minerals, water etc. These substances and the different gases present in the atmosphere have provided a suitable environment for living beings. At the very beginning of organic evolution, the formation of various biomolecules like carbohydrates, proteins, nucleic acids, etc led to the evolution of very simple and unicellular creatures. Their continuous evolution resulted in the present biodiversity on Earth.

11.1 Minerals

Discuss after observing the given figure :

(a) Are all stones shown here similar in composition and quality?

(b) What is a stone composed of ?

The outer surface or crust of the earth is composed of rock, soil, sand, rock, metals, and water-like substances. If deeply examined, all these rocks, soil, sand, and stones are found to be formed of various particles of elements and compounds. According to geology (earth science), a naturally made solid and pure substance is a mineral. Minerals are found either in elementary or in compound forms and the combination/mixing of which has formed earth's crust having all rocks, soil, stones etc. Water parts of the earth also contain some minerals in dissolved form. Simply, a mineral is a substance obtained from mines and some economic importance. According to this explanation, useable substances like coal, petroleum, limestone, marble, diamond and other gemstones, granite, quartzite, slate, red clay, white clay etc are all minerals. The branch of geology which deals with the study of minerals is called Mineralogy.

Fig 11.1 different types of stones

Types of Minerals

Based on composition and characteristics, minerals can be divided into three groups :

(a) Metallic minerals, (b) Non-metallic minerals, (c) Energy Minerals

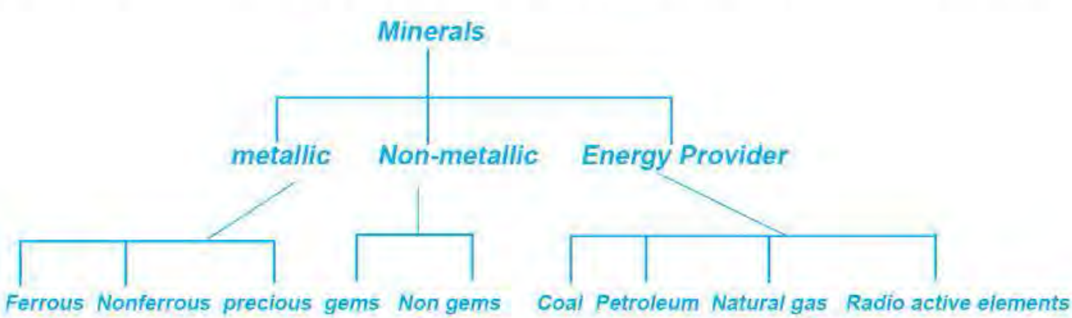


Fig. 11.3 Flow chart of elements

(a) Metallic minerals

Normally hard, lustrous, and good conductors of heat and electricity, relatively denser minerals are metallic minerals or ores. The ores can exhibit some metallic characteristics. The ores of iron, tin, nickel, copper, gold, silver, zinc, cobalt etc are some examples of metallic minerals. These metallic minerals are again divided into three types: Ferrous, Non-ferrous and Precious minerals. Hematite, magnetite, limonite, siderite, pyrite etc are ferrous minerals and iron can be extracted from them. The ores of copper, lead, tin, aluminium etc have no iron or very less iron, so they are called non-ferrous. The minerals which have comparatively very less deposition but great economic value and are chemically very less reactive are called precious minerals. They are the minerals of gold, silver, platinum, palladium etc.

Fig. 11.4 Various metalic minerals

(b) Non-metallic minerals

The non-metallic mineral has properties like that of non-metals though they may contain some metals or metalloids in their molecules. they are bad conductors of heat and electricity and light in density. Because of their being light, they are found on the upper part of the crust. Most of them are found in the form of rocks but some are in the pure state. They can be further divided into two types: gems and non-gems. Diamonds, emeralds, sapphire, topaz, garnet, etc are gem minerals and silica, feldspar, mica, sulphur, graphite, gypsum, talc, etc examples of non-gem minerals.

Fig. 11.5

Fig. 11.5 b

(c) Energy Minerals

The fuels used in industries and daily life that are obtained from mines are called energy minerals. These minerals are found under the ground and used as a non-renewable source of energy. Coal, petroleum, natural gas and radioactive elements like uranium are examples of energy minerals

Peat Lignite Bituminous Anthracite

Fig. 11.6

Project work 11.1

Visit some natural places in your surroundings. Take photos of minerals found there or collect them from other sources. Present the photographs of minerals in your class with their characteristics.

Properties of Minerals

(a) Minerals exist in various colours. The minerals/ores of iron are black or reddish brown and that of gold and copper are light yellow or red. Some minerals are colourless too. Muscovite is a colourless mineral.

(b) Most of the minerals have fixed geometric shapes so they exist in crystalline forms. Very few are in an amorphous form which does not make any crystal naturally. Minerals usually exist in cubical or prismatic forms. For example, pyrite is cubical and tourmaline is a prismatic mineral. Opal is an amorphous mineral.

(c) Minerals are usually hard, bright and lustrous.

(d) Metallic minerals are usually good conductors of electricity and heat, but non-metallic minerals are insulators.

(e) Minerals are found in a solid state and they are homogeneous solids having definite chemical composition.

Activity: 11.1

Collect some minerals from your surrounding and fill the given table making separately on a chart paper and exhibit in your class.

Name of mineral	Colour	Shape	Lustre	State

Uses of minerals

Many minerals are used as raw materials in industries. The importance and uses of some minerals in various sectors are given below :

(a) Uses in agricultural sectors

Minerals are essential to maintain the fertility of the soil and to increase crop productivity. Calcium, potassium, nitrogen, iron, and phosphorus minerals are necessary for the proper growth, greenery, and blooming of plants. These elements are supplied in the soil through minerals. Chemical fertilizers, pesticides, micronutrients etc are manufactured from minerals which support farming, pisciculture, animal husbandry, and poultry farming. Nitrogen, potash, phosphorus, gypsum, sulphur etc are the minerals used in the agriculture sector.

(b) Uses in the industrial sector

Minerals are used in industries as raw materials or as a source of energy. Industries like cement, glass, paint, ceramics, detergent etc are based on minerals. Silica, mica, gypsum, limestone, magnesite, granite etc are some minerals being used in various industries. Many limestone-based cement factories like Udaypur Cement, Hetauda Cement and many others factories are running in Nepal. Electric cables, iron rods, tools, machinery, weapons etc are produced from metallic minerals.

Fig. 11.7

(c) Uses in the construction sector

Minerals are also used in the construction sector. Rocks, sand, gravel, and gypsum-like substances are used to construct houses, bridges, and roads like infrastructures. There is a tradition of making slate-roof in many parts of Nepal where slate is naturally available. Limestone and marble are used to make images, idols, and stone inscriptions. Decorative items like marble, granite, talc, slate etc are also minerals.

Fig. 11.8

(d) Uses in the energy sector

Coal, graphite, zinc, petroleum, lithium, lead, manganese etc are used as the source of thermal or electrical energy. Petroleum is used to run vehicles, cook food and generate electricity. Coal is used in cement factories, brickkilns, blast furnaces, etc to generate very high temperatures. Lead, graphite, lithium, manganese, zinc etc are used in dry cells to generate electricity.

Project work: 11.2

Visit the local community near your school. Prepare a report of minerals with their utility the people of the community are using traditionally for a long time and present it in your class.

Minerals in Nepal

More than 60 types of minerals are identified in Nepal among which 21 types are metallic, 23 types are related to chemical fertilizer and insulating material, 6 types are gems, 9 types of constructing material and 4 types of minerals are related to fuel and geothermal energy. The plane land of the Terai region is likely to be enriched in construction material, underground water, petroleum and natural gas, the Himalayan region is for construction material, radioactive minerals, petroleum and natural gas, the lower of the Himalayan region is likely to bear iron, zinc, lead, copper, gold, magnesite, phosphorite, limestone, dolomite, slate, garnet etc. Despite great potentiality, not enough research has been made to explore such valuable minerals which could uplift the economic status of the country more rapidly than any other resources. The Himalayas and its periphery hold about 83% of the total minerals. Nepal has all metallic, non-metallic, energy minerals as well as constructional, decorative stones in considerable volume. Limestone, dolomite, silica, coal, gold, iron, gypsum, and mica, as well as radioactive uranium, are also found in Nepal. From very ancient times mines of iron, coal, and copper mines are being used in Nepal from pre-historical times. The iron mine of Ramechhap and the coal mine of Dang were in use in the past time. The prime minerals found in Nepal are given in the table below.

Table 11.1 A Glimpse of Minerals in Nepal

SN	Name of minerals	Places of potentiality
1	Iron	Fulchoki (Lalitpur), Those (Ramechhap), more than 88 places
2	Copper	more than 107 places
3	Zinc and Lead	Ganesh Himal and surrounding. More than 57 places
4	Gold	The sand of Rapti, Sunkoshi, Kaligandaki, Bishnumati and many other rivers
5	Limestone	Udaipur, Makwanpur, Chobhar (Kathmandu)
6	Dolomite	Mahabharat mountain range
7	Phosphorite	Dang, Pyuthan, Baitadi
8	Magnesite	Dolkha, Udaipur, Palpa
9	Ceramics clay	Makwanpur, Kathmandu Valley
10	Silica	Sand of rivers
11	Rock salt	Mustang, Dolpa
12	Quartz crystal	Dailekh, Taplejung, Rasuwa
13	Marble and Granite	Godawari (Lalitpur), Sindhuli
14	Slate	Dhankuta, Achham, Gorkha, Benighat (Dhading)
15	Coal	Dang, Palpa, Pyuthan
16	Radioactive Uranium	Upper Mustang

11.2.1 Origin and Age of Earth

From the study of the age of rocks and fossils, the earth is estimated to be originated about 4.6 billion years ago. Stars, planets, and satellites like heavenly bodies are formed after the origin of the universe. Some hypotheses related to the origin of the earth are as follows :

(a) Kant's and Laplace's Nebular hypothesis

(b) George Buffon's Planetesimal hypothesis

(c) Chamberlin's and Moulton's Binary hypothesis

(d) Jean's and Jeffrey's Tidal hypothesis

(a) Nebular Hypothesis

German scientist Immanuel Kant proposed the Nebular hypothesis in 1755 based on Newton's law of gravitation. According to this hypothesis, there was a super big, nearly circular and flat nebula spinning slowly in the present site of the solar system. The dust and gas particles of the nebula gradually came closer in the central part due to mutual gravitation among those particles. The formation of eddy current by the collecting particles accelerated the rate of collection and the central mass started to grow and rotate more rapidly. Due to the eddy current, more particles were collected in the centre and it became a very big ball of matter (protostar) rotating more rapidly. Tremendous pressure in the core of the protostar resulted in millions of degrees of temperature which started thermonuclear fusion in the core and the big ball became the sun. Because of comparatively high spinning speed and less consistency, the outer part of the ball started to be flat from the equator due to centrifugal force keeping their motion continuing around the central sun. The substances present in the flattening part of the protostar also started collecting nearby particles at many places and gradually converted into planets and the materials around them became satellites. The remaining particles of the spinning nebula became asteroids, comets and meteoroids.

In 1796, a French scientist Pierre Simon Laplace slightly corrected Kant's hypothesis saying that planets originated from the equator of the newly formed sun by sudden ejection of rings of some of its mass one after another due to strong centrifugal force just like the drops of water ejecting all around if a wet cloth is spun rapidly. And, satellites were also formed from the planet in the same way.

The speciality of the nebular hypothesis

i) According to this hypothesis, all planets, satellites and other heavenly bodies of the solar system are solid and cold from the very beginning of their origin. But due to the powerful collision of substances during the formation of planets and satellites, they might have been molten partially and cooled time and again.

ii) As heavenly bodies of the solar system have originated from the flattening and spinning of the central part of the protostar/sun, all the planets and satellites revolving around the central sun from more or less the same plane and same direction.

(b) Planetesimal hypothesis

This hypothesis is presented by French scientist George Buffon in 1745 before the nebular hypothesis of Kant. According to this, there was only the sun before the formation of other heavenly bodies of the solar system. Long ago, a giant comet collided forcefully making a very low angle and splashed away some solar mass in space among which, some parts escaped into space, some fell again on the sun and the remaining parts which can be called 'Planetesimal' started to revolve round the sun. Later on, the revolving parts cooled down and became planets and other members of the solar system.

The speciality of the Planetesimal hypothesis :

(a) According to this hypothesis, earth and all other members of the solar system were extremely hot in the beginning and started cooling slowly due to the distance maintained between them and the sun.

(b) Because the total mass of all planets, satellites, asteroids etc of the solar system is only about 1% of the solar mass, the event that happened in the sun long ago as he claimed cannot be ignored completely.

(c) Binary hypothesis

The binary hypothesis was forwarded in 1905 by two American scientists Thomas Crowder Chamberlin and Forest Ray Moulton. According to this, our sun had a very big co-partner star of the binary system and they were revolving around each other. Once, the partner star, became very close to our sun and some solar mass was pulled out due to its strong gravitation. The binary star continued its way swiftly before the separated solar mass could fall on its surface. Later on, the separated solar mass started revolving sun, gradually cooled down, and became planets, satellites and other members of the solar system.

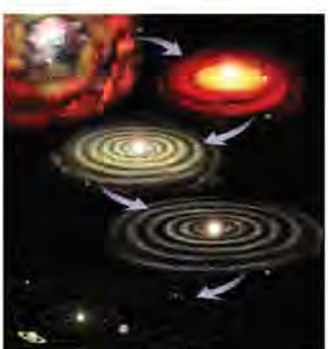
Criticism of the Binary hypothesis

Still, it is not in anyone's knowledge that our sun has any binary star.

(d) Tidal hypothesis

English scientists Sir James Jeans and Harold Jeffrey put forward their Tidal hypothesis in 1919. They claimed that there was only one sun in this galactic region and a very big star swiftly passed away by the sun. The strong gravitation of that heavier star pulled a big lump of hot matter from the sun's surface in the form of a tide and started revolving the sun. The separated tidal mass somewhat looked like a cigar. Later on, smaller planets Mercury and Pluto at the two ends and bigger planets Jupiter, Saturn etc formed at the middle portion of the lump due to mutual gravitation and cooling process.

The speciality of the Tidal hypothes



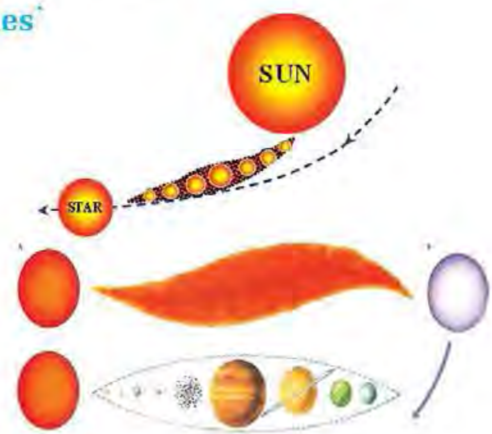


Fig. 11.9

(a) As the shape of the tidal mass of the sun was spindle having tapering ends and swollen middle part, the planets formed from it at two ends are much smaller. In the middle, the size of the planets gradually grows bigger and central Jupiter has become the biggest one.

(b) Mars, which is farther than the Earth should be bigger but due to some reason, it must have been broken into pieces forming thousands of Asteroids lying between the orbits of Mars and Jupiter. Due to this breaking, Mars has become smaller than Earth.

Activity: 11.2

Objective: To construct the model of the Nebular hypothesis.

Material required: Knife, thermocol sheet, different colours, pencil and compass.

Procedure :

(a) Take the thermocol sheet. Draw an outline figure of the solar system on the thermocol with the pencil and compass based on the Nebular hypothesis.

(b) Inscribe the sheet with a knife carefully to represent the sun, planets, orbits, satellites etc and apply suitable colour.

(c) Present your model in class and arrange a talk program on the various hypothesis about the origin of the solar system.

11.2.2 History of Evolution of Living Beings on Earth

At the beginning of formation, because of the collision of big boulders of rocks from every direction with tremendous velocity, the particular part of the earth had melted many times. Everything here was unstable. The molten heavy metals like iron, nickel, gold etc gradually sank into the core and the lighter silicon, magnesium, aluminium etc. accumulated towards the surface. In the process of repeated expansion and contraction, the surface of the earth turned into various topography like mountains, valleys, planes, anticlines & synclines. The thermal decomposition reaction among various molecules of rocks originated various volatile gases including water vapour, carbon dioxide, sulphur dioxide, nitrogen, oxygen, ammonia, methane etc. which gradually formed the atmosphere. Condensation of water vapour caused heavy rain which filled all lowlands and created oceans, seas, and ponds like water bodies. In this way, the environment of the earth gradually became suitable for living beings. Similarly, the reaction between hydrogen, oxygen, nitrogen, carbon etc formed different biomolecules like nucleic acids and proteins and with this, very simple prokaryotes evolved. All present lives on earth are developed from those simplest means of life through a gradual and continuous process of organic evolution.

To make the study of organic evolution easy, the total history of the earth has been divided into different units called Geological time scales. The longest time scale is called Eon. There are two Eons: Cryptozoic and Phanerozoic. Both of the Eons are further divided into three Eras each.

(a) Cryptozoic Eon

Cryptozoic Eon simply means the Eon of false life. It is very long in comparison to the Phanerozoic Eon and covers almost 88% of the total life of earth till now. It is further divided into Archeozoic, Proterozoic and Eozoic Eras. Archeozoic Era spent its tenure creating a suitable physical environment i.e. atmosphere, hydrosphere and lithosphere, for life. Proterozoic Era evolved the first primitive unicellular lives in water and in Eozoic Era, some soft-bodied unicellular and multicellular aquatic animals, algae were evolved in water.

Fig. 11.10

Cryptozoic Eon is the first part of the earth's history. It started 4.6 billion years ago and ended just 570 million years ago. Many geologists call Cryptozoic Eon as Precambrian or Azoic Era. We don't have much information about this Eon.

(b) Phanerozoic Eon

This Eon is running for 570 million years to till now. Although its duration is only about 12% of total life, it is much important because of the evolution and existence of a very vast diversity of life. Based on the origin and destruction of lives, this Eon is also divided into Palaeozoic, Mesozoic and Cenozoic Eras.

i) Palaeozoic Era

Fig. 11.11

Palaeozoic Era, with a duration of 330 million years is the longest among the rest two later Eras. It started 570 million years ago and ended 240 million years ago. During this Era, the evolution of varieties of multicellular animals and plants took place in water and some of them gradually dwelled on the land. Almost all invertebrates like arthropods, mollusks, echinoderms and pieces, amphibians and small reptiles evolved including Cryptogams or non-flowering plants.

Main Events and Lives

Continuous geological disturbances took place in this Era. In its first Cambrian period, maximum varieties of aquatic arthropods and algae evolved more than in any other geological period. Trilobites, crustaceans, mollusks, lung-fishes, snails, corals, marine scorpions and four-legged amphibians along with algae, bryophytes and pteridophytes (lycopodium, dense forest of tree-fern etc) are the creation of this period. Due to the occurrence of immense geological and tectonic disturbances at the end of this era, most lives went extinct forever.

ii) Mesozoic Era

The total duration of this Era is 175 million years from 240 million years ago to 65 million years ago. In this Era, many geological and climatic changes took place and many further advanced organisms evolved. Due to the evolution of vast floral and faunal biodiversity, this Era has great importance in the history of organic evolution.

Main Events and Lives

The climate became dry and the effects of season change started to take place in this eara. The shallow sea became further deeper and the area of land expanded. Occurrences of physical activities like storms, the formation of clouds, heavy thundershowers, and considerable differences in day and night temperature were some important events of this Era. Replacing the pteridophytes, a coniferous forest of large gymnosperms like cycas, pines, ginkgo, juniper, ephedra etc occupied almost all moist land. therefore, this Era is also called the Era of Gymnosperms or Era of Conifers. At the end of this Era, some least-developed flowering plants also evolved.

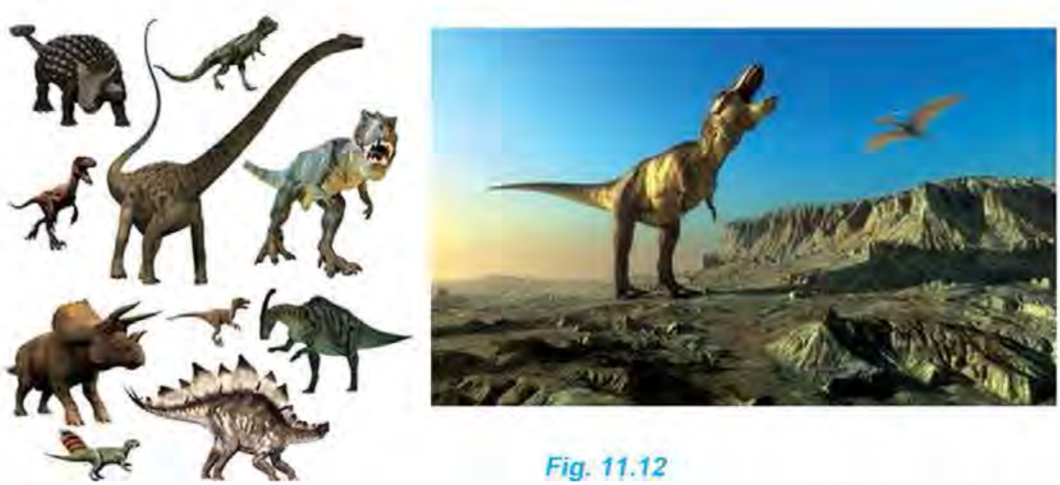


Fig. 11.12

Fig. 11.13

evolution and extinction of many big reptiles including crocodiles and dinosaurs the noticeable events of the Mesozoic Era. Dinosaurs were dominant in all habitats (water, land and air). They were herbivores, omnivores as well as the top carnivores. Dinosaurs evolved in the first Triassic period, became dominant in the second Jurassic period and they were extinct at the end of the third Cretaceous period. It is said that heavy meteor-shower took place on earth along with devastating volcanic eruptions which spread flames of fire and poisonous gas everywhere enough to kill every organism that dwelt on the surface and in the shallow sea. Because of the abundance of reptiles and their dominance, Mesozoic Era is also called the Era of Creepers. Toothed birds, mosquitoes, fruit-feeding insects and small mammals also evolved at the end before the deadly devastation had occurred suddenly.

iii) Cenozoic Era

Cenozoic is the name of the current Era in the history of the earth. This Era started about 65 million years ago and still running. All mammals including human beings and phanerogams (seed-making plants) have evolved in this Era so it is also called the Era of Mammals and Era of Angiosperms.

Fig. 11.14

Main Events and Lives

In this modern era, all seven continents separated from each other due to the tectonic movement of the earth's crust and developed their own climatic conditions. The increase in height of the Himalayas, the formation of many mountains, rivers, lakes, planes, plateaus, valleys, regular changes in season etc caused the evolution of many kinds of modern animals and plants. Many giant mammals including elephants, horses, cats, monkeys, rhinos, primates, whales, entelodon wild boar, monocot and dicot plants evolved and most of them extinct in this Era. First wild human beings evolved about 6 million years ago from primates and they started using two hind limbs for walking only about 4 million years ago. Modern human beings called Cro-Magnons or Homo sapiens evolved only 56,800 years ago. Spending a long time as wild animals, the Homo sapiens started social life by cultivating plants, rearing animals, keeping faith in God in the name of various religions, practising married life etc. only 10,000 to 12,000 years ago, and this recent time frame is called Holocene epoch.

Exercise

1. **Choose the correct alternative from the given options :**

   (a) What is called the branch of science that deals with the study of minerals?

   i) Geology ii) Paleontology

   iii) Mineralogy iv) Archeology

   (b) Which mineral is necessary for the proper growth of plants?

   i) Nitrogen ii) Dolomite

   iii) Uranium iv) Gypsum

   (c) Which of the following statement resembles the tidal hypothesis?

   i) Earth originated from the splashed mass due to the collision of two stars.

   ii) Earth originated from a hot lump of a star projected due to the strong force of gravitation when another giant star passed quickly by it.

   iii) Earth originated from nebular dust.

   iv) Earth originated from the explosion of a big heavenly mass.

   (d) In which Era has the given organism evolved?

   i) Precambrian ii) Palaeozoic

   iii) Mesozoic iv) Cenozoic

2. **Differentiate :**

   (a) Metallic minerals and Non-metallic minerals

   (b) Palaeozoic Era and Cenozoic Era

3. Give reason :

(a) Minerals are said to be pure chemicals.

(b) Mesozoic Era is also called the era of coniferous.

(c) Living beings have evolved after a very long time on Earth's evolution.

4. Answer the following questions :

(a) What is a mineral? Give examples

(b) What are the hypotheses about the origin of the earth? Explain any one of them.

(c) Explain the importance of minerals for Nepal.

(d) Make a flowchart of minerals showing their types.

(e) Which Era was inappropriate for the evolution of life and why? Explain with an example.

(f) When did mammoths with long tusks and fish with lungs evolve?

(g) Make a list of places in Nepal for any five minerals with their uses.

(h) Name the Era in the following organisms to be evolved :

Tree-fern, entelodon wild boar, dinosaur, frogs, monocot plants, bacteria, mosquito, trilobites, jellyfish.

(i) Read the given passage and answer the following questions:

"Various types of minerals are found in Nepal. Recently, very precious uranium-like minerals are also reported to be found in Nepal. Some minerals like iron, copper, coal, gold etc. are being extracted and used traditionally but the effective exploring, extracting and commercial use of minerals is yet to be done. Such minerals are not being extracted sustainably."

i) What may be the reason that minerals are not being explored, extracted and utilized sustainably in Nepal?

ii) Which minerals are being extracted traditionally in Nepal? What should be done to extract and use such minerals sustainably?

(j) Study the given figure and answer the following questions:

i) In which Era did these animals evolve and extinct?

ii) What are the reasons for their extinction?

iii) If these animals were still roaming on earth, what impact, in your opinion would be occurred in biological balance?

11.3 The Universe

What are the heavenly bodies seen if observed in the sky at clear night? How far is this sky extended? Guess and discuss with your friends.

Planets, satellites, stars, meteors, asteroids, comets etc seen in the sky are all heavenly bodies. Except these, universal substances like dust particles, clouds, air molecules, ordinary matter, dark matter, leptons, and photons and the energy contained in them also exist in the sky. They all are very far from Earth.

Fig. 11.15

Boundless view of the sky is called space. No one can predict or even imagine the region up to which the space is expanded. The limitless expansion of visible space is called the sky. The aggregate form of limitless space, time, matter and energy is the universe. In another word, the universe stands for total existence. Earth, moon, sun, stars and all other celestial bodies are only parts of the universe. The extension and demarcation of the universe are infinite. The coverage of a powerful telescope is called the observable universe. The diameter of the observable universe is estimated to be 46 billion light years. The distance travelled by light in one year through the vacuum is called 1 light year (l.y.) which is equivalent to 9.46×10^{12} km. The branch of science, that deals with the study of the universe is called Astronomy.

Origin of the Universe and the Big-Bang Theory

The universe is estimated to be originated about 13.8 billion years ago. Although there is no factual evidence about its origin and age, various research about the expansion of the universe has established the theory of the Big Bang. In 1924, an American scientist Edwin Powell Hubble found a spiral nebula that was going farther from the earth at a very high speed, which developed a new concept about the theory of the origin of the universe. Three years later in 1927, a Belgium scientist George Lemaitre described that the universe is expanding continuously with a great speed and if this rate of expansion is imagined to be reversed, all the matter and energy of the universe (which exist in different forms of heavenly bodies), will crunch to be a single point (he called it as 'Primeval atom') after 13.8 billion years. It means the present universe has been initiated from the primaeval atom 13.8 billion years ago.

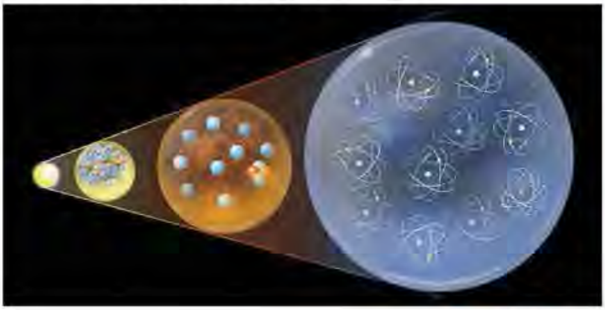



Fig11.16

According to him, the unimaginably dense and pressurized primaeval atom exploded 13.8 billion years ago. This explosion is called Big Bang. After the Big Bang, the primaeval atom started to expand at a very high speed forming the pre-matter at first and then subatomic particles. With their combination, atoms were formed followed by the formation of molecules. From atoms and molecules, the formation of all heavenly bodies of the universe including galaxies, nebulas, stars, planets etc. could be possible with time. Stephen Hawking has redescribed the origin of the universe from a mathematical singularity in the book "A brief history of Time: From the Big Bang to Black Holes".

Project work 11.3

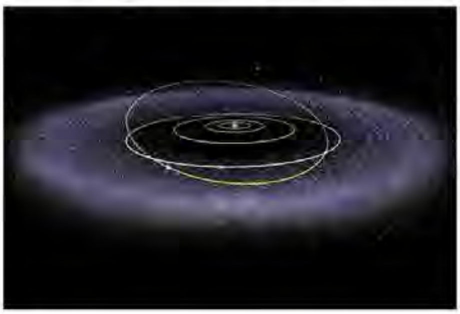
Search the findings and facts about the theory of the Big Bang by Hubble, Lemaitre and Hawking on the internet and prepare a chart of their short biography and contribution to the origin of the universe with their photos on cardboard paper and present it in your class.



Fig11.17

Asteroids

Different types of objects exist in the solar system. The heavenly body whether they are bigger or smaller, which revolves around the sun is a member of the solar system. Asteroids are also members of the solar system. The smaller masses of rocks without any specific shape that revolve around the sun along their orbits are called Asteroids or baby planets. There are too many asteroids in our solar system. Their orbits around the sun are somewhat irregular so while revolving around the sun, they hit and collide with each other.



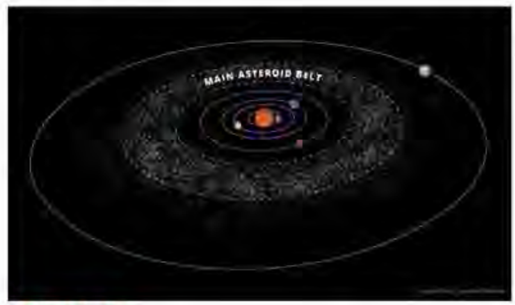


Fig11.18

Many Asteroids revolve around the sun and lie between the orbits of Mars and Jupiter. This region is called the Asteroid belt. Similarly, many asteroids revolve around the sun lying far away from the orbit of Neptune. This region is called the Kuiper Belt. the dwarf planet Pluto also lies within the Kuiper belt. The frozen icy particles of the Kuiper belt are the remnant of the substance with which our solar system has been formed. Some Asteroids revolve around the sun using the orbits of Jupiter, and Mars and they are called Trojans.

Many of the asteroids revolve around the sun intersecting the orbit of our Earth and they are called 'Near Earth Asteroids'. Some times. some of them fall into the earth and cause great devastation.

Asteroids have various sizes and most of them are irregularly shaped. Because of less mass contained, their gravity is not strong enough to shape them around. They are found to have 1 km to about 1000 km in diameter. Ceres, the largest asteroid is nearly round with a diameter of 940 km. Eros, another asteroid, is elongated and its diameter is only 16.8 km.

Asteroids are composed of rocks, minerals, metals, clay etc.

Activity: 11.3

Objective: To prepare a model of an asteroid

Materials required: Clay, water, colour, knife, cardboard & chart paper, glue, pencil, compass

Procedure:

(a) Make a hard paste of clay mixing it with water little by little and leave for some time.

(b) Paste chart paper on the cardboard paper to outline the solar system.

(c) Draw all planets around the sun showing their orbits with pencil and colour them.

(d) Cut the paste of clay into small irregular pieces and cling them indicating Asteroid Belt and Kuiper Belts.

(e) Let the model dry in the sun and colour. Now the model is ready to present in your class.

Comet

The smaller members of the solar system that appear with the long bright tail when coming closer to the sun are called Comets. Their orbits are highly elliptical and most of them are extended up to the Kuiper Belt. Once they come very close to the sun and go very far away from the sun while revolving. Many comets do not go outside the Kuiper belt and they are called Endocomets and some come to revolve sun from outside the solar system and they are called Exocomet. Comets are composed of ice, dust particles, fragments of rocks and gases. The central core of a comet is an icy solid called Nucleus. When they come closer to the sun, most of the substance present in them gets evaporated and makes a bright and spherical cloud around the nucleus which is called Coma. Similarly, strong solar wind makes the evaporated particles fly away from them in the opposite direction of the sun which appears as a long and bright tail due to the reflection of sunlight. If observed, two distinct tails can be seen in the opposite direction of the sun. The thicker and whiter tail is composed of dust particles and another thinner and bluish tail is composed of ions or plasma. As is already mentioned that the orbits of comets are highly elliptical and the distance between them and the sun goes on increasing and decreasing regularly, a comet when becomes closer to the sun starts producing its tail. The length of the tail gradually increases as it comes further closer but when it goes away from the sun, its tail also starts shortening and gradually disappears due to decreasing effect of solar energy. When the distance between them and the sun further increases, they seem to be lost in the dark space. Comets take 2 to 2,50,000 years to make a complete revolution around the sun. Hyakutake comet, identified in 1996, had spent 70,000 years making a revolution. It means it will be seen from the earth only after 70,000 years. Encke, another comet, takes only 3.3 years for a revolution.

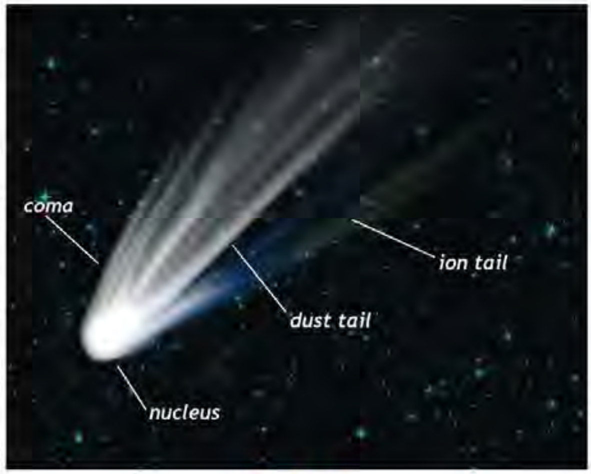


Fig11.18

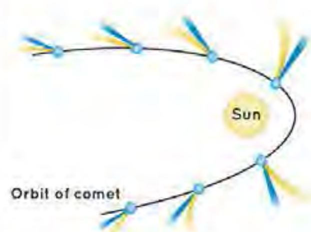



Fig11.19

Some comets revolve around the sun being very close to the earth and may bang down very forcefully. At the end of the Cretaceous period of the Mesozoic Era, many such comets and meteors fell like a shower which destroyed almost all life on Earth including dinosaurs within a few minutes. Similarly, Shoemaker-Levy in 1994 had fallen into Jupiter. About 4584 comets are identified and provided names till now. At every revolution, a comet losses some of its mass in space due to evaporation, so after making many revolutions, a comet is turned into an asteroid by losing all its volatile substances and gases. Such comets are called Extinct comets.

Examples of some comets with their revolutionary period are given in the table:

Comet	Discovered by	Orbital period (year)	Finding Date (AD)
Halley	Ed. Halley	75.32	1758
Encke	J. Encke	3.3	1786
Tempel Tuttle	H. Tuttle	`13.61	1858

Meteoroid, Meteor and Meteorite

Small irregular fragments of rocks and metals roaming randomly within the solar system are called Meteoroids. They range the size from dust grains to a small asteroids. They may enter into the gravitational field of planets and satellites and fall on them at very high speed. Sometimes they also enter into the earth's gravitational field at the rate of 20 km/s to 80 km/s. Due to this very high speed, they cause great friction with air particles in the Mesosphere by which they burn to leave a streak of light behind within a few seconds. Such streak lo light caused by falling meteoroids is called Meteors and is seen only at night due to the absence of sunlight. Some people say such meteors as falling stars or shooting stars. Most the meteor completely burn before they reach the troposphere, but some bigger meteors can reach the surface of the earth causing great destruction. Remnants of fallen meteors are called Meteorites. Scientists claim that about 200 meteoroids are facing down to Earth at very high speed every day but almost all of them will be evaporated before reaching the surface without any harm. Sometimes, many meteors fall at a particular region at a particular time and may cause devastation everywhere. This is called a Meteor shower.

Questions to think:

(a) How are the smaller and bigger circular craters formed on the surface of the moon?

(b) Do meteors fall during day time too?

Project work: 11.4

Make a video of asteroids, comets and meteors from the internet with some still photographs and make a power-point slide to present in your class.

Fig11.21

Galaxy

Observation of a clear sky at night may exhibit a cluster of many brighter or dimmer stars in different regions of the celestial sphere. Some of them, which look like a single star to the naked eye may be a collection of millions of stars. Such a massive collection of millions of stars are called Galaxies. Because of the very great distance between them and the earth, they appear just as a dot of light.

In such galaxies, there may be very big clouds of dust and gases called Nebula. Such organization of millions of stars, nebulas, remnants of nebulas, planetary systems of many stars, dark matter and energy is called Galaxy. Our solar system also lies in a galaxy named The Milky Way which constitutes about 150 million stars and our sun is also one of them. Galaxies may have various shapes elliptical, spiral, lens-like, ring-like, peculiarly shaped or irregular. The Milky Way, Andromeda, Whirlpool, Sombrero, and Messier are some examples of the galaxy.

Fig11.21

According to the report obtained from NASA which was delivered by a spacecraft called New Horizons in 2021, there are about 2×10^{11} galaxies in the observable universe. Galaxies are formed due to the Big Bang of the primaeval atom. There is often a Black-hole at the centre of each galaxy around which the member stars of the galaxy revolve from the same direction.

Fig11.22

Activity 11.4

Visit the Observatory Centre or Planetarium near your school and observe the sky with a powerful telescope or the projector of the Planetarium to prepare a report about heavenly bodies and submit it to your subject teacher.

Fig11.23

Project work: 11.5

Have a virtual tour of the sky through any software or app or device and observe planets, stars, comets, galaxies, asteroids, and constellations. Prepare a report illustrating their special features and submit it to your subject teacher.

Constellation

The region in the sky with some stars making a particular pattern is called Constellation. The patterns of the constellation may resemble various animals, geometric shapes, or any tools or objects. Many such constellations can be seen through the naked eye and their total number is counted as 88. Among the 88 constellations, the twelve which lie in the ecliptic (the circular region of the sky through which the sun seems to move around the earth) are called Zodiacs. Aeries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpios, Sagittarius, Capricorns, Aquarius, and Pisces are the name of the twelve zodiacs.

Fig11.24

Ursa Major, The Orion, Carina, Vela, Draco, Cepheus, Cassiopeia, Canis, and Ursa Minor are some other examples of the constellation. Constellations have a different number of stars, for example, there are 7 stars in Ursa Major and 5 stars in Cassiopeia. Crux is the smallest and Hydra is the biggest constellation.

An experienced one can easily predict the current time and the running season by the observation of these constellations. Similarly, they also help to declare geographic direction from the position of any constellation in the sky. Before the invention of watches and compasses, sailors used the position of constellations in finding the geographic direction for their successful journey.

Fig11.25

Activity 11.5

With the assistance of your parents, observe the clear sky at night and try to identify comets, meteors, The Milky Way, Ursa Major some other celestial bodies. If available, use a telescope. Prepare a list of the known bodies and present it in class for discussion.

Exercise

1. Choose the correct alternative from the given options:

(a) Who put forward the concept of expanding the universe?

(i) Einstein (ii) Lemaitre

(iii) Halley (iv) Pythagoras

(b) Which comet was destroyed in Jupiter?

(i) Shoemaker-Levy (ii) Bennett

(iii) Temple-Tuttle (iv) Halley

(c) Which of the following statement represents the character of Trojans?

(i) They are in the Kuiper Belt.

(ii) They revolve around the sun along the orbit of Mars or Jupiter.

(iii) They will be destroyed by burning in the atmosphere.

(iv) They have a long bright tail.

(d) What is 'A' shown in the figure made of?

(i) Rock, metal and dust particles

(ii) Ice, gas, and dust particles

(iii) Star, ice, and dark matter

(iv) Stars, nebular dust and cloud

2. Differentiate

(a) Meteors and Meteorites (ii) Galaxy and Constellation

(c) Asteroids and Comets

3. Give a reason

(a) Near-earth asteroids are dangerous for our planet.

(b) Comets gradually lose their material when revolving around the sun many times.

(c) Most of the meteors are completely destroyed after revolving some rounds around the sun.

(d) Galaxies are more important than other celestial bodies to study the universe.

4. Answer the following questions :

(a) What is the universe?

(b) Describe the Big Bang theory in brief.

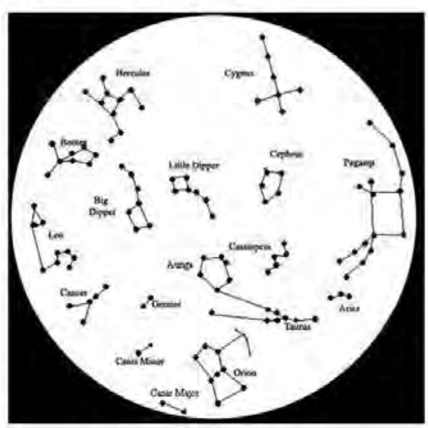
(c) Mention the characteristics of asteroids.

(d) What is a comet? Explain its different parts with a suitable diagram

(e) What are meteoroids? How are they turned into meteors?

(f) Explain 'meteor shower' and 'observable universe'.

(g) Study the given figure and answer the following questions:



   (i) Describe the special features of the celestial bodies shown in the figure.

   (ii) Why are they important to study the celestial bodies?