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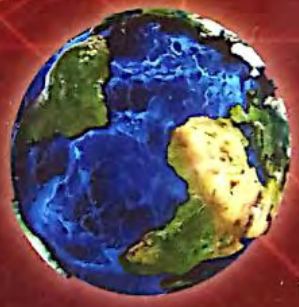

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GENERAL SCIENCE

GRADE

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Based on Single National Curriculum 2022

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Authors:
- Ms. Ruqayya Shaikh
- Mr. Mian Imran Khaliq
- Ms. Sidra Qasim
- Ms. Gul e Zehra

Review Supervision:
Mr. Jaffar Mansoor Abbasi, Director, DCTE Khyber Pakhtunkhwa Abbottabad

Focal Person:
Syed Amjad Ali, Additional Director (CTR), DCTE Khyber Pakhtunkhwa Abbottabad

Reviewed by:
- Mr. Muhammad Arshad, SS GHSS Lassan Takral Mansehra
- Dr. Muhamamd Ibrahim, SS GHSS Tarnab Charsadda
- Mr. Gulzar Ahmad, SS GHSS Bandi Dhodan Abbottabad
- Dr. Gul Nazir, Desk Officer DCTE Khyber Pakhtunkhwa Abbottabad
- Ms. Salmana Zaman Khan, Subject Specialist (Science) Khyber Pakhtunkhwa Textbook Board, Peshawar

Editor:
Ms. Salmana Zaman Khan, Subject Specialist (Science)
Khyber Pakhtunkhwa Textbook Board, Peshawar

Printing Supervision:
Mr. Arshad Khan Afridi, Chairman
Mr. Abdul Wali Khan, Member (E&P)
Khyber Pakhtunkhwa Textbook Board, Peshawar

Academic Year: 2022-23
Email: membertbb@yahoo.com
Website: www.kptbb.gov.pk
Phone: 091-9217714-15

Table of Contents

UNIT 1

PLANT SYSTEMS

Learning outcomes:

At the end of this unit, students will be able to:

- Explain the root and shoot system in plants. Label different parts of leaf, stem and root (external and internal structure).
- Predict the role of xylem and phloem in transport of water and food in plants by observing the cross section of the stem.
- Define the process of photosynthesis and derive word equation for it.
- Know that plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein).
- Explain that the structure of leaves is adapted to the process of photosynthesis.
- Describe the process of respiration and write word equation for it. Compare and contrast the processes of photosynthesis and respiration.
- Investigate the phenomena of transpiration and its importance in a plant (wind, temperature, light, humidity affecting rate of transpiration in plants).
- Explore and apply natural raise of water based on the principle of transpiration.

بیجوں کا نظام

UNIT 1 PLANT SYSTEMS

1.1 PLANT SYSTEMS

Plants have only two systems i.e. Root system and shoot system.

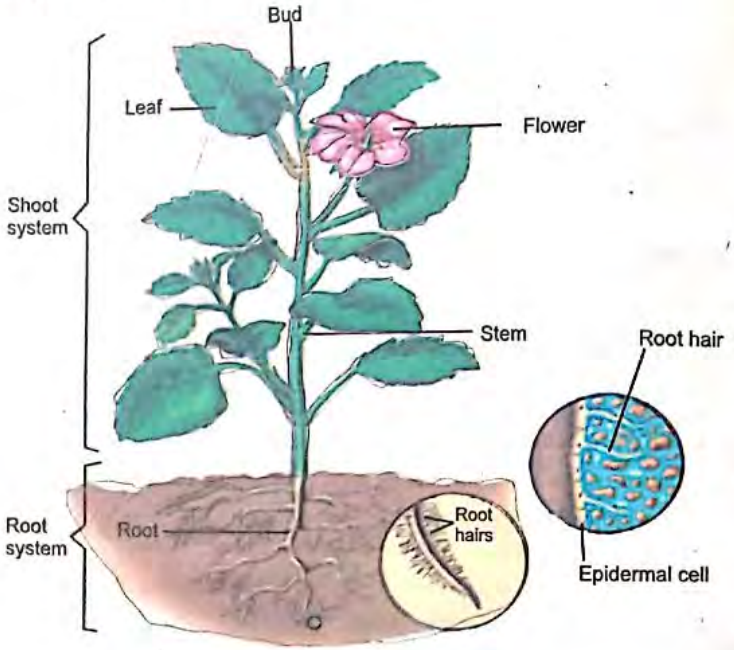


Figure 1.1 Systems of Plant

1.2 ROOT SYSTEM

Have you ever wondered why the whole plant does not blow away with the wind? This is due to the roots of the plant. The roots of a plant spread in the soil and anchor it. They absorb water and minerals from the soil by the process of diffusion. There are many tiny root hairs on the epidermis which help in the absorption. Vascular bundle including xylem and phloem is present in the centre of roots. Cortex is present between epidermis and vascular bundle.

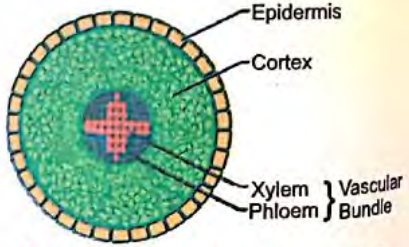


Figure 1.2 Internal Structure of Root

There are two main types of roots: taproots and fibrous roots. A taproot system has one main root called primary root that grows downward. Many smaller roots branch out from the primary root known as secondary roots. The branches of secondary roots are called tertiary roots. Taproots are found in many plants, trees and shrubs. While fibrous roots are thread like structures that spread out from the base of the stem of a plant e.g. grasses and wheat.

DO YOU KNOW?

Aerial roots are roots that grow on the parts of a plant above the ground. The aerial roots in Banyan mature into thick, woody trunks and help the tree spread over a wide area.

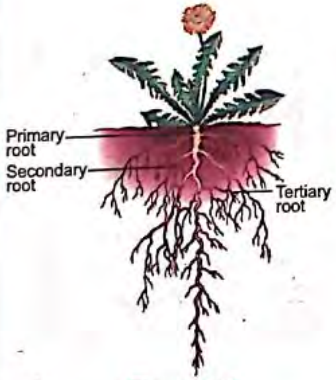


Figure 1.3
Tap Root System

Figure 1.4
Fibrous Roots

1.3 SHOOT SYSTEM

Shoot system has stem, leaves, flowers and fruits.

Stem:

The stem gives support to the plant. It transports substances between the roots and aerial parts of the plant including leaves, flowers and fruits.

Two main types of stem are herbaceous stem and woody stem. Plants with green and flexible stems are called herbaceous (e.g. daisies, grass and cereals) while plants with hard and strong stems are called woody plants (e.g. trees and shrubs).

In a stem, vascular bundles are arranged, just beneath the epidermis. The vascular bundles are strong and provide support to the plant. Pith is present in the centre for storage.

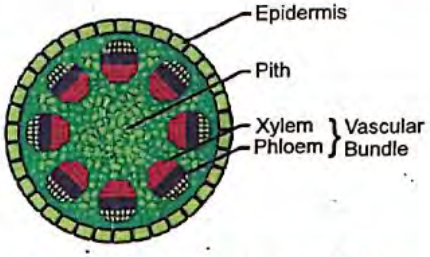


Figure 1.5 Internal Structure of Stem

UNIT 1 PLANT SYSTEMS

DO YOU KNOW?

In desert plants like Cactus thick stems store water and are green to perform photosynthesis.

INTERESTING FACTS

Sargodha has the largest tree in Pakistan. This Banyan tree is amazing with over one thousand roots and covers an area of approximately three acres.

1.4 LEAVES

Leaf consists of two parts i.e. leaf blade and leaf stalk. The flat green portion of a leaf is called **leaf blade**. Each leaf has a central **midrib** and many veins. Midrib is the extension of leaf stalk. The midrib and veins provide support to the leaf. They contain vascular bundles to transport substances to and from the leaves.

The process of photosynthesis takes place in mesophyll of leaves. The outer most layer of a leaf is epidermis. There is a water proof covering over epidermis called cuticle. Gases move in and out through small holes in the leaf epidermis, called stomata. Surrounding each stoma is a pair of guard cells. The two guard cells work together to open and close the stomata. Stomata open during day time and close at night time.

Figure 1.6 External Structure of Leaf

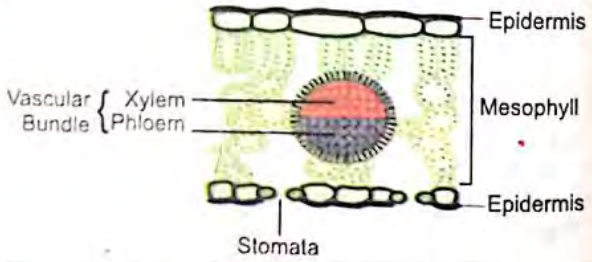


Figure 1.7 Internal Structure of Leaf

1.5 TRANSPORT

Transportation is the movement of materials from one place to another. The transport system of a plant consists of network of tubes called xylem and phloem.

Xylem: The xylem transports water and dissolved minerals from the roots to the leaves through the stem. They have thick and strong walls which support the plant. Xylem is a dead tissue. In trees new xylem is made each year forming rings in the tree trunk. Xylem forms wood.

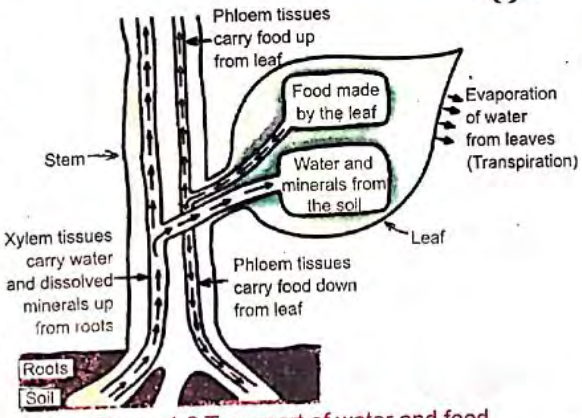


Figure 1.8 Transport of water and food

Phloem: The phloem transports food in the form of sugar solution from leaves to all other parts of the plant. Sugar solution can go up and down the phloem at the same time.

Try It out

Take a flower with a twig and place it in coloured water. For this purpose you can add a few drops of ink or food colour to the water. Leave the flower in the water for some time. Observe the change in the colour of flower. Why has the colour changed?

Predict the role of xylem and phloem in transport of water and food in plants by this activity.

1.6 TRANSPIRATION

The loss of water from the stomata in the leaf is called transpiration. As the water evaporates from the leaves, more is pulled up through the xylem to replace it. The main force which draws water up the plant is called transpiration pull.

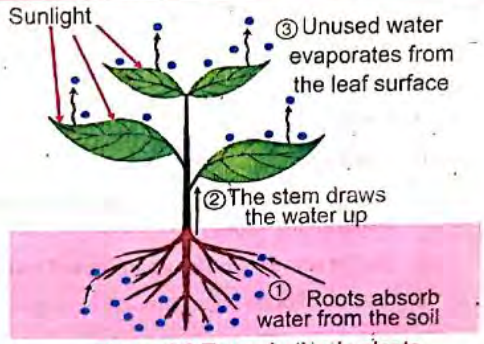


Figure 1.9 Transpiration in plants

When water loss is more than the water intake by a plant, it will wilt. It mostly happens on a hot, dry, sunny day.

The light intensity, temperature, humidity, wind and water supply will all affect the transpiration rate.

Figure 1.10 Wilting in a Potted Plant

Try it out

Select a small branch on a plant with fresh leaves. Fix a polythene bag on that branch and seal it. Similarly, fix a polythene bag on another branch with no leaves. Observe the two bags after half an hour and answer the following questions.

- Which bag has small droplets of water?
- Why are these droplets formed?

Activity 1.1 Transpiration from leaves

To demonstrate the transpiration from leaves by using cobalt chloride paper.

Material required

- Cobalt chloride paper
- Plant in bright light
- A pair of scissors
- Scotch tape (broad)

Procedure

1. Attach a small piece of dry cobalt chloride paper on the upper surface of an intact leaf using scotch tape.
2. Do the same on the lower surface of that leaf.
3. Cobalt chloride paper should be completely covered with scotch tape.

Activity 1.1 Cont...

4. After a short while, observe the colour of the papers.

a. Why does the cobalt chloride paper attached with leaves changes colour?

_____

b. Which piece of cobalt chloride paper changes its colour first?

_____

c. Why is scotch tape used in this experiment instead of office pins?

_____

Note: Cobalt chloride paper is blue when dry and turns pink when it comes in contact with water vapour.

1.7 PHOTOSYNTHESIS

Leaves and other parts of the plant are green because of chlorophyll. It is a green pigment that absorbs light energy and is present in the chloroplast of the plant cell. It enables a plant to make its own food by the process of photosynthesis. During photosynthesis, plants use light energy from the sun, carbon dioxide from the air and water from the soil to make glucose and oxygen.

$$\text{carbon dioxide} + \text{water} \xrightarrow[\text{Chlorophyll}]{\text{sunlight}} \text{glucose} + \text{oxygen}$$

Carbon dioxide enters the leaf through stomata and water comes from xylem to the leaf cells. The glucose produced is transported to all parts of the plant. Oxygen is also produced by photosynthesis. Plant cells use some of the oxygen for respiration, extra oxygen moves out through stomata.

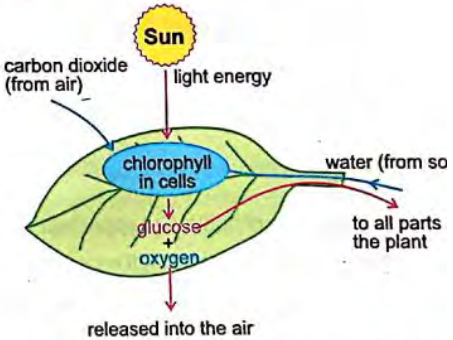


Figure 1.11 Photosynthesis in a Leaf

Teaching Point: All life forms depend on the process of photosynthesis for food and oxygen. It is the only source of oxygen on planet earth.

UNIT 1 PLANT SYSTEMS

1.8 LEAVES AS BEST PHOTOSYNTHESIS SITES

Leaf structure is best suited for the process of photosynthesis due to the following adaptations:

- Broad and flat shape to help absorption of sunlight and carbon dioxide
- Thin to help diffusion of gases
- Large air spaces for easy movement of gases
- Large number of stomata for exchange of gases
- Network of veins to supply water to the cells
- Transparent epidermis to allow entry of light
- Waxy cuticle to slow water loss
- Large number of chloroplasts in photosynthetic cells

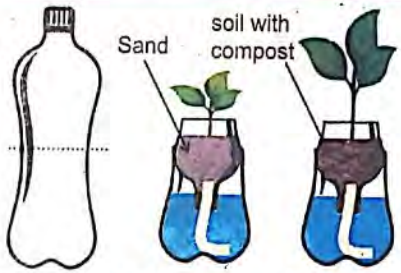
1.9 MINERALS FOR PLANT GROWTH

Do you like to grow plants? Growing healthy plants is not always easy! They require water, sunlight, air and some minerals as well. Plants need nitrates to make proteins which help to form new cells and tissues. For photosynthesis they need magnesium to make chlorophyll.

Activity 1.2 Minerals and plant growth

Material

- Two litre bottles
- Wick (strip of fabric)
- Growing media (sand, soil with compost)
- Small plants of same size
- Scissors



Procedure

- Remove cap of bottle. Cut upper half of bottle and invert it on the bottom part of bottle.
- Make a hole in cap and stuff wick through it.
- Put the cap and hang the wick in bottom part of bottle.
- Fill growing media in upper part of the bottle.
- Fill one bottle with sand and other bottle with soil containing composed. Plant small plants of same size in bottles. Pour some water in bottom part. Make sure that wick becomes completely wet. Leave the set up near light for two weeks

Activity 1.2 Cont...

a. Predict what will happen?

_____

b. Which plant will show better growth?

_____

Observe after two weeks.

c. Are both plants equal in size?

_____

d. Is the number of leaves same in both plants?

_____

e. Is the colour of leaves same in both plants?

_____

f. Which plant is showing better growth?

_____

g. What can be the reason of this difference?

_____

Note: In previous activity you used compost mixed with soil for better growth of plants. Compost is a type of fertilizer that is made from rotting plants. It is easy and cheap to make. The vegetable waste is broken down by bacteria, and turned into compost. You can make compost at your home to give all nutrients to your garden plants.

1.10 RESPIRATION

Living things get energy from their food by the process called cellular respiration. In plant cells glucose reacts with oxygen to form carbon dioxide, water and energy. Carbon dioxide and water are the waste products. This process mainly takes place in the mitochondria.

Glucose + Oxygen → Carbon dioxide + Water + Energy

Plant cells respire all the time, so they need continuous supply of oxygen. During day time, they make more oxygen by photosynthesis so extra oxygen goes into air. At night, photosynthesis stops, so plants take in oxygen and give out carbon dioxide like animals.

UNIT 1 PLANT SYSTEMS

1.11 COMPARISON BETWEEN RESPIRATION AND PHOTOSYNTHESIS

	Respiration	Photosynthesis
Occurs in	All living things	Only green parts of plants
When it occurs	All the time	Only in day light
Organelle involved	Mitochondria	Chloroplast
Reactants	Glucose and Oxygen	Carbon dioxide and Water
Products	Carbon dioxide and Water	Glucose and Oxygen
Energy link	Energy is released	Energy is absorbed

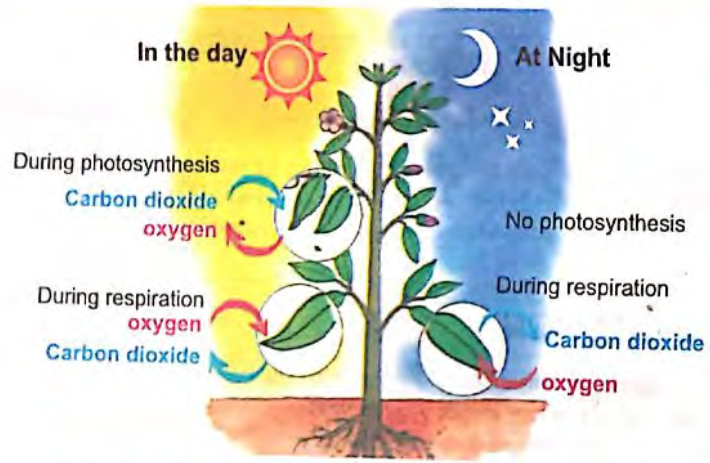


Figure 1.12 Gaseous Exchange of Plants during day and night

Key Points

- Plants have two systems i.e. root system and shoot system.
- Xylem transports water and phloem transports food.
- Transpiration is the loss of water from stomata.
- Leaves make food by photosynthesis. Photosynthesis cannot take place if any of the light, carbon dioxide, chlorophyll, water or suitable temperature is not available.
- Respiration is the breakdown of food to get energy.
- Leaves are best adapted to perform the process of photosynthesis.
- Plant cells perform respiration to release energy from food.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. The root system which can get water from deep underground sources is:
   a. Fibrous roots b. Tap roots
   c. Storage roots d. Root nodules
2. Which of the following is not an organ of plant?
   a. Epidermis b. Root
   c. Stem d. Leaf
3. Vascular bundles are present in every part of the plant. They are made up of:
   a. Xylem only b. Phloem only
   c. Xylem and phloem d. Xylem, phloem and root hair cells
4. Amna liked to grow plants on her terrace. The plants were getting light and water everyday but they were not growing properly. What suggestion can you give her to improve plant growth?
   a. Add sugar to plant pots b. Give water once a week
   c. Add compost fertilizer to plant pots d. Shift them indoors
5. If water available to plants become less, then stomata are closed even at daytime. This protects plants from:
   a. Photosynthesis b. Respiration
   c. Wilting d. Transport of water
6. The protective layer around plant parts is:
   a. Epidermis b. Cortex
   c. Mesophyll d. Vascular bundle

7. If the concentration of carbon dioxide increases in the air during daytime the process of
   a. photosynthesis will decrease. b. respiration will decrease.
   c. photosynthesis will increase. d. respiration will increase.
8. Plants perform respiration all the time. The purpose of respiration in plants is to
   a. prepare food. b. release energy.
   c. absorb energy. d. maintain healthy growth.
9. If you stay under trees at night, you can feel dizziness due to
   a. high level of oxygen and low level of carbon dioxide.
   b. low level of oxygen and high level of carbon dioxide.
   c. poisonous gases released by trees.
   d. ghosts living in trees.
10. Which of the following is the correct word equation for respiration?
   a. Carbon Dioxide + Water → Glucose + Oxygen
   b. Carbon Dioxide + Water + Sunlight → Glucose + Oxygen
   c. Glucose + Oxygen → Carbon Dioxide + Water
   d. Glucose + Oxygen → Carbon Dioxide + Water + Energy

B. True and False (correct the statement if it is False)

1. Exchange of gases in plants takes place through tiny holes called stomata located on the margins of leaves.

_____

2. The rate of photosynthesis is slow in variegated leaves because there is maximum amount of chlorophyll in them.

_____

3. Respiration only takes place in animal cells because they need energy.

_____

4. The job of the root hairs is to protect the roots from damage.

_____

5. Xylem is dead tissue while phloem is living tissue.

_____

C. Short questions

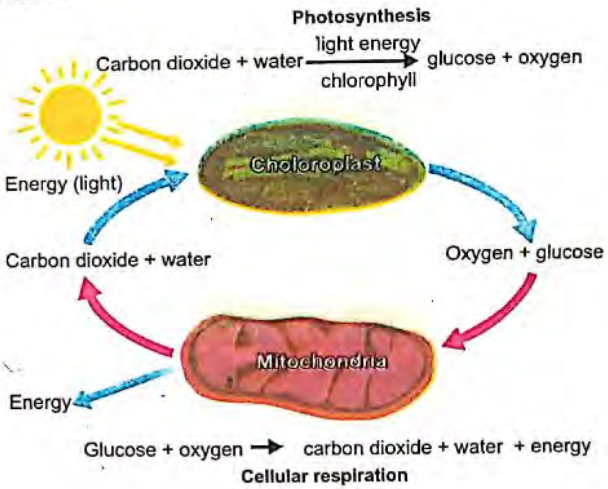
1. What are the three functions of roots?
2. How stomata help in the process of photosynthesis?
3. Why respiration takes place in plants?
4. How is photosynthesis important for:
   a. plants
   b. humans and other animals
   c. atmosphere

D. Long questions

1. Compare the properties of xylem and phloem.
2. Photosynthesis and respiration are two different processes. Differentiate between them.

E. Structured response questions

1. The following diagram shows the two processes taking place in the plant cell i.e. photosynthesis and cellular respiration.



a. Which process takes place only in green parts of the plant?

_____

b. Which process takes place in all living cells, at all times?

_____

c. Which process only takes place during the day time?

_____

d. Which process can help to balance carbon dioxide level in the air?

_____

e. Which structure acts as a solar panel?

_____

2. The table shows the transpiration rate of a plant in different conditions.

Conditions	Transpiration rate (mm/min)
Darkness	1
Bright light	17
Still air	9
Moving air	21
Dry air	11
Moist air	5
Warm air	16
Cold air	6
Dry soil	2
Moist soil	18

a. Which condition causes the fastest rate of transpiration?

_____

b. What sort of conditions can increase the rate of transpiration?

_____

c. What sort of conditions can decrease the rate of transpiration?

_____

d. How does transpiration help in the water cycle?

_____

F. Project work

Make a poster on photosynthesis and respiration.

UNIT 2

HUMAN RESPIRATORY AND CIRCULATORY SYSTEM

Learning outcomes:

At the end of this unit, students will be able to:

- Differentiate between the processes of respiration and breathing.
- Differentiate between aerobic and anaerobic respiration.
- Trace the path of air in and out of the body and how the oxygen it contains is used during the process of respiration.
- Sketch and label the human circulatory system.
- Hypothesize how exercises of varying intensity (from rest to high intensity interval training) would impact their pulse rate, test their hypothesis, calculate their pulse rate and record their findings.
- Describe the role and function of major organs in the human respiratory system including trachea, lungs and alveoli (air sacs).
- Explain that living organisms have a complex transport system for transfer of various solids, liquids and gases across the body.
- Describe the structure and function of the human heart.
- Explain how blood circulates in the human body through a network of vessels (arteries, veins and capillaries), and transports gases, nutrients, wastes and heat.
- Compare and contrast arteries, veins and capillaries.
- Describe the composition of blood and the functions of red blood cells, white blood cells, platelets and plasma.

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

Our body needs energy for doing different functions, for example playing:

Figure 2.1 Energy is required for Movement

All our energy comes from the food we eat. The food we eat is broken down into small molecules like glucose. Cells use glucose to get energy. Energy is released from food by the process of cellular respiration. **Cellular respiration** is a series of chemical reactions which slowly releases energy stored in the food molecules. It is essential for the survival of every living cell. It occurs continuously throughout the life.

2.1 AEROBIC AND ANAEROBIC RESPIRATION

Cellular respiration is of two types. It can take place with or without oxygen. If it takes place in the presence of oxygen, it is called **aerobic respiration.** During aerobic respiration glucose reacts with oxygen in mitochondria of cells to release large amount of energy. Carbon dioxide and water are produced as the waste products.

Glucose + Oxygen → Carbon dioxide + Water + Energy

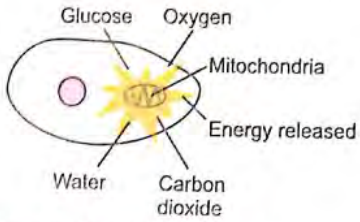


Figure 2.2 Aerobic Respiration

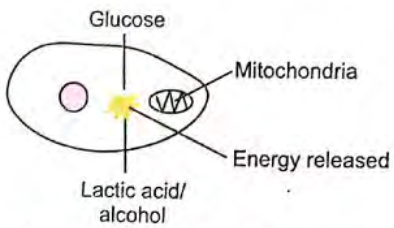


Figure 2.3 Anaerobic Respiration

If oxygen is not available, then some cells temporarily shift to **anaerobic respiration.** This releases a small amount of energy from food as compared to aerobic respiration. Waste products can be lactic acid or alcohol and carbon dioxide.

Glucose → Lactic acid

Glucose → Alcohol + Carbon dioxide

2.2 HUMAN RESPIRATORY SYSTEM

Respiratory system helps in the process of breathing and exchange of gases. It consists of air ways and lungs. Air enters in nasal cavity through nostrils. In the nasal cavity the air becomes clean, warm and moist. Then air passes through larynx and enters in the trachea. Trachea divides into two bronchi which enter into lungs. Inside lungs the bronchi further branch into bronchioles. Bronchioles end at tiny, thin walled air sacs called alveoli. Exchange of gases between air and blood takes place at alveoli. Lung is like a huge sponge as it contains millions of alveoli.

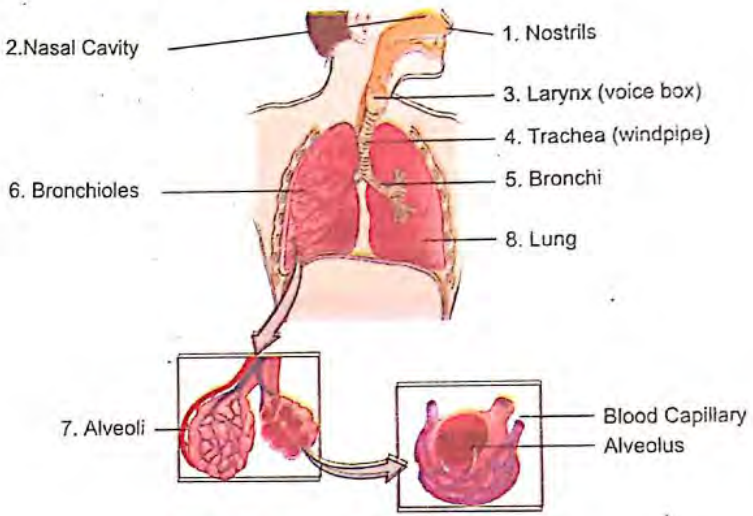


Figure 2.4 Human Respiratory System

Exchange of Gases:

Oxygen from the inhaled air diffuses from alveoli to the blood in the capillaries. This oxygenated blood is carried to the cells in other parts of the body. The waste product of cellular respiration i.e. carbon dioxide is added to the blood. This deoxygenated blood (blood with less oxygen and more carbon dioxide) reaches lungs. Carbon dioxide from blood capillaries diffuses into alveoli air. Eventually the carbon dioxide is breathed out of the body.

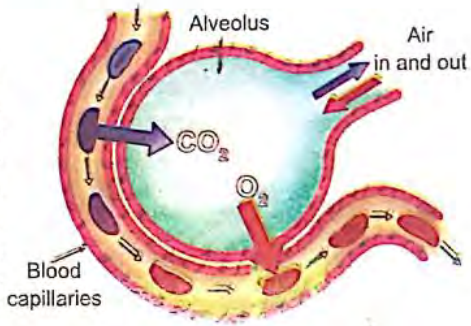


Fig. ... between ... blood

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

DO YOU KNOW?

Alveoli are perfect respiratory surfaces as they

- are thin walled (single cell thickness)
- have a large surface area
- are moist
- are surrounded by blood capillaries
- have a supply of fresh air

INTERESTING FACTS

If all alveoli of your lungs are flattened and put together, their surface area will be equal to that of a tennis court.

Breathing:

Breathing is simply the exchange of gases between your lungs and the air. It is a physical process that takes place at organism level. Lungs are spongy in nature and they cannot move on their own. The muscles surrounding the lungs expand or compress the lungs. When lungs expands air moves in (inhalation). When lungs compress the air moves out (exhalation).

Difference between Breathing and Respiration

Breathing	Respiration
It is a physical process involving exchange of oxygen and carbon dioxide.	It is a biochemical process involving reaction of glucose with oxygen to produce carbon dioxide and water
Energy is not released	Energy is released
It takes place outside the cells	It takes place within the cells
Enzymes are not involved	Respiratory enzymes are involved

Try it out

Working model of lungs

Take a small plastic bottle and remove the bottom portion of it. Cut a large balloon and fix it on the bottom of plastic bottle. Attach a small balloon on the top of bottle and push it inside.

Now pinch the large balloon and pull it downwards.

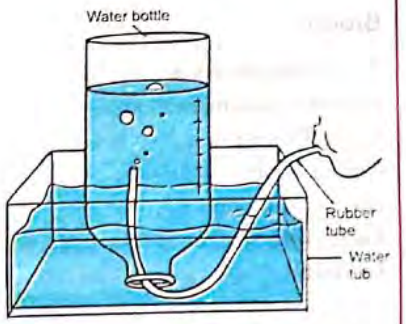
- What happens to the size and shape of small balloon?
- Can you relate these two balloons with some parts of your body?

Activity 2.1 How much air can you breathe out?

Group work

Materials

- A plastic bottle with a lid
- A rubber tube
- A water tub
- A permanent marker



Procedure

1. Fill the bottle with water and put the lid on. Hold it upside down in the tub of water and take off the lid.
2. Push the rubber tube into the neck of the bottle. Breathe in deeply, then blow gently into the rubber tube until your lungs are empty.
3. All the air you breathe out will be trapped at the top of the bottle. This is how much air your lungs hold. Mark that point with a line and write your name with it.
4. Other members of the group do the same. Compare how much air do your lungs hold with other group members.

2.3 CIRCULATORY SYSTEM

Think about the cells in your toes. How do they get food and oxygen? How is the waste removed? Your blood transports all these substances. The system that moves blood throughout body is called the circulatory system. It includes the blood, blood vessels and the heart. The blood circulates in your body through a network of vessels and transports gases, nutrients, wastes and heat. Heart pumps this blood through your blood vessels.

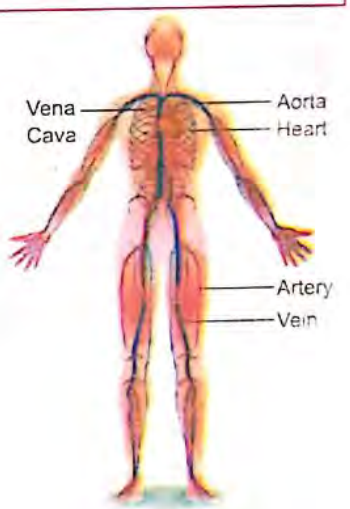


Figure 2.6 Human Circulatory System

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

Blood

The blood consists of plasma and blood cells. The plasma makes more than half of the volume of the blood. Plasma is a pale yellow coloured liquid. It carries water, nutrients, gases, wastes and chemicals (hormones, ions etc.) from one part of the body to another. Blood cells are of three types i.e. red blood cells, white blood cells and platelets.

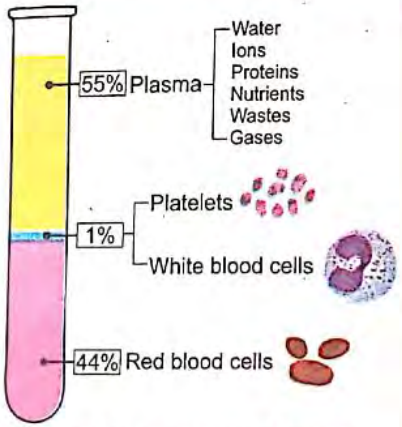


Figure 2.7 Components of Blood

Types of blood cells: Their structrure, function and deficiency diseases

	Red blood cells	Platelets	White blood cells
Structure	Disc shaped with a depression on each side. Contain red haemoglobin	Irregular shaped, small pieces of cell	Different types, sizes and shapes
Function	Carry oxygen from lungs to rest of the body	Stop bleeding by forming clots	Protect your body from germs and harmful things. They make the immune system
Example of Deficiency Diseases	Anaemia due to less number of RBCs or haemoglobin quantity	Dengue fever virus reduces number of platelets	AIDS virus attacks WBCs and body immune system fails

Blood Vessels

Blood vessels can be thought of as highways your blood uses to move through your body. Your blood is always confined in blood vessels hence, it is called a closed circulatory system.

Arteries are blood vessels that carry blood away from the heart to other parts of your body. They have thick muscular walls that stretch when the heart pushes blood into artery. This stretching and thumping back produces pulse. Heart pushes blood into arteries with a pressure called blood pressure. Arteries carry oxygenated blood except pulmonary artery.

Arteries branch off into tiny vessels called **capillaries**. Capillaries are so narrow that RBCs flow through them in a single line. The walls of capillaries are only one cell thick so gases and small molecules can easily diffuse through these thin walls. Blood flow is slow in capillaries.

Capillaries join to form smallest veins. **Veins** are the blood vessels that take blood from cells back to the heart. The small veins join to form larger veins. Veins have thinner walls than the arteries. Veins have valves to avoid backward flow of blood.

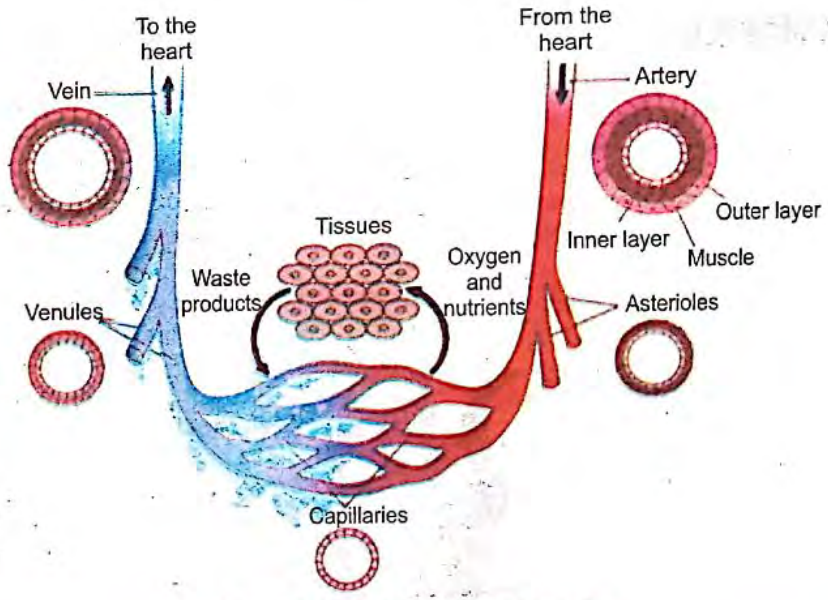


Figure 2.8 Structure of Blood Vessels

Teaching Point: Compare circulatory system with the transport system in a city. Blood vessels as highway, blood cells as trucks and things to be transported as goods carried by trucks.

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

INTERESTING FACTS

- Your blood vessels are very long. If all your blood vessels are laid end to end, they would stretch around earth more than twice
- Your blood sample is taken from veins as they are larger, have thinner walls and blood flow is slower in them

Try it out

Stand in front of the mirror and gently pull down your eyelid to see some blood vessels on your eye ball.

2.4 HEART

The heart is divided into two sides. Each side of the heart has two parts. The upper, blood receiving part of each side is called an atrium. The lower, blood distributing part is called a ventricle. Ventricles are larger, thicker walled and more powerful than atrium. The right side gets deoxygenated blood from the veins of the body and pumps it to lungs. In the lungs, the blood gets oxygen and gives up carbon dioxide. This oxygenated blood flows to left side of the heart. The left side pumps this oxygenated blood through arteries to the body. Heart also has valves to keep blood flowing in one direction.

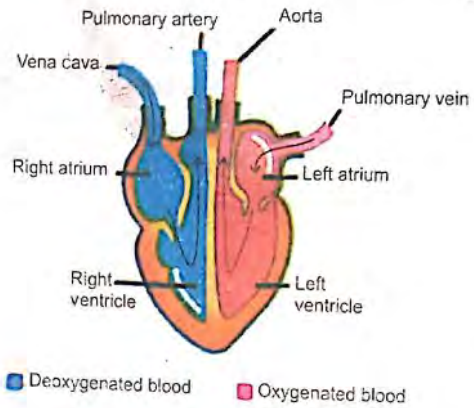


Figure 2.9 Human Heart

Try it out

Brainstorm ideas to make a model of human heart or circulatory system using different ecofriendly materials. Work in groups. Share your model with the class.

DO YOU KNOW?

- Your heart beats almost 42 million times in one year.
- You have almost 5 litres of blood in your body.
- Your heart is made up of special type of muscles called cardiac muscles.
- Cardiac muscles work continuously without getting tired.

Activity 2.2 Pulse rate and exercise

Heart beat produces pulse in your arteries. Pulse rate is your heart beat rate.

You can feel your pulse while placing your fingers below the base of the thumb on your wrist. Using a watch, count the number of pulses per minute.

Now you know that your circulatory system is fulfilling the needs of all cells of your body. Write possible outcomes before performing the next step.

a. If you start jumping or running which cells of your body will need more oxygen?

_____

b. How your heart will respond to this challenge?

_____

c. Will your breathing rate show any changes?

_____

d. Do jumping or running for two minutes. Count the number of pulses again. _____

e. Count your breaths _____

f. After taking rest for five minutes, count your pulse again. _____

g. How did the exercise effect your pulse rate?

_____

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

Key Points

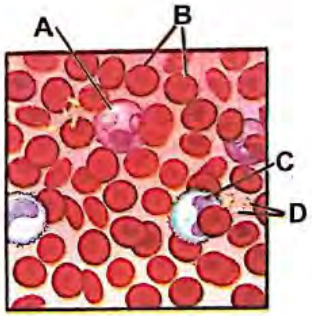
- Respiration provides energy to the cells. It is of two types; aerobic and anaerobic.
- Respiratory system has air passage way and lungs. Lungs take in oxygen and remove carbon dioxide from blood.
- Circulatory system is the transportation system. It consists of blood, blood vessels and heart.
- Blood flows in the blood vessels. Its components are plasma, red blood cells, white blood cells and platelets.
- Arteries, veins and capillaries are the three types of blood vessels. Blood is always confined in these blood vessels.
- Heart pumps blood throughout life. It has four chambers i.e. right atrium, right ventricle, left atrium and left ventricle. Oxygenated and deoxygenated blood are always separate from each other.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. A team of climbers was climbing a high mountain. When they reached near top they felt difficulty in breathing because at high altitude there is
   a. more oxygen. b. less oxygen. c. more carbon dioxide. d. low temperatures.
2. The exchange of substances between blood and body cells can take place at the:
   a. Capillaries b. Veins c. Arteries d. Heart
3. A person affected with anaemia looks pale and feels tired. All his body cells are getting
   a. less food. b. less oxygen. c. less water. d. less carbon dioxide.
4. The exchange of gases between blood and air takes place at:
   a. Trachea b. Bronchi c. Bronchioles d. Alveoli
5. Cellular respiration always requires
   a. glucose and oxygen. b. glucose. c. glucose, oxygen and carbon dioxide. d. alcohol, Lactic acid and carbon dioxide.

6. Valves are flaps that keep blood flowing in one direction. Valves are found in:
   a. Artery and vein b. Artery, vein and capillary c. Vein and heart d. Artery, vein, capillary and heart
7. Oxygenated blood is found in two chambers of heart including:
   a. Right and left atrium b. Right and left ventricle c. Right atrium and right ventricle d. Left atrium and left ventricle
8. Which component of blood is liquid?
   a. Plasma b. Red blood cell c. White blood cell d. Platelets
9. The diagram shows different types of blood cells.
   Which cell is filled with haemoglobin?
   a. A b. B c. C d. D



10. The diagram shows blood flow through a human heart.
    Which chamber pumps the blood to lungs?
    a. A b. B c. C d. D

UNIT 2 RESPIRATORY AND CIRCULATORY SYSTEM

B. True and False (correct the statement if it is False)

1. Breathing is a chemical reaction and cellular respiration is a physical process.

2. Blood clotting requires platelets in the blood.

3. Anaerobic respiration releases large amount of energy.

4. Thick walls of alveoli help in the exchange of gases.

5. Most veins carry blood rich with oxygen and food.

C. Short questions

1. Can cells survive without energy?
2. Arrange these words in such a way as to show how oxygen from air reaches into your blood; nasal cavity, bronchioles, blood capillaries, air, alveoli, bronchi, nostrils, trachea
3. Which substances are transported by blood?
4. Differentiate between
   a. artery and vein b. atrium and ventricle.
5. How does the blood circulate around the body?
6. Compare respiration and breathing.

D. Long questions

1. Differentiate between aerobic and anaerobic respiration.
2. How do the respiratory and circulatory system work together to provide body cells with the materials they need?

D. Structured response questions

1. The table shows how the composition of the air changes when you inhale and exhale

Gas	Amount in inhaled air	Amount in exhaled air
Oxygen	21%	16%
Carbon dioxide	0.04%	4%
Nitrogen	78%	78%
Water vapour	Variable	saturated

   a. Why oxygen percentage is reduced in the air that is breathed out?

   b. Amount of which gas is unchanged and why?

   c. Why carbon dioxide percentage is increased in the exhaled air?

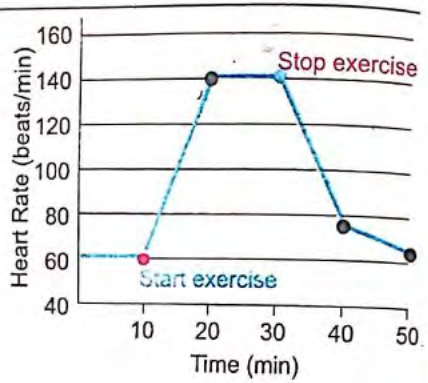
2. The following diagram shows structure of artery, capillary and vein.

   a. Which blood vessels can be seen only through microscope?

b. Which blood vessel will hold more blood than the other two?

c. Why pulse is produced only in arteries?

3. Anum measures her pulse rate before she exercises. It is 60 beats per minute. She exercises for twenty minutes and measures her pulse rate again. She then measures it every minute for several minutes. She draws a graph to show her results.



a. Why does her pulse rate keep on increasing during exercise?

b. After how many minutes does her pulse rate return to normal?

c. What can be concluded from her results?

E. Project work

With the help of recycled material make the model of the circulatory system or respiratory system.

UNIT 3

IMMUNITY AND DISEASES

Learning outcomes:

At the end of this unit, students will be able to:

- Explain the various lines of defences that the body has against pathogens.
- Describe the three types of immunity in humans – innate, adaptive, and passive.
- Identify the various types of pathogens that cause infectious diseases.
- Describe the parts of the immunity system and how they function to produce an immune response.
- Illustrate how adaptive immunity develops over time.
- Visualize the ways to add additional layers of defence (such as wearing masks, using sanitizers, etc.).
- Propose some common strategies for strengthening their immune system.
- Explain how infectious diseases such as hepatitis, covid-19, typhoid, and dengue are caused /contracted, how they are tested and diagnosed, and how they can be prevented.
- Suggest ways in which communities of people can safeguard against the spread of infectious diseases.

UNIT 3 IMMUNITY AND DISEASES

3.1 IMMUNITY

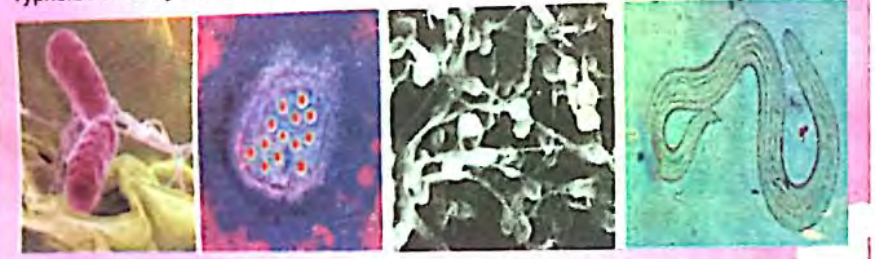
Your body has a powerful army that protects it from various types of threats including:

- Mechanical injuries e.g., cuts, wounds etc.
- Attack by pathogens
- Entry of foreign particles like dust and pollen

DO YOU KNOW?

Pathogens are disease causing germs including virus, bacteria, fungi and parasites.

Infectious diseases are diseases caused by these pathogens e.g., Flu caused by virus, Typhoid caused by bacteria etc.



Bacteria Viruses Fungi Parasites

This personal army is called immune system. Every day we encounter a huge number of pathogens. However, we do not fall ill every other day which is due to our **immune system**. An army of cells is always roaming our body ready to ward off any attack. Immunity is the ability of the body to resist harmful microorganisms. There are three types of immunity i.e. innate, adaptive and passive immunity.

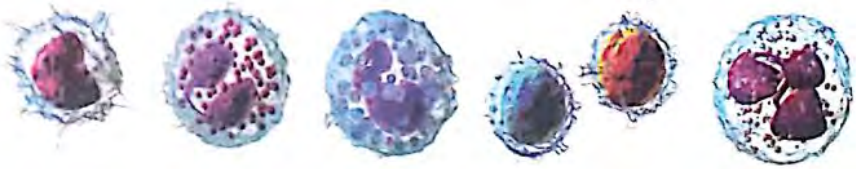


Figure 3.1 Different types of White Blood Cells

3.2 INNATE IMMUNITY

Innate immunity or nonspecific immunity is the natural defence of body against any intruder. This immunity acts without recognizing and differentiating the intruder. It has two components i.e., first line of defence and second line of defence.

- **First line of defence** stops entry of germs in the body. It includes skin and mucus membranes of mouth, nose, lungs etc.
- **Second line of defence** includes some white blood cells, chemicals and fever. These act after germs enter into body. All these factors kill germs and protect the body.

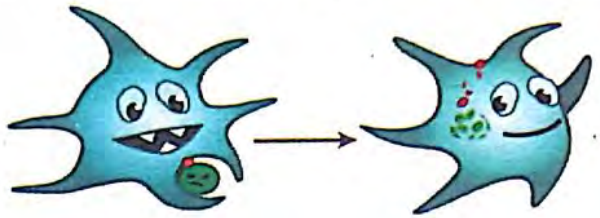


Figure 3.2 Second Line of Defence Cells Eating Pathogens

DO YOU KNOW?

There are ways to support your first line of defence. You can add layers of defence to protect your body like face mask, gloves, sanitizer etc.

Can you think of some other ways to add additional layers of defence?

3.3 ADAPTIVE IMMUNITY

Adaptive immunity or learned immunity includes the third line of defence. It identifies the germ and start making special types of white blood cells i.e., T cells and B cells.

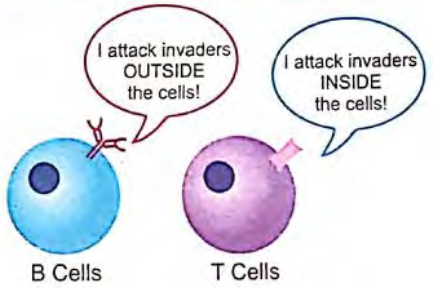


Figure 3.3 Third line of Defence: B Cells and T Cells

UNIT 3 IMMUNITY AND DISEASES

T cells directly kill virus infected cells and activate all other cells of immune system to fight the germs. **B cells** after activation start making antibodies. **Antibodies** are special proteins flowing in blood which can recognize and kill viruses and bacteria. If our body develops antibodies against a disease, then we become immune to that disease. The way the body defends itself against harmful or foreign substances is called **immune response**.

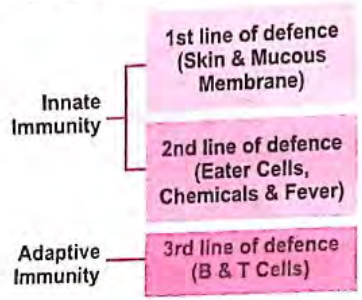


Figure 3.4 Types of Immunity

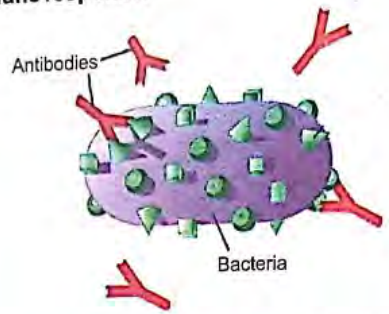


Figure 3.5 Antibodies attacking bacteria

3.4 MECHANISM OF ANTIBODY FORMATION

There are two ways to start antibody formation by your immune system. Either you get disease or you get vaccination. Your immune system requires exposure of pathogen to activate and start antibody formation. A **vaccine** works by training the immune system to recognize and fight pathogens. To do this some part from the pathogen must be introduced into the body to trigger an immune response. Vaccine can be in the form of oral drops e.g., Polio vaccine or injection e.g., Covid-19 vaccine.

B and T cells form **memory cells** as well. These memory cells remember their enemies. Next time when the pathogen enters these two types of memory cells become active immediately and start killing pathogens. This quick immune response assures that pathogen will be unable to grow in the body and cause disease. So if you are vaccinated against Polio, then after the entry of Polio virus in your body your immune response will kill all Polio viruses. You will stay healthy and protected from diseases.

Teaching Point: Every one has first and second line of defence by birth. Third line of defence grows with time due to vaccine and exposure of pathogens.

Activity 3.1

Role play

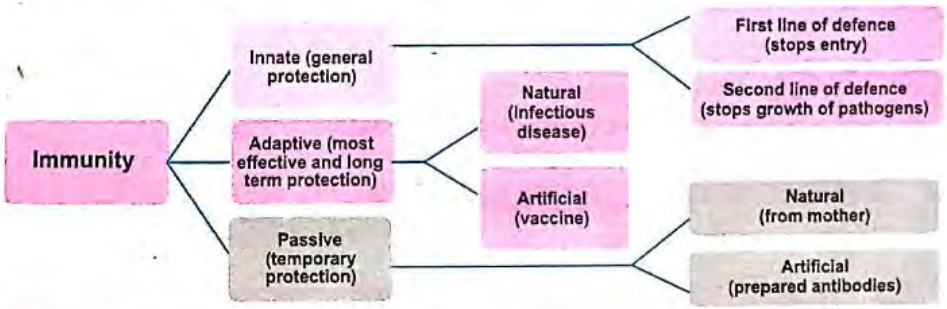
Imagine your class room as a human body and students as cells and pathogens.

1. Some masked students acting as pathogens will try to enter in the class room.
2. Closed door of the class room will indicate that skin is intact.
3. When door is opened it indicates injury and after that pathogens will enter and try to spread in the class room.
4. Few students acting as second line of defence cells will try to stop pathogens without looking at their faces.
5. Then B cells and T cells will come near pathogens. They will take off their masks and recognize the pathogens. They will take picture of pathogens and save it in "Memory file".
6. T cells will directly stop pathogens and take them out of class room.
7. B cells will attach small sticky notes (antibodies) on pathogens and take them outside class room.

(Throughout role play caring and compassionate behaviour among students is required)

3.5 PASSIVE IMMUNITY

Sometimes a pathogen or toxin harms body very quickly and immune system cannot protect the body. In such situation already prepared antibodies can save a person's life; Like after a snake bite, a person's life is threatened. Already prepared antibodies are injected which stop the effect of snake venom. This type of immunity is short lived and it is called passive immunity.

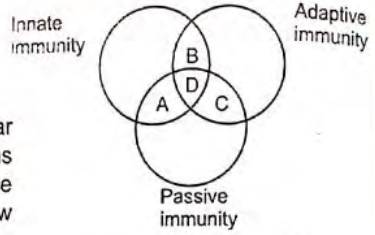


DO YOU KNOW?

You get passive immunity naturally from your mother. Before birth, antibodies are passed through the placenta to protect the child from illness. After birth, an infant receives antibodies found in mother's breast milk. It is also called maternal passive immunity.

UNIT 3 IMMUNITY AND DISEASES

Activity 3.2 Learn about three types of immunity.



a. Which letter will indicate the state of immunity in a new born child?

b. Ahmed lives in a village. He was playing near fields when a poisonous snake bit him. He was rushed to hospital. Doctors asked about the details of snake. Why doctors need to know about type of snake?

c. Which letter will indicate his state of immunity before coming to hospital?

d. Then Ahmed was injected with prepared antibodies. After few days he was playing again. Which letter will indicate his immunity after treatment?

3.6 WAYS TO BOOST YOUR IMMUNITY

- Eat lots of fruits and vegetables.
- Drink plenty of water.
- Exercise regularly and maintain healthy weight.
- Get a good night's sleep.
- Stay hopeful, happy and connected with family and friends.
- Wash your hands more often and keep yourself clean.
- Avoid fried foods, sugar, smoking, drugs etc.
- Get recommended vaccination.

Try it out

Make a poster on, "How to boost your immune system". Display it in your class. Share your healthy practices with your family and friends. Try to involve maximum people in your Immune booster campaign.

3.7 INFECTIOUS DISEASES

Infectious diseases commonly spread through the direct transfer of bacteria, viruses or other germs from one person to another. Germs can spread from person to person through:

- the air as droplets
- faecal-oral spread (food and water)
- blood or other body fluids
- skin or mucous membrane (direct contact)

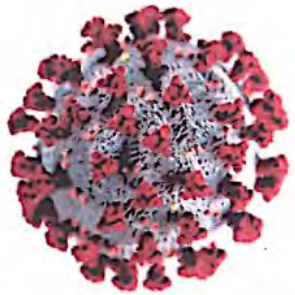
COVID-19

Cause:
COVID-19 virus

Symptoms:

Slight:	Severe:
Fever	Respiratory difficulty
Cough	Pneumonia
Cold	Kidney failure
Body pains	
Fatigue	

Diagnostic Test:
Test of sample from nose, throat or saliva to check presence of COVID-19 virus



Spread through:
- Direct contact
- Breath droplet
- Coughing
- Sneezing

Prevention:
- Vaccination
- Social distancing
- Face mask
- Use of sanitizer
- Wash hands with soap often
- Avoid crowded indoor gatherings

Dengue

Cause:
Dengue virus

Symptoms:

High grade fever	Vomiting
Severe headache	Skin rash
Pain behind eyes	Body pains
Nausea	Weakness

Diagnostic Test:
Blood test for presence of virus

Spread through:
Bite of Aedes mosquito

Prevention:
Use mosquito repellents, mosquito nets, mosquito killing sprays etc.

Wear fully covered clothes

Drain all standing water sites as these are breeding area of mosquitoes

UNIT 3 IMMUNITY AND DISEASES

Hepatitis-B

Cause:
Hepatitis B virus

Symptoms:
Low grade fever
Loss of hunger
Nausea
Vomiting
Stomach pain
Weakness

Diagnostic Test:
Blood test for presence of Hepatitis B virus

Spread through:
- Blood & Body fluids
- Multiple use of syringes, needles, razors, dental and surgical instruments
- Transfusion of blood

Prevention:
- Vaccination
- Single use of disposable syringes, needles etc.
- Proper disinfection of dental and surgical instruments
- Screening before blood donation

Typhoid

Cause:
Salmonella typhi bacteria

Symptoms:
High grade fever
Headache
Stomach pain
Weakness
Dizziness
Loss of hunger

Diagnostic Test:
Blood culture test for presence of typhoid bacteria

Spread through:
- Faecal oral route
- Ingestion of food/ drink contaminated with faeces/urine of typhoid patient

Prevention:
- Vaccination
- Wash hands properly after using toilet and before handling food
- Eat freshly prepared and properly cooked food
- Drink boiled/ bottled water

Activity 3.3 Learn about Dengue fever

Dengue fever is caused by dengue virus. This disease spreads through mosquito.

1. List five ways to reduce mosquitoes in your area.
2. Do you think everyone in your area should know about symptoms of dengue infection? If yes explain why.
3. Why it is important to keep dengue patients away from mosquitoes all the time?
4. Do you think scientists should focus on development of dengue vaccine? Why?
5. After development of dengue vaccine, what should be the next step of your government, hospitals and people of Pakistan?

Try it out

Make an infographic poster of any disease you had suffered in your life. Include the cause, symptoms, transmission and prevention of this disease.

Key Points

- Three various lines of defences protect the body against pathogens.
- Three types of immunity in humans are – innate, adaptive and passive.
- Innate includes first two lines of defences, adaptive is third line of defence and passive immunity is transferred in the body from outside sources.
- Adaptive immunity increases with exposure of pathogens or vaccines.
- We can help our immune system by adding additional layers of defence (such as wearing masks, using sanitizers, etc.).
- Pathogens including virus, bacteria, fungi and parasites cause infectious diseases.
- Healthy life style choices are common strategies for strengthening your immune system.
- Hepatitis A, B, C and D, COVID-19 and dengue fever are caused by viruses. Typhoid is caused by bacteria.
- If you know the symptoms of diseases, then your disease can be diagnosed.
- All infectious diseases can spread and their spread can be controlled by adopting specific measures.

UNIT 3 IMMUNITY AND DISEASES

END OF UNIT ASSESSMENT:

A. MCQs (Choose the correct option)

1. When the skin is damaged, bacteria enter in our body. Which line of defence is crossed by these bacteria?
   a. First line of defence b. Second line of defence
   c. Third line of defence d. Fourth line of defence
2. A new born baby has less immunity as compared to other people. The baby has only:
   a. Innate immunity b. Adaptive immunity
   c. Passive immunity d. Innate and natural passive immunity
3. The army of your body has special bullets which can identify the enemy and kill it. These bullets are small proteins called:
   a. Pathogens b. Antibodies c. Virus d. Bacteria
4. Third line of defence learns about the enemy and adapts accordingly. It is also called
   a. adaptive/ learned immunity. b. innate immunity.
   c. passive immunity. d. natural passive immunity.
5. Benish is allergic to dust and pollen. Her health issue is a/an
   a. infectious disease. b. disease due to pathogen.
   c. viral attack. d. non infectious disease.
6. Rabies is a very serious threat to health and life of a person. If a rabies infected dog bites a person, the only way to save him is by providing
   a. innate immunity. b. adaptive immunity.
   c. passive immunity. f. learned immunity.
7. Maximum number of additional defence layers is required for
   a. medical staff. b. teachers.
   c. students. d. lawyers.
8. Typhoid and polio spread by faecal oral route. If we want to prevent such diseases in our area we should
   a. control mosquitoes. b. control air pollution.
   c. improve hospitals. d. improve sanitation and hygiene condition.
9. Respiratory system related diseases mostly spread through
   a. water. b. food. c. blood. d. droplets in air.

10. Which of these can provide you with long term immunity against infectious diseases?
    a. Antibiotics b. Vitamins c. Vaccines d. Red blood cells

B. Short questions

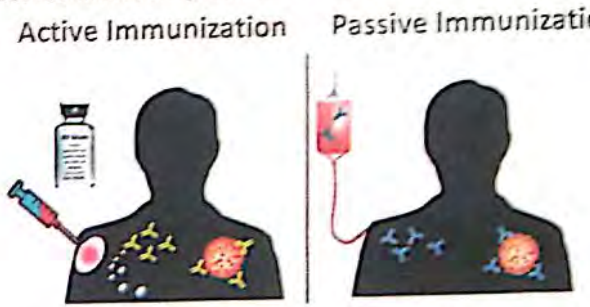
1. Which line of defence acts last in immune response? List its components.
2. Which line of defence is are not concerned with recognition of the pathogen intruder?
3. Some harmful chemicals can make you sick but chemicals are not included in the list of pathogens. Why?
4. Adaptive immune response increases with time. Why?
5. People throughout the world have become focussed on improving immune system from March, 2020. Why?

C. Long questions

1. Explain different types of immunity.
2. Explain the mechanism of antibody formation.

D. Structured response questions

1. Differentiate between active and passive immunization.



a. Which immunity is produced by a person's own immune system?

_____

b. Which type of immunity is provided by already prepared antibodies?

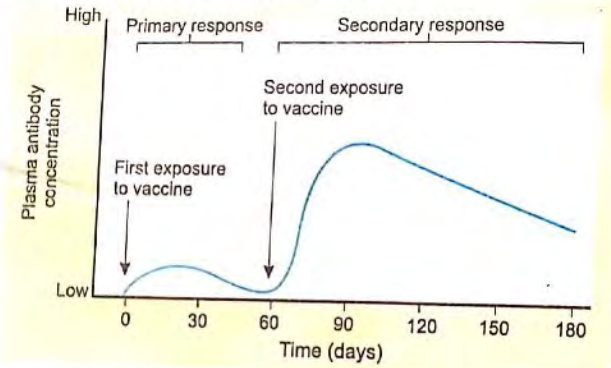
_____

c. Which type of immunity will protect for long period of time?

_____

UNIT 3 IMMUNITY AND DISEASES

1. The graph shows immune response after first and second dose of vaccination. Primary response is produced after first dose and secondary response is produced after second dose of vaccination. Analyse the graph and response.



a. Which response is capable of controlling disease effectively?

_____

b. Which response is slow to develop antibodies?

_____

c. What is the importance of booster dose of vaccines?

_____

d. What will happen if the pathogen of this disease enters in the body at day 90?

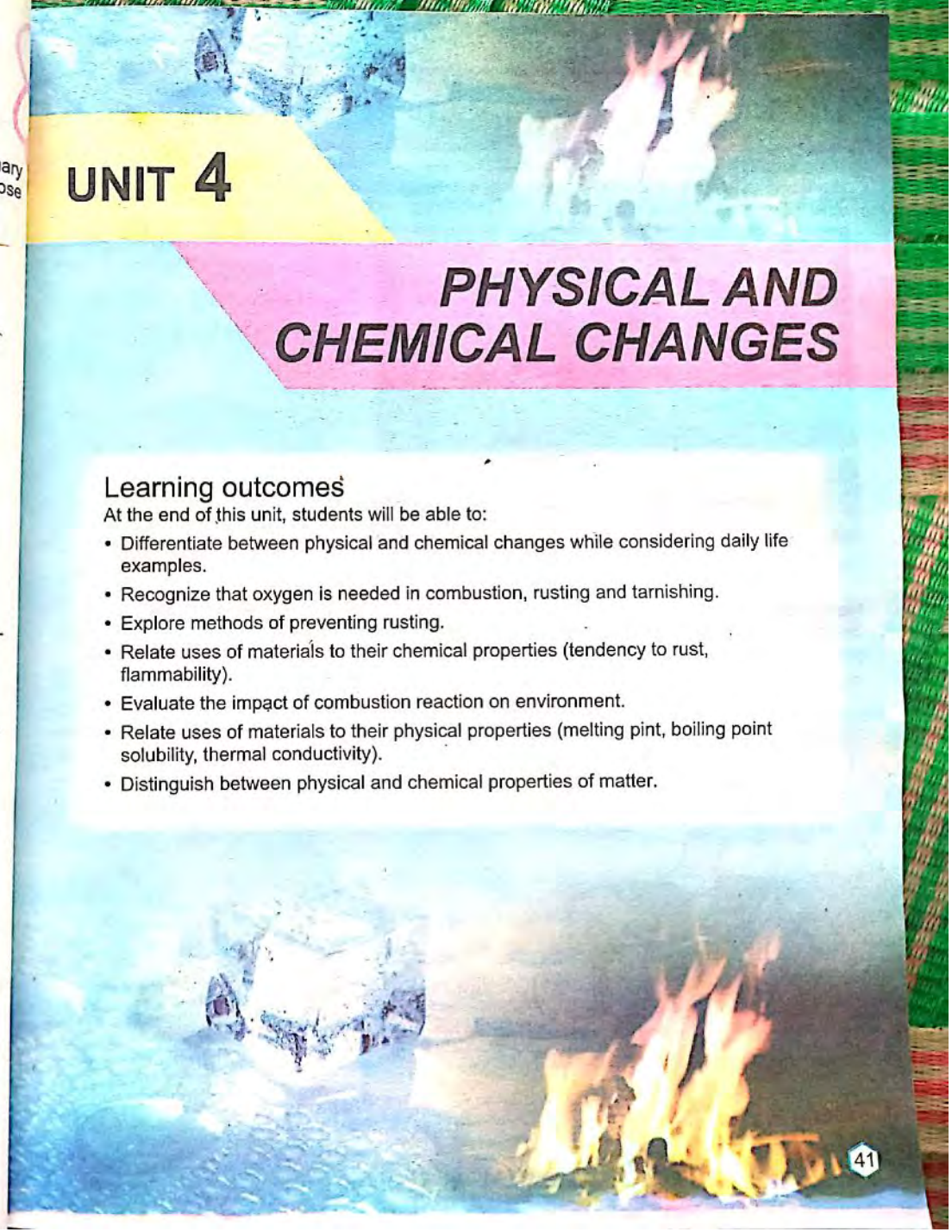
_____

e. What will happen if the pathogen of this disease enters in the body at day 0?

_____

E. Project work

Run a campaign to give awareness about different diseases in your surroundings.



UNIT 4 PHYSICAL AND CHEMICAL CHANGES

Learning outcomes

At the end of this unit, students will be able to:

- Differentiate between physical and chemical changes while considering daily life examples.
- Recognize that oxygen is needed in combustion, rusting and tarnishing.
- Explore methods of preventing rusting.
- Relate uses of materials to their chemical properties (tendency to rust, flammability).
- Evaluate the impact of combustion reaction on environment.
- Relate uses of materials to their physical properties (melting pint, boiling point solubility, thermal conductivity).
- Distinguish between physical and chemical properties of matter.

UNIT 4 PHYSICAL AND CHEMICAL CHANGES

The universe is made of matter and matter is constantly changing around us in one way or the other. Look at the picture below and see some changes.

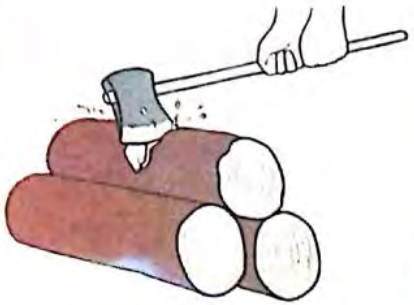
- wood is chopped,
- cooking over a fire,
- drinking,
- eating,
- burning.

Figure 4.1 Camping Site showing Physical and Chemical changes

Many activities take place around us where we can observe matter changing into other forms. Sometimes the changes can be reversed while sometimes the changes cannot be reversed. Do you think the burning of wood can be reversed?

There exist two types of changes in matter 1) Physical Changes 2) Chemical Changes

Physical Change



Chemical Change

Ashes

Figure 4.2 Physical and Chemical Changes

4.1 PHYSICAL CHANGES

Chopping of wood and melting of ice are examples of physical changes. In physical changes, no new substances are formed. When ice melts it changes its form from solid ice to liquid water which can be reversed by putting it back in a freezer. Similarly, when the wood is chopped, it is broken into smaller pieces and each piece is still wood. No new change has occurred. Cutting, tearing, grinding, shredding and mixing are examples of physical change because they change the form but not the composition of a material.

Figure 4.3 Examples of Physical Change

Add more examples of physical changes that you see around!

4.2 CHEMICAL CHANGES

Chemical changes take place only when matter changes to become an entirely different kind of matter. For example, when we burn wood it changes into two new substances: black smoke (gas) and ashes. Burning is also called **combustion**.

Formation of yoghurt and making of food by plant in the process of respiration are also examples of chemical change.

Figure 4.4 Examples of Chemical Change

UNIT 4 PHYSICAL AND CHEMICAL CHANGES

INTERESTING FACTS

Always remember: A new substance is always formed in a chemical reaction, because, the particles in the matter can be rearranged however, the mass of the matter will always remain the same.

Antoine Lavoisier was the scientist who recognised the discovery of the **law of conservation of mass.**

This law states that, "In a chemical reaction, the matter is neither destroyed nor created but it may be changed from one form to another."

Father of Chemistry: Antoine Lavoisier

Activity 4.1 Observe a chemical change

Materials Needed:

- A bottle
- vinegar
- baking soda
- a balloon
- a funnel

1. Place a small amount of baking soda in the balloon using the funnel.
2. Then pour vinegar into the bottle so it is about half full.
3. Carefully stretch the balloon around the top of the bottle
4. Allow the baking soda to drop into the bottle. Make sure to hold the top of the balloon so that it doesn't come off.

What type of change occurred? How do you know? What is inside the balloon?

Teaching Point: Make students aware of importance of conserving energy.

Combustion

Combustion is referred to what we call burning. We know that burning is a chemical reaction in which new matter is made. A more scientific definition of combustion would be "a chemical process where fuel (wood/petrol/oil) reacts with air (oxygen) to give heat and light energy. Combustion is used in cars, rocket engines and many other types of machinery.

Fuel + Oxygen → Carbon Dioxide + Water + Energy (heat and light)

Activity 4.2 Effects of combustion

Have a class discussion and talk about the effects of combustion on the environment. Also suggest ways to avoid combustion.

Harmful Effects of Burning Fuel

- **Complete Combustion / Burning**
  - Releases Unburnt Carbon Particles → Causes Asthma, Respiratory Diseases
  - Releases Carbon dioxide → Causes Global Warming
  - Releases Sulphur dioxide → Causes Acid Rain
- **Incomplete Combustion / Burning**
  - Releases Carbon monoxide → Poisonous Gas that Can kill people

Energy obtained by burning **fossil fuels** has revolutionized our lives but at the same time, it has an impact on the environment as we can see in the table shown above. ***Write a paragraph to judge the value and impact of combustion on the environment.***

UNIT 4 PHYSICAL AND CHEMICAL CHANGES

Figure 4.5 Rusting

We also observe that certain objects which are made of metals left in open decolour and develop rough edges. This happens because iron can easily get rusted and tarnished. Iron is hard and silver in colour but when it combines with air (oxygen) it becomes a different material called iron oxide which is reddish-brown and has rough edges. Can you write a word equation for this process?

How to prevent rusting?

Metals only rust when they are exposed to air. Think of the ways to protect the metal from exposure to air.

Figure 4.6 Rusting

A few suggestions are:

- Protect and do not allow any material made of metal to be left in open
- Apply a coating of another metal that does not get rusted easily, this is also called galvanizing
- Paint the exposed part of the metal object
- There are more ways to prevent rusting, can you add them to the list?

Tarnishing of silver

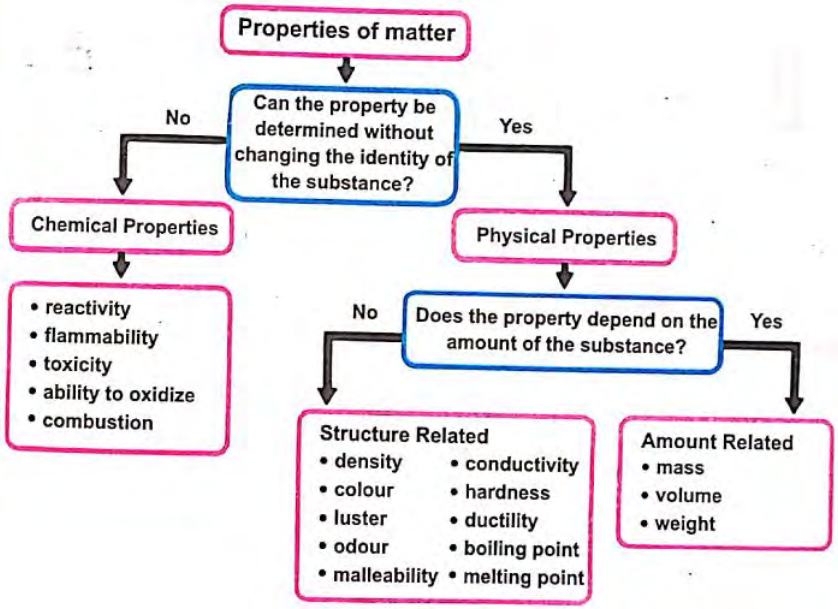
Figure 4.7 Silver Tarnishing

Silver objects get a black coating over time when they are exposed to air (i.e. polished silver articles gradually blacken). This is due to traces of hydrogen sulphide (H_2S) in the air, which reacts with a silver (Ag) to form black silver sulphide (Ag_2S)

The word equation for a chemical reaction is:

Silver + Hydrogen Sulphide + Oxygen ⟶ Silver Sulphide + Water

Chemical and Physical Properties of Matter



Matter can be put to use based on properties they have, there are two types of properties Physical and chemical. Every substance has certain physical and chemical properties.

UNIT 4 PHYSICAL AND CHEMICAL CHANGES

4.3 PHYSICAL PROPERTIES

Physical properties referred to the characteristics that can be observed or measured

Three states of matter

At room temperature most substances exist in one of three physical states

Figure 4.8 Matter in three States

Thermal Conductivity: It is the ability of a substance to conduct heat.

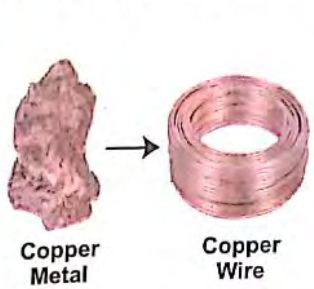
Activity 4.3 Thermal conduction

- Take three spoons of different materials: metal, plastic and wood
- Scoop butter in all three spoons
- Immerse the spoons in glasses with boiling water
- Record your observation

Where did you see the butter melt first? Why do you think this happened?

Ductility: ability to be shaped or drawn into a wire

Malleability: ability to be hammered in a sheet



What do you think why copper is used for making wire and gold is use for making jewellery?

Gold is the most malleable metal.

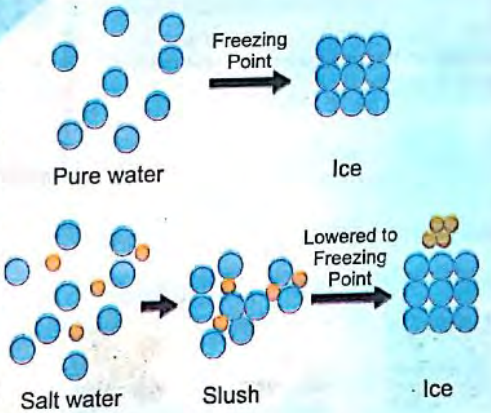
Figure 4.9 Malleability

Melting point is the temperature at which solid changes into liquid is called its melting point.

Boiling point is the temperature at which a liquid boils and converts into vapours.

Solubility is the maximum amount of solute that can be dissolved in a certain quantity of solvent at a particular temperature.

INTERESTING FACTS



In places where heavy snowing takes place, a salt solution is sprayed on the road, salt lowers the freezing point, therefore, making it difficult for water to freeze on the roads

Chemical Properties

A chemical property is a characteristic of a substance that may be observed when it participates in a chemical change. To identify a chemical property, we look for a chemical change. A chemical change always produces one or more types of matter that differ from the matter present before the change. The explosion of nitroglycerin is a chemical change because the gases produced are very different kinds of matter from the original substance.

A few examples of chemical properties are flammability, ability to rust, reactivity of many types.

Figure 4.10 Symbols showing flammability

Flammability is defined as how easily can a substance burn. When matter burns, it combines with oxygen and changes to different substances. Wood is an example of flammable matter however, chemicals like gasoline, acetone, diethyl ether, are hazardous as they ignite at moderate temperatures. You must have seen hazardous signs on certain places like petrol stations and on products like perfumes, sprays etc.

Iron, for example, combines with oxygen in the presence of water to form **rust** (Iron oxide).

Figure 4.11 Chemical Change

Some of the important symbols are shown below in figure 4.12.

Figure 4.12 Symbols

Key Points

- Changes in the matter: 1) Physical Change 2) Chemical Change
- Physical changes: No new substances are formed and be easily reversed
- Chemical changes: new substance are formed and cannot be reversed
- Burning is also known as combustion
- Burning and rusting are both examples of chemical changes
- Properties of matter can be categorised into physical and chemical properties
- Physical properties can be amount related i.e. mass, volume and weight
- Physical properties can be structure related like melting and boiling points
- Chemical properties include flammability, rusting etc.
- Flammability is the ability to catch fire easily.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. Which of the following is an example of physical change?
   a. Mixing baking soda and vinegar causes bubbles.
   b. Chopping of log
   c. Burning a paper with a lighter
   d. Baking a birthday cake for your mother.
2. Which of the following is an example of chemical change?
   a. Filling up a balloon with air.
   b. Freezing of water.
   c. Photosynthesis.
   d. Boiling of water.
3. Which change can be easily reversed?
   a. Chemical Change
   b. Physical Change
   c. Both physical and chemical changes.
   d. Neither a physical nor chemical change
4. When a new substance is formed with properties different from the ones it was formed
   a. chemical change.
   b. physical change.
   c. freezing.
   d. boiling.

UNIT 4 PHYSICAL AND CHEMICAL CHANGES

5. If the chemical properties of a substance remain unchanged and only the state changes it is called a
   a. chemical change. b. physical change.
   c. both physical and chemical changes. d. neither physical nor chemical change.
6. Which of the following is an example of a physical change?
   a. Metal rusting b. Silver tarnishing
   c. Boiling of water d. Burning of a paper
7. What best describes a physical change?
   a. Composition changes b. Composition stays the same
   c. State stays the same d. Mass is lost
8. Which of the following is an example of chemical change?
   a. Water freezes b. Wood is cut
   c. Bread is baked d. Wire is bent
9. Rusting can be prevented by
   a. scratching b. painting. c. washing. d. cleaning.
10. Milk turns sour, this is a
   a. physical change. b. chemical change.
   c. physical property. d. chemical property.

B. Short questions

1. Why is boiling of egg a chemical change and boiling of water is a physical change?
2. What is a chemical property?
3. Define the chemical property called rusting.
4. What is flammability? Identify examples of flammable matter.
5. Why silver gets tarnished after some time?

C. Long questions

1. Distinguish between physical and chemical changes. State with at least two examples from daily life.
2. Describe combustion with the help of word equation? Explain the harmful effects of combustion on the environment.
3. What is rusting? Suggest any three ways to prevent the rusting of iron.

D. Structured response questions

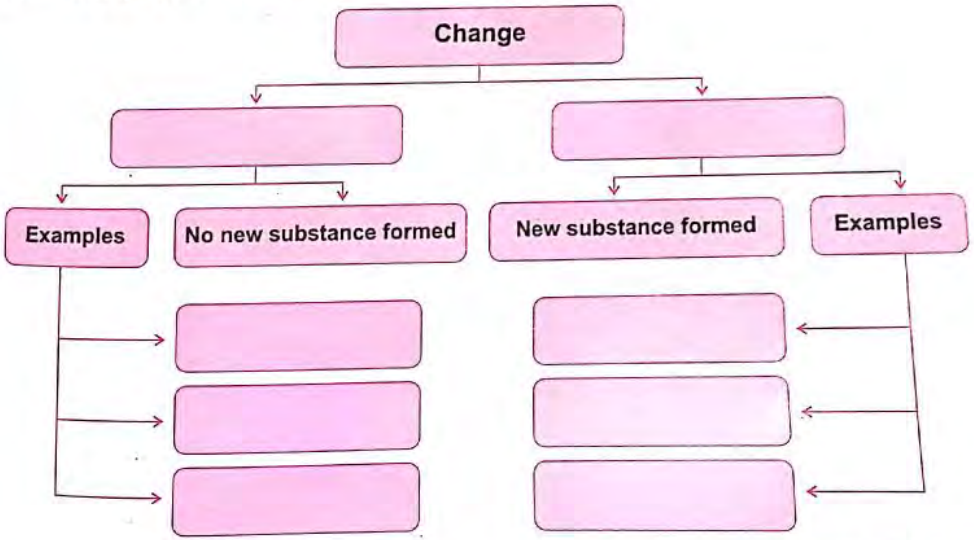
1. Why is the pan made of metal and handle of a plastic?

2. In the process of making chapatti, there are 3 steps from A to B to C
   Which stage is a physical and chemical change? Give your reasons also.

a. b. c.

Cooking on a tava/pan

3. Complete the following flow chart



4. When a candle is burned both Physical and chemical changes take place.
   a. Identify and explain the changes.
   b. Give another similar example where both physical and chemical changes take place.

5. During the process of digestion, proteins are broken down into amino acids and molecules (you must have read it in the chapter on digestion in grade 6)
   a. Is digestion a chemical change? How do you know?
   b. Identify the process in plants where a chemical change takes place, Justify your answer.

6. Combustion takes place in the internal combustion engine of a car. What burns in the engine to release energy for the car to move? Can it burn without air or oxygen?

7. Melting of butter is a change where a substance changes from a solid to a liquid state? Write a few more examples.

E. Project work

Make a poster to show comparison of physical and chemical change.

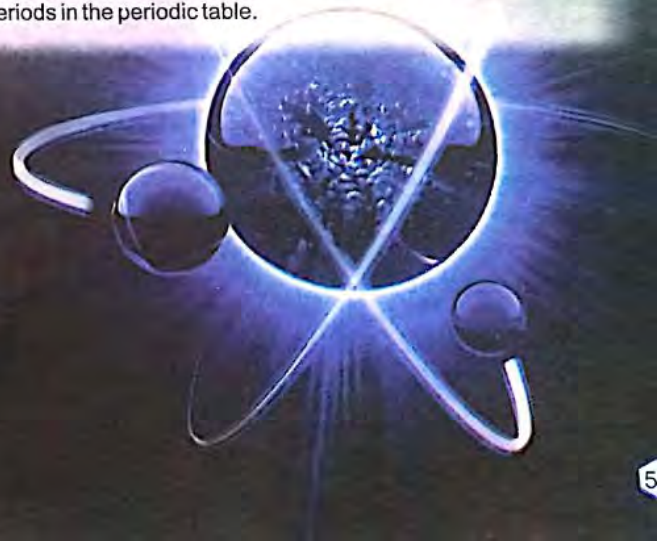
UNIT 5

STRUCTURE OF AN ATOM

Learning outcomes:

At the end of this unit, students will be able to:

- Describe and draw the structure of an atom in terms of electrons, protons and neutrons.
- Describe how an atom is electrically neutral.
- Differentiate between atomic number and mass number.
- Determine the atomic number and mass number of elements based on the number of protons, electrons and neutrons.
- Show the arrangement of electrons in K, L and M shells of elements.
- Draw the atomic structure of the first eighteen elements of the periodic table.
- Explain that the periodic table is a way to organize elements systematically.
- Recognize groups and periods in the periodic table.



UNIT 5 STRUCTURE OF AN ATOM

Let's see if you remember, what is a matter made of? Can you see an atom? Which is smaller; an atom or a molecule?

The matter is made of tiny particles called atoms. Just as a wall is made of small bricks, living organisms consist of cells and honeycomb is made up of smaller hexagonal cells. Element is a pure matter which has the same type of atoms and retains all of the chemical properties of that element. For example, a gold coin is made up of gold atoms put together in a shape of a coin.

5.1 STRUCTURE OF AN ATOM

An atom consists of two regions as shown in the diagram in the figure 5.1. The centre of the atom is called a nucleus. The nucleus contains protons and neutrons. Protons have a positive charge, whereas neutrons have no charge, means they are neutral. The second, much larger, region of the atom is a "cloud" of **electrons**. Electrons carry a negative charge and they orbit around the nucleus in fixed shells. Protons, neutrons and electrons are called subatomic particles.

The number of protons and electrons of an atom is always the same which makes an atom a neutral entity.

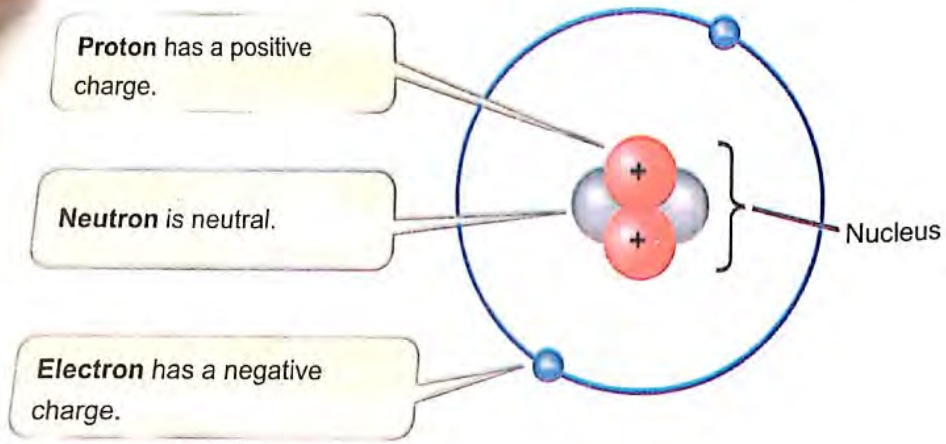
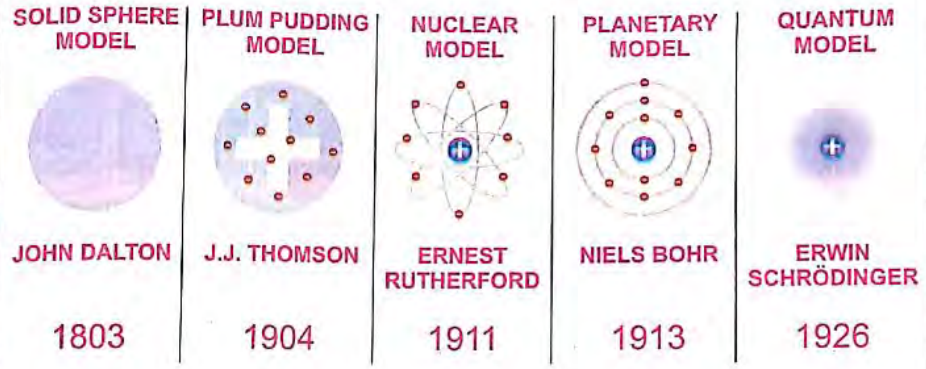


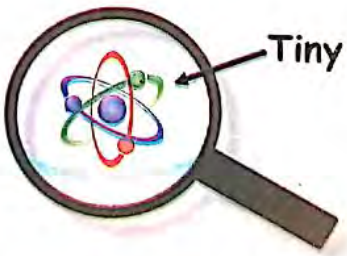
Figure 5.1 Structure of an Atom

Structure of an atom over the years

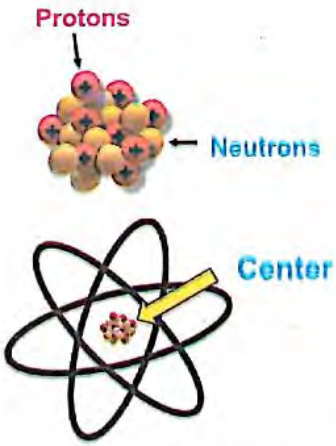


Atoms are present everywhere!

From your car to your bicycle, a ladder, a chair, your cat and even your boots!



They are tiny and cannot be seen with naked eye



They form the centre of the nucleus!

Figure 5.2 Picture Story of an Atom

UNIT 5 STRUCTURE OF AN ATOM

5.2 ATOMIC NUMBER

The number of proton(s) in an atom is called the proton number or atomic number and it is represented as Z. Atoms of different elements have different atomic numbers i.e., an element with 6 protons is a carbon atom, which means the atomic number of carbon is 6, similarly, the number of protons in oxygen is 8. In a modern periodic table, elements are arranged in order of increasing atomic numbers. The number of protons defines the identity of an element.

5.3 MASS NUMBER

The number of protons and neutrons together is the mass number of an atom and it is represented with the letter A. Both protons and neutrons are also called nucleons. For example, an atom of carbon has 6 protons and 6 neutrons. Thus, its mass number is 12.

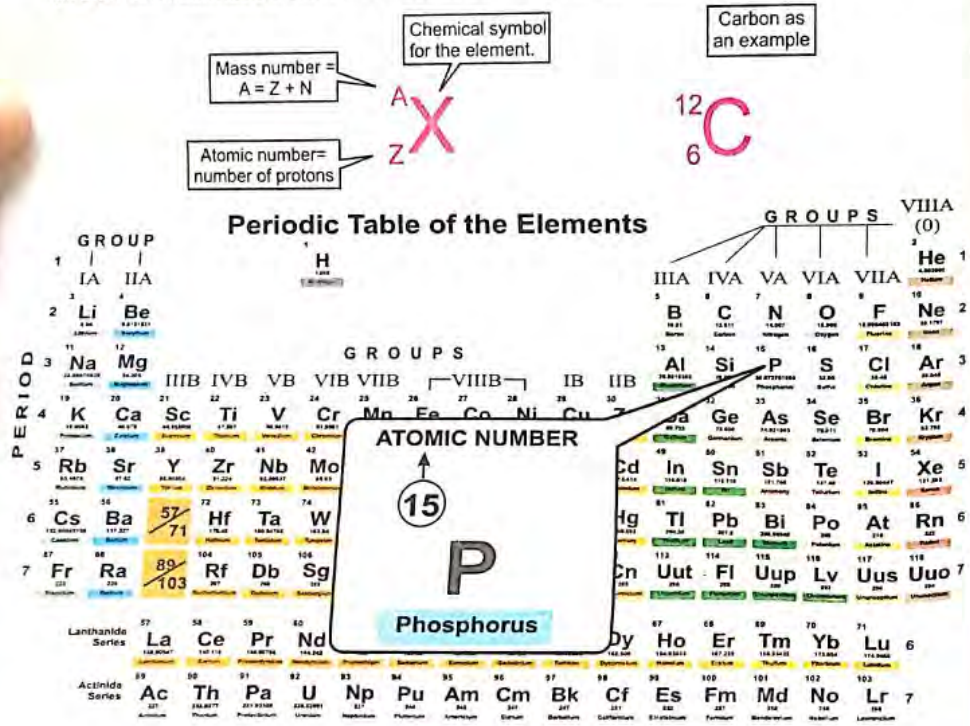


Figure 5.3 Periodic Table

Modern periodic Table

- Elements are arranged in increasing number of protons or we can say increasing atomic number.
- Horizontal rows are also called periods that show the same number of shells for the elements. There are 7 periods in the periodic table. Elements like Hydrogen and Helium are in Period-1 which mean they have one orbit of the electron. Elements such as Sodium and Magnesium, Aluminium, are in Period-3 meaning they have three electron orbits.
- Vertical columns are also called groups, there are 18 groups and they have different properties. For example, Group 18 has the noble gases – Helium, Neon, Argon, Radon, Krypton and Xenon which have low melting and boiling points, and they each are colourless, odourless, tasteless, and non-flammable. This group is called as low chemical reactive group.

Distribution of metals and non-metals in the periodic table is shown in figure 5.4:

Finding the Number of Protons

The number of protons in an atom is equal to the atomic number of the element. For example according to the periodic table, oxygen has the atomic number eight. The atomic number is placed above the element's symbol. It means it has eight protons.

Finding the Number of Neutrons

The number of neutrons in an atom can be calculated by subtracting the atomic number from the atomic mass. Both of these numbers can be found in the periodic table. The atomic number is listed above the symbol of the element whereas the mass number is placed below.

Number of neutrons = A-Z

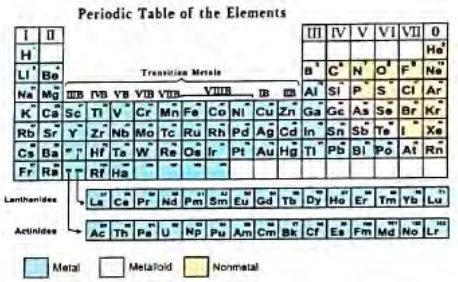


Figure 5.4 Periodic Table

Finding the Number of Electrons

The number of electrons in an atom is equal to the atomic number of an element. The number of electrons and the number of protons in an element are equal. Therefore, the number of electrons in oxygen is 8. These subatomic particles, electrons and protons, have opposite charges, they cancel out and keep the atom neutral.

Activity 5.1 Finding number of protons, electrons and neutrons

An atom has an atomic number 9 and a mass number 19.

1. Determine the number of protons, neutrons and electrons present in it

UNIT 5 STRUCTURE OF AN ATOM

5.4 DISTRIBUTION OF ELECTRONS IN SHELLS

Just like the way planets orbit around the sun, electrons also revolve in fixed circular paths around the nucleus in an atom. These fixed circular paths are called shells. The distribution of electrons in different shells is called electronic configuration.

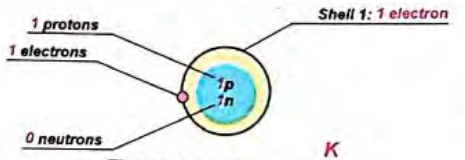
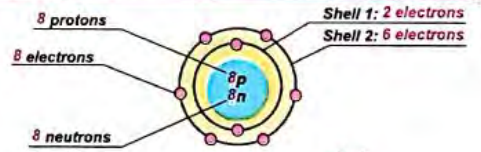
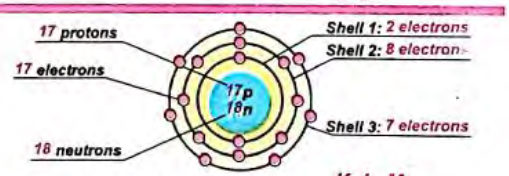
The distribution of electrons is calculated by a formula $2n^2$ where n is the number of the shells. The first three shells are called K, L, M and they are in order of increasing energy. For instance, the K shell is the first shell and it can hold up to $2(1)^2 = 2$ electrons. In the same way, L shell is the second shell and it can hold up to $2(2)^2 = 8$ electrons.

How many electrons do you think the M shell can hold?

Shell name	Shell number	Maximum number of electrons
K	n=1	$2 \times (1)^2 = 2x1 = 2$
L	n=2	$2 \times (2)^2 = 2x4 = 8$
M	n=3	$2 \times (3)^2 = 2 \times 9 = 18$

Name of element	Symbol	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Distribution of Electrons K L M
Hydrogen	H	1	1	-	1	1 - -
Helium	He	2	2	2	2	2 - -
Lithium	Li	3	3	4	3	2 1 -
Beryllium	Be	4	4	5	4	2 2 -
Boron	B	5	5	6	5	2 3 -
Carbon	C	6	6	6	6	2 4 -
Nitrogen	N	7	7	7	7	2 5 -
Oxygen	O	8	8	8	8	2 6 -
Fluorine	F	9	9	10	9	2 7 -
Neon	Ne	10	10	10	10	2 8 -
Sodium	Na	11	11	12	11	2 8 1
Magnesium	Mg	12	12	12	12	2 8 2
Aluminium	Al	13	13	14	13	2 8 3
Silicon	Si	14	14	14	14	2 8 4
Phosphorus	P	15	15	16	15	2 8 5
Sulphur	S	16	16	16	16	2 8 6
Chlorine	Cl	17	17	18	17	2 8 7
Argon	Ar	18	18	22	18	2 8 8

Composition of the atoms of the first eighteen elements

Atomic No	Protons, Neutrons and Electrons of the Elements	Atomic structure
1.	**Hydrogen** has **1** proton, **0** neutron and **1** electron	 Electrons arrangement: K 1
2.	**Lithium** has **3** protons, **4** neutrons and **3** electrons	 Electrons arrangement: K L 2 1
3.	**Boron** has **5** protons, **6** neutrons and **5** electrons	 Electrons arrangement: K L 2 3
4.	**Oxygen** has **8** protons, **8** neutrons and **8** electrons	 Electrons arrangement: K L 2 6
5.	**Chlorine** has **17** protons, **18** neutrons and **17** electrons	 Electrons arrangement: K L M 2 8 7

Teaching Point: Use PhET website or app research station to allow students to interact with virtual atom for practice

UNIT 5 STRUCTURE OF AN ATOM

DO YOU KNOW?

- Atoms of noble gases are less reactive and stable due to their complete outer most shells. The maximum number of electrons filled in the first shell is two. This is called the duplet. Helium has a duplet.
- The maximum number of electrons which can be filled in the second shell is eight. This is called octet. Neon (Atomic number= 10) has eight electrons in its outermost shell and has complete octet.

Key Points

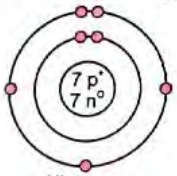
- An atom is made up of three subatomic particles protons, electrons and neutrons.
- An atom is electrically neutral. This means that in an atom the number of protons is equal to the number of electrons.
- Mass number of an element is the sum of the number of protons and the number of neutrons present in the nucleus.
- Atomic number is the number of protons in an atom.
- The distribution of electrons in their shells is called the electronic configuration.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. *Neutrons carry*
   a. no electric charge. b. positive charge. c. negative charge. d. unit charge.
2. *The smallest particle of an element is:*
   a. Molecule b. Atom c. Cell d. DNA
3. *Carbon has a mass number of 12. It has protons and neutrons:*
   a. 6,6 b. 12,6 c. 12,12 d. 6.12
4. The nucleus of an atom contains:
   a. Protons, electrons and neutrons b. Electrons and protons
   c. Protons and electrons d. Protons and neutrons
5. Protons carry:
   a. Positive charge b. Negative charge c. No charge d. Zero charge

6. The atomic number of an element tells the number of:
   a. Electrons and neutrons b. Protons only
   c. Protons and neutrons d. Neutrons only
7. If the atomic mass of nitrogen is 14, and it has 7 neutrons, how many electrons does a nitrogen atom have?
   a. 8 b. 6 c. 14 d. 7
8. The mass number of an atom is represented by
   a. A b. B c. Z d. M
9. Nitrogen is an element with the symbol N and the atomic number is 7. It's electronic configuration is represented as
   a. 2,5 b. 2,6
   c. 5,2 d. 2,2



Nitrogen

10. what is the sequence of the elements in the periodic table, $_3$Li, $_4$Be, $_2$He, $_7$N
    a. He, Li, Be, N b. N, Li, Be, He c. He, N, Li, Be d. N, He, Li, Be

B. Short questions

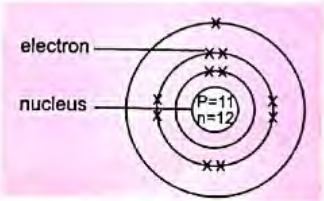
1. An atom has an atomic number of 8 and a mass number of 16.
   a. Determine the number of protons present in it
   b. Determine the number of neutrons present in it
   c. Determine the number of electrons present in it
2. Find the meaning of periodic from the dictionary. Explain the arrangement of elements into periods and groups in a periodic table.

C. Long questions

1. What is an atom? Describe the structure of an atom in terms of protons, neutron and electrons. Explain with the help of an example that atom is electrically neutral.
2. How is Periodic table a way to organize elements in a systematic manner? What are the rows and columns of the periodic table and how are they helpful.

D. Structured response questions

1. The diagram shown on the right is the structure of an atom.
   i. Recognize the atom.



ii. How many electrons are there in this atom?

_____

iii. What is the electrical charge on an electron? (Choose from: negative, neutral, positive)

_____

iv. Give the names to the different levels of the electrons around the nucleus?

_____

2. The nucleus of an atom contains two types of particles.

i. What are the names of these two types of particles?

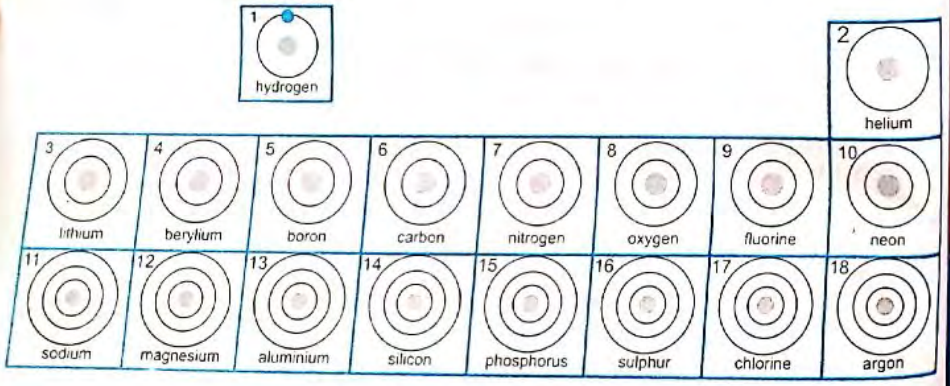
_____

ii. What is the electrical charge on the nucleus of an atom?

_____

3. With the help of given diagrams draw the electronic arrangement of first eighteen element showing the number of electron, protons and neutrons. Write the number of protons and neutrons in the nucleus and colour the electrons in blue colour.

for example



E. Project work

Design and build a 3D model of a specific atom of your choice showing the atomic structure (including protons, neutrons and electrons). The model must be free-standing and creative.

UNIT 6

CHEMICAL BONDS

Learning outcomes:

At the end of this unit, students will be able to:

- Define valency and explain the formation of ions.
- Write chemical formulae on the basis of valency of the constituent elements such as H_2O, NaCl, NH_3, CO_2, CO, etc.
- Recognize that a chemical bond results from the attraction between atoms in a compound and that the atoms' electrons are involved in this bonding.

UNIT 6 CHEMICAL BONDS

6.1 VALENCY

Have you ever thought why do elements combine?

Elements combine to form bonds. The combining capacity of the atom to form a chemical bond is called its valency. The Valency of an element is the number of electrons its atom gains, loses or shares, to form a compound. Valency is always in small whole numbers or zero. The elements which have zero valency do not form compounds.

Look at the table and observe, how compounds formed by using valency.

Elements	No. of valence electron	In forming a compound, the atom...	The valency of the element
Group I	1	Loses 1 electron	1
Group II	2	Loses 2 electrons	2
Group III	3	Loses 3 electrons	3
Group IV	4	Shares 4 electrons	4
Group V	5	Gains or shares 3 electrons	3
Group VI	6	Gains or shares 2 electrons	2
Group VII	7	Gains or shares 1 electrons	1
Group 0	8	Rarely form compounds, least reactive	Zero

STOP AND CHECK

- *Which group is likely to lose two electrons?*
- *The atomic number of Neon is 10. It is in group VIII A. What will be its valency?*

6.2 FORMATION OF IONS

You have studied that an atom loses or gains one or more electrons to form a compound.

An atom is a neutral particle. But, when an electron is added or removed from atom, it becomes a charged particle known as an ion.

An ion is a charged particle formed either by loss or gain of one or more electrons.

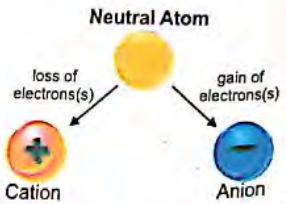


Figure 6.1 Formation of Ions

Formation of Cations (Losing electrons):

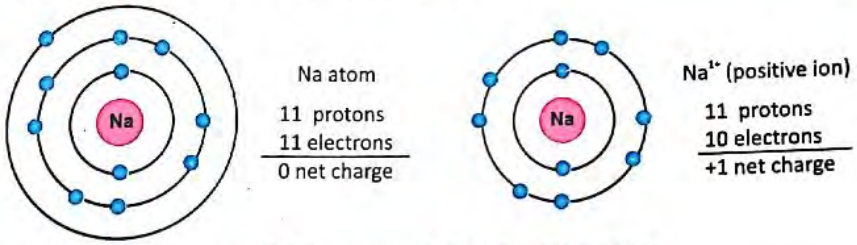


Figure 6.2 Formation of a Positive Ion (Cation)

Sodium metal loses an electron and becomes a positively charged ion called "cation".

For example:

Sodium atom (Na)	Sodium ion (Na^{1+})
Number of protons = +11	Number of protons = +11
Number of electrons = - 11	Number of electrons = - 10
Number of neutrons = 12	Number of neutrons = 12
Na →	Na^{1+} + e (loses 1 electron)

Formation of Anion (Gaining Electrons)

Chlorine gains an electron and becomes negatively charged ion called "anion".

For example:

Chlorine atom (Cl)	Chlorine (Cl^{1-}) ion
Number of protons = + 17	Number of protons = +17
Number of electrons = -17	Number of electrons = -18
Number of neutrons = 18	Number of neutrons = 18
Cl + e →	Cl^{1-} (gains 1 electron)

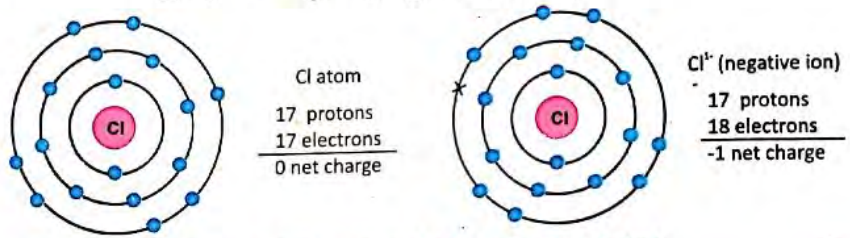


Figure 6.3 Formation of a Negative Ion (Anion)

Teaching Point: Here example of sodium and chlorine ions has been given. Teacher can give some more examples of cations and ions.

UNIT 6 CHEMICAL BONDS

Try it out

The elements hydrogen, lithium and oxygen can form ions. Draw their structures and predict the charge of the ion that each element forms:

Atomic number: Hydrogen: 1, Lithium: 3, Oxygen: 8

H	Li	O
Hydrogen ion	Lithium ion	Oxygen ion

STOP AND CHECK

What will be the charge on the atom that has gained three electrons?

6.3 CHEMICAL FORMULA

Every compound has a chemical formula. For example, the compound of sodium and chlorine is called sodium chloride. Chemical formula can also be determined by using the valency of an atom. The chemical formula is symbolic representation of the elements that are bonded together in a compound. Chemical formula is used to describe the types of atoms and their numbers present in a compound / molecule.

Steps for writing chemical formula:

1. Write down the symbols of the elements.
2. Above each symbol write its valency.
3. Cross the valency of both elements.
4. If the valency can be simplified, divide them by the least valency.
5. Write the chemical formula.

How to write chemical formula

1. NaCl
   Na: Group IA
   Cl : Group VII A

$$Na^{1} \times Cl^{1} = NaCl$$

2. H_2O
   H: Group IA
   O: Group VI A

$$H^{1} \times O^{2} = H_2O$$

3. NH_3
   N: Group VA
   H: Group I A

$$N^{3} \times H^{1} = NH_3$$

4. CO_2
   C: Group IVA
   O: Group VI A

$$C^{4} \times O^{2} = C_2O_4 = CO_2$$

Try it out

Identify the number of atoms in H_2SO_4 molecule.

Element	Hydrogen	Sulphur	Oxygen
Number of Atoms			

UNIT 6 CHEMICAL BONDS

6.4 CHEMICAL BOND

A chemical bond is a mutual attraction between the nuclei and valence electrons of different atoms that binds the atoms together. The valence electrons are involved in bonding of one atom to another. The attraction of each atom's nucleus for the valence electrons of the other atom pulls the atoms together.

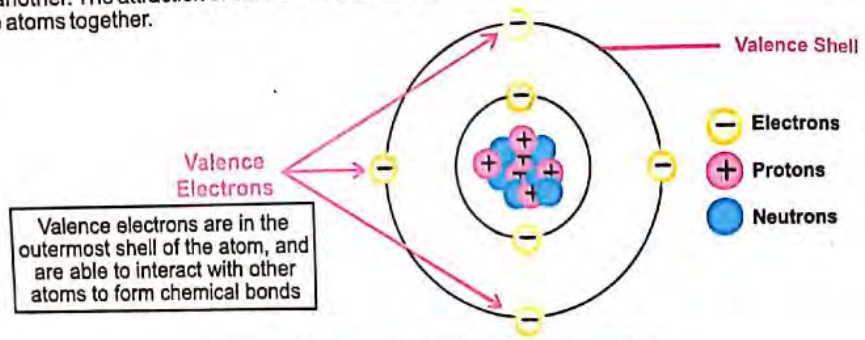


Figure 6.4 Valence Electrons in Outermost Shell

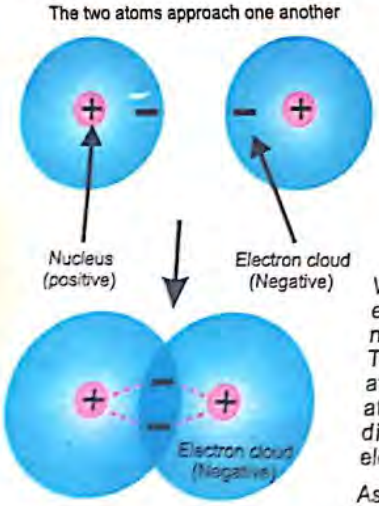


Figure 6.5 Formation of a chemical bond

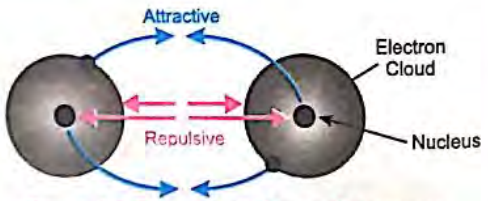


Figure 6.6 Electrostatic Force of Attraction between Two Atoms

When two atoms interact with each other, they experience a force of attraction. Electrons have a negative charge and the nuclei have positive charge. The nucleus of one atom attracts the electrons of other atom. When atoms comes close to each other both attractive and repulsive forces increases as the distance between the atom decreases. This electrostatic attraction holds the two atoms together.

As the attraction brings the atoms together, electrons from each atom are attracted to the nucleus of both atoms and form chemical bonds.

Key Points

- Valency is the combining capacity of atoms to form bonds.
- The chemical formula is the symbolic representation of the elements that are bonded together in a compound.
- Chemical formula can also be determined by using the valency of an atom.
- A chemical bond is mutual force of attraction between atoms that cause them to come together in a specific pattern to form compound.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. The valency of nitrogen is 3 and that of hydrogen is 1. The chemical formula of ammonia is
   a. NH b. NH_2 c. NH_3 d. NH_4
2. During the formation bonds, metals tend to:
   a. Gain electrons b. Lose electrons c. Gain protons d. Lose neutrons
3. Electrostatic attraction occurs between two
   a. neutral atoms. b. ions of opposite charges.
   c. ions of similar charges. d. bonded atoms.
4. The electrons involved in bonding are found in
   a. closest to the nucleus. b. in the nucleus.
   c. in the outermost shell. d. innermost shell.
5. An atom that has 6 out of 8 electrons in its outermost shell will
   a. give up 2 electrons. b. gain 2 electrons.
   c. give up 6 electrons. d. considered stable and not react with other elements.
6. A negative ion is formed when an atom has:
   a. Gained a proton b. Gained an electron
   c. Lost a proton d. Lost an electron
7. Aluminum oxide is formed from aluminum ion (Al^{3+}) and an oxide ion (O^{2-}). The formula of aluminum oxide is?
   a. AlO b. AlO_2 c. Al_2O_3 d. Al_3O_2
8. The atomic number of hydrogen atom is one. The number of valence electron in Hydrogen atom is
   a. 0 b. 1 c. 2 d. 3
9. The elements of group II loses
   a. one electron. b. two electrons. c. three electrons. d. do not lose electrons.

UNIT 6 CHEMICAL BONDS

10. A chemical formula is used to describe the types of:
   a. Ions and their numbers
   b. Atoms and their numbers
   c. Molecules and their numbers
   d. Valence electrons and their numbers

B. True or false (correct the statement if it is false)

1. Opposite charges attract each other.

2. Ions with same charges are held together by electrostatic force of attraction between them.

3. Chemical formula are used to describe the types of atoms only.

4. The combining capacity of an atom to form a compound is called its valency.

5. Chemical bond formed as a result of attraction between nuclei and valence electrons.

C. Short questions

1. Why the valency of group II elements is 2?
2. By using valency, write the chemical formula of carbon dioxide?
3. In the formation of an ion, why magnesium atom loses two electrons?
4. How could you relate the formation of chemical bond with valence electrons?
5. With the help of venn diagram compare and contrast between cation and anion.
6. Briefly explain the formation of chemical bond as a result of electrostatic force of attraction between atoms.
7. How are H^+ ion and O^{2-} ion different from each other?

D. Long questions

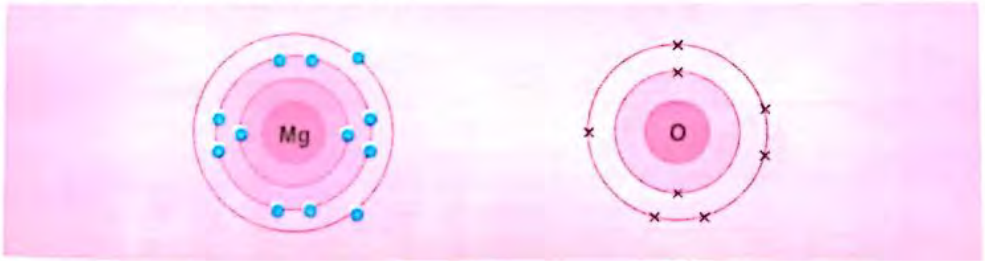
1. Write the steps for writing a chemical formula. Illustrate with few examples.
2. How chemical bond is formed? Explain in detail with the help of an example.

E. Structured response questions

1. Complete the table

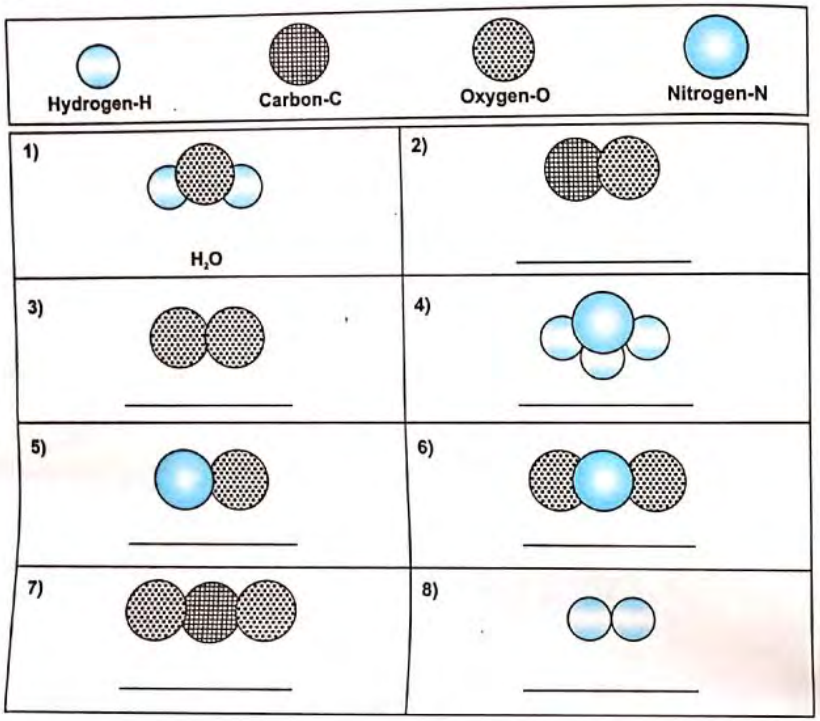
Element	Atomic number	Electronic distribution	Outer most electrons	In forming a compound the atom.....	Valency
Nitrogen	7	2, 5			
Beryllium		2, 2			
Neon	10	2, 8			
Magnesium		2, 8, 2			
Lithium	3	2, 1			
Helium		2			

2. Magnesium and oxygen react to form magnesium oxide (MgO). The electronic arrangement for the two elements is:



   a. Answer these questions about magnesium atom.
      i. Does it gain or lose electrons to form an ion?
      ii. How many electrons are transferred?
      iii. Is the ion form positive or negative?
      iv. What charge does the ion have?
   b. Now repeat (a), but for Oxygen atom.

3. The four circles below represent atoms of four common elements. Study these carefully and then write the chemical formula for each of the eight molecules shown in the chart. Water (H_2O), has already been done for you.



F. Project work

With the help of chart paper, colour markers and coloured play dough, make the model of the lithium atom and the lithium ion. Highlight the difference between them.

UNIT 7

SOLUTIONS

Learning outcomes:

At the end of this unit, students will be able to:

- Demonstrate the process of solution formation(using water as universal solvent).
- Distinguish among solute, solvent and solutions; saturated and unsaturated solutions.
- Define solubility.
- Recognize that the amount of solute which dissolves in a given solvent has an upper limit.
- Identify the factors which affect the solubility of a solute in a solvent and recognize the importance of these factors in homes and industries.
- Explain what is meant by a concentrated and dilute solution.
- Identify ways of accelerating the process of dissolving materials in a given amount of water and provide reasoning (i.e., increasing the temperature, stirring, and breaking the solid into smaller pieces increases the process of dissolving).
- Explore the effectiveness of various cleaning solutions in cleaning tarnished and oxidized coins. (STEAM).
- Make a rock candy with sugar using crystal seeding technique. (STEAM).

UNIT 7 SOLUTIONS

7.1 SOLUTIONS

In hot summer days, it feels refreshing to drink a glass of lemonade. Have you ever thought what lemonade drink is?

Lemonade is mixture of lemon juice and sugar. Sugar and lemon juice dissolve in water to form lemonade solution. A homogeneous mixture of two or more substances is called solution. Solutions are made up of two parts: solvent and solute

- The substance that dissolves and is present in less amount is called a solute.
- The substance in which the solute gets dissolved and is in greater amount is called a solvent.

In lemonade, water is the solvent. Sugar and lemon juice are solutes.

Following are example of solutions around us. Can you identify the solute and solvent in each solution?

Solution = Solute + Solvent

Lemonade = Lemon Juice & Sugar + Water

Figure 7.1 Solution and its Components

Tincture of iodine is an antiseptic made of iodine dissolved in alcohol

Air consists of oxygen, carbon dioxide and few noble gases dissolved in nitrogen

A fizzy drink is made up of carbon dioxide and sugar etc. dissolved in water

Gold jewellary is alloy of 80 % gold and 20% silver and some other metals.

Figure 7.2 Different types of solutions

Point to ponder?

Have you ever experienced the smell while passing through the kitchen during cooking?

In this example, there are two mediums, the air of the environment and the smell. Identify solute and solvent.

Try it out

Identify solvent and solute in the given solutions.

Solution	Solvent	Solute
 Chocolate milk	Milk	
 Jelly		Jelly crystals
 Vinegar		Acetic acid
 Sea water		

7.2 WATER AS UNIVERSAL SOLVENT

Water is a common solvent. The most valuable property of water is its ability to dissolve more substances than any other liquid. A solution in which water is used as solvent is known as an aqueous solution. Sugar solution, salt solution and mineral water are all aqueous solutions.

Can you give some other examples of aqueous solutions?

UNIT 7 SOLUTIONS

7.3 FORMATION OF A SOLUTION

When solute particles dissolves in a solvent, solution is formed.

In a solution, solute and solvent particles are mixed together. These particles are too small to be seen in a homogenous solution.

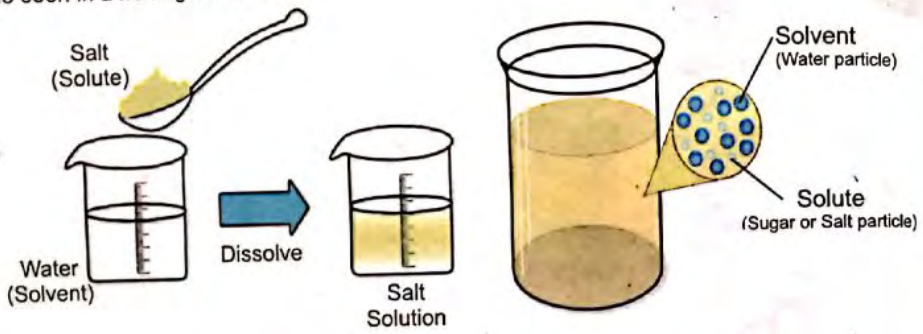


Figure 7.3 Formation of a Solution

In cooking, making tea, coffee or juice, washing our clothes or dishes and in many more activities we need to dissolve some sort of solute in a solvent. For example, in washing, it is important that soap or washing liquids get dissolved in water and in making a glass of orange juice, it is important that sugar and the juice of the orange to be dissolved in water.

DO YOU KNOW?

- *Turpentine as a solvent is used in the production of paints, inks and dyes.*
- *Water as a solvent is used in making of food, soaps and detergents.*
- *Alloys are solid solutions that are used in the manufacture of cars, aerospace and other vehicles.*

STOP AND CHECK

Smoke is an example of solution. Identify the solute and solvent.

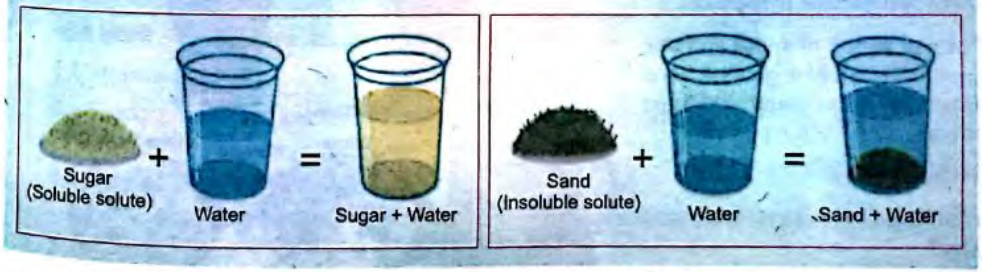
Activity 7.1 Solution around us

Solutions do not exist only in liquid state. Solutions can be formed in different states. Observe the types of solutions and examples. Identify the solutes and solvents.

Types of solution	Example of solution	Solute	Solvent
gas in gas	air (oxygen dissolved in nitrogen)	oxygen gas	nitrogen gas
gas in liquid	water (oxygen gas dissolved in water)		
gas in solid	hydrogen in Palladium	hydrogen gas	
liquid in gas	humid air (water dissolved in air)	water	air
liquid in liquid	alcohol (ethanol dissolved in water)	ethanol	
liquid in solid	dental fillings (mercury dissolved in silver)		silver
solid in Gas	smoke		air
solid in liquid	salt water (salt dissolved in water)	salt	
solid in solid	metal alloy (bronze has tin dissolved in copper	tin	copper

DO YOU KNOW?

A substance is soluble in water when it completely dissolves in water. Insoluble substance does not dissolve in water.



Teaching Point: Simple experiments in class can be performed for better understanding of concepts of different types of solution.

7.4 DILUTE AND CONCENTRATED SOLUTION

Add one spoon of salt in one glass of water and three spoon in another glass of water. What did you observe?

The proportion of solute and solvent in solutions is not same. The amount of solute in a given amount of solvent is called the concentration of a solution. Depending upon the amount of solute, a solution can be dilute and concentrated solution.

Dilute solution is one in which there is relatively small amount of solute dissolved in the solution.

Concentrated solution is one in which there is relatively large amount of solute dissolved in the solution.

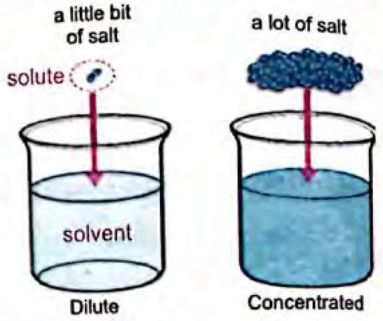


Figure 7.4 Dilute and Concentrated Solution

	Dilute Solution	Concentrated Solution
Description	A solution that has less solute dissolved in the solvent	A solution that has more solute dissolved in the solvent
Concentration	Less Concentrated	More Concentrated
Solute	Less Solute	More Solute

Activity 7.2 Investigate dilute and concentrated solution

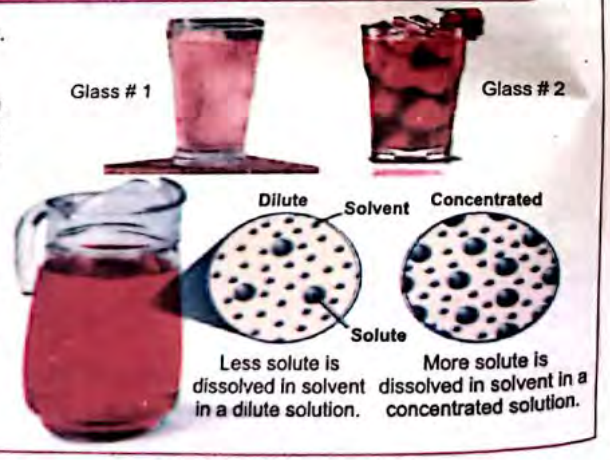
Sharbat is favorite drink of kids. Make two glasses of sharbat.

Put one spoon of sugar and one spoon of sharbat in glass # 1 and three spoons of sugar and three spoons of sharbat in glass # 2.

INVESTIGATE

Which glass is more tasty and why?

What is the effect of amount of solute and solvent on the sharbat?



Activity 7.3 Applications of solutions

Aim: The aim of this experiment is to investigate the effectiveness and applications of different solutions used in everyday life.

CLEANING COINS

In previous chapter you have learned the concept of tarnishing.

The oxygen in the air and the copper in the pennies form an oxide that coats the pennies and makes them tarnished.

The concentrated solution of different acids containing food items, remove the copper oxide layer from the penny.

THINK

Hypothesis?

What do you predict will happen? Which solution will work the best? Why?

Investigate: Work in a pair

- Do the coins become clean or do they remain tarnished?
- Which food items solution works best?

Solutions provided:

Here are some solutions used for cleaning coins.

1. Ketchup

Soak your pennies in ketchup to clean. The salt and acetic acid in vinegar will clean the tarnished coins.

2. Cola (Carbonated drink)

Cola will quickly remove the tarnish. Cola contains phosphoric acid that cleans the oxides.

3. Citrus Juice

Citric acid from citrus juice works similar to the other acids.

4. Vinegar and Salt

Solution of vinegar and salt takes the tarnish away.

UNIT 7 SOLUTIONS

Activity 7.3 Cont....

Ketchup Cola Lemon Vinegar Salt

Procedure:

1. Take four cups with different food item solutions.
2. Carefully record each coin's condition prior to placing it into its cup.
3. Place one coin into each solution.
4. Let all coins soak overnight.
5. Using the plastic spoons and latex gloves, scoop each coin out of its cup. Wash the coins thoroughly with water and place it on the covered table. Label each coin to keep track of which coin came from which solution.
6. Use the toothbrushes to clean the coins, rinse with water, re-examine the coins, and record your observations.
7. Examine the coins and record what you see before you start using the toothbrushes.

Share your Findings

When you have cleaned your tarnished coins, display your work and discuss it with another pair. Put forward one best thing you have done and one thing you need to improve the experiment.

STOP AND CHECK

A cup of coffee and cough syrup are examples of solutions. Inquire, what is the difference between these two solutions?

Coffee Cough syrup

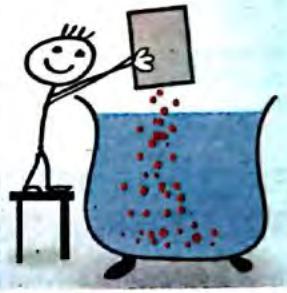
DO YOU KNOW?

DISSOLVING

Dissolving is the process that occurs when a solute is added to a solvent and the solute disappears.

SOLUBILITY

The solubility of a substance is the amount of substance that will dissolve in a given amount of solvent at a particular temperature.



7.5 SOLUBILITY

Solubility is the maximum amount of solute that can be dissolved in a certain quantity of solvent at a particular temperature. It is the limit of solute that can be dissolved in a given amount of solvent

How can you distinguish between unsaturated and saturated solution?

An unsaturated solution is a solution in which the solute has completely dissolved in the solvent leaving no remaining substance.

Whereas, a saturated solution is a solution in which the maximum amount of solute has been dissolved in the solvent at a given temperature.

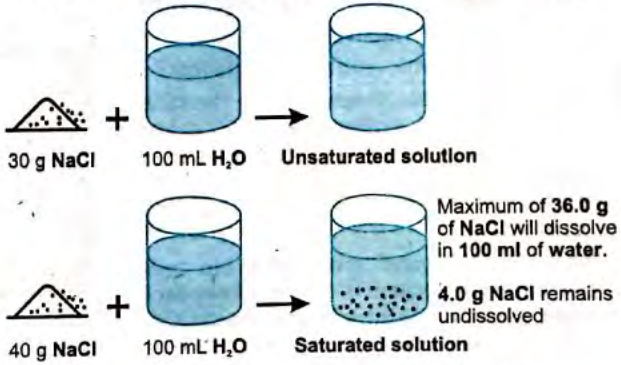


Figure 7.5 Saturated and Unsaturated Solution

When 30.0 g of NaCl is added to 100 ml of water, it all dissolves, forming an unsaturated solution. When 40.0 g is added, 36.0 g dissolves and 4.0 g remains undissolved, forming a saturated solution.

Food for thought:

Think of the word saturated as "full".

UNIT 7 SOLUTIONS

STOP AND CHECK

Adding washing powder in the washing machine is an example of dilute solution or concentrated solution?

DO YOU KNOW?

Medical solutions are important for treating dehydration and for cleaning and treating wounds. One class of medical solutions is known as saline solutions. These solutions are composed of water and sodium chloride. Normal saline is also used in management and treatment of dehydration.

7.6 FACTORS AFFECTING THE SOLUBILITY OF A SOLUTE IN A SOLVENT

Solubility of a solute in a solvent depends on:

- The nature of solute and solvent
- The temperature
- The pressure

How nature of solute and solvent affects the solubility?

What happens when you mix oil and water?

'Like dissolves like,' means that the chemical compounds with similar chemical features will dissolve in one another. The chances of solubility between two unlike substances are more challengeable than the like substances.

Figure 7.6 Oil in Water

Both oil and water are liquids but their chemical composition is different from each other. Water molecules attract each other and the oil molecules stick together.

It causes oil and water to form two separate layers. Water molecules pack closer together, so they sink to the bottom, leaving oil sitting on top of the water.

For example, the oil spills at sea can cover beaches with a thin coating of oil. Oil does not mix with water.

Have you seen the same separated layer on milk when oil is added?

STOP AND CHECK

Explore, the solubility of every substance is same or different?

How increase in temperature affects the solubility?

Why do you need to use hot water to dissolve sugar? More sugar can dissolve in hot water. This is because increase in temperature increases the solubility. The solubility of solute in a solvent typically depends on temperature. Generally, as compared to gases, liquids and solid have higher solubility in water at higher temperature.

Decrease in temperature ↓ Decrease in solubility

Increase in temperature ↓ Increase in solubility

Figure 7.7 Effect of temperature on solubility

Interestingly, the amount of solute which dissolves in a given solvent has an upper limit. More solute can be added to the saturated solution with an increase in temperature. This type of solution is stated as a **supersaturated solution.**

UNIT 7 SOLUTIONS

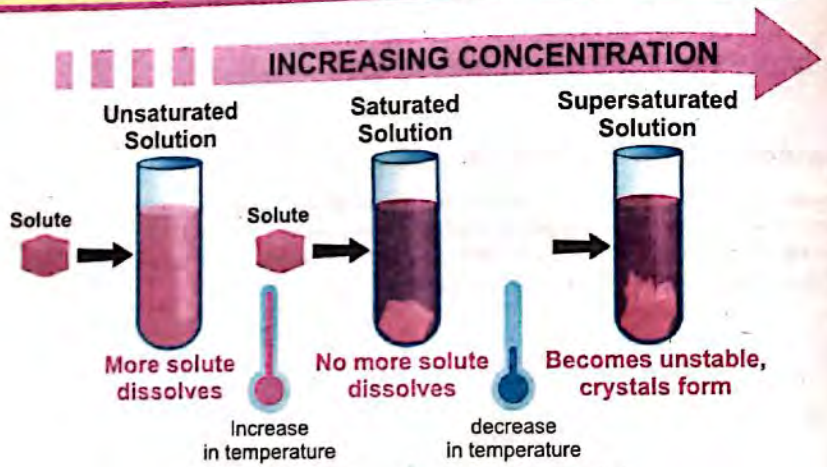


Figure 7.8 Formation of Supersaturated Solution

If the temperature is lowered, the solute becomes less soluble and crystals are formed. This process is called crystallization. Rock candy is made by this process.

Activity 7.4 Making of rock candy-crystal by seedling techniques

Rock candy is the best example of supersaturated solution. Rock candy is formed by allowing a supersaturated solution of sugar and water to crystallize onto a surface suitable for crystal nucleation, such as a string or stick.

Material Required

Water: one cup, sugar: three cups, a sauce pan, a spoon to stir, three glass jars, three different food colours some wooden sticks

Caution: The sugar/water solution is extremely hot. Please take care when mixing and pouring it.

Procedure: Boil one cup of water in a saucepan, add three cups of sugar and stir with a spoon until sugar dissolves. Then pour the solution into three different glass jars. Add few drops of a food colour in each jar to get coloured rock candies. Dangle wet wooden sticks first in the solid sugar crystals and then into the syrup and leave it for a few days. Recrystalization happens and rock candy forms. The solid sugar crystals form on the stick.

On the other hand, solubility of a gas in water tends to decrease with increase in temperature Gases have higher solubility at lower temperature.

Increase in temperature
↓
Decrease in solubility of gases
Higher temperature → Less gas dissolves

Decrease in temperature
↓
Increase in solubility of gases
Lower temperature → More gas dissolves

How increase in pressure affects the solubility?

Solubility of solids and liquids hardly gets affected by changes in pressure. However, in gases solubility increases with increase in pressure. Gases dissolve in liquids to form solution. Increasing pressure squeezes gas solute into solvent.

Gases have higher solubility at higher pressure.

Increase in Gas Pressure
↓
Increase in solubility

Decrease in Gas Pressure
↓
Decrease in solubility

Figure 7.9 Solubility of Gas in Liquids

For example: The solubility of carbon dixoide in water under normal atmospheric pressure is low, but when the water surface is subjected to higher pressure, a lot of CO_2 gas gets dissolved in it.

Have you ever noted, on opening the bottle of soda water, the dissolved gas rapidly bubbles out because the pressure on the surface of the water suddenly decreases.

UNIT 7 SOLUTIONS

DO YOU KNOW?

Acetone is a liquid solvent that can break down and dissolve other substances. Companies include acetone in products such as nail polish remover, paint remover and varnish remover. Some also use acetone to manufacture plastics, lacquers and textiles.

7.7 PROCESS OF DISSOLVING MATERIALS

The process of dissolving the solute in a solvent can be accelerated by increasing the temperature of solvent, by stirring the solvent after mixing the solute and by grinding the solute particles.

Temperature: Dissolving the solute can be faster by heating the mixture.

Figure 7.10 Temperature Increases the rate of Dissolving

Stirring: *Dissolving the solute can be speeds up by stirring the mixture. Stirring increases the rate of dissolving because it distributes the solute particles throughout the solvent.*

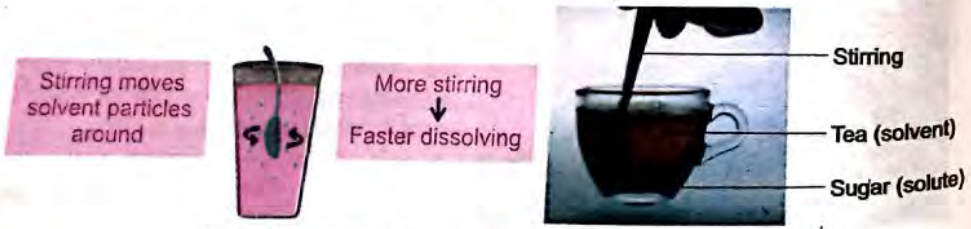


Figure 7.11 Stirring Increases the Speed of Dissolving

Grinding: The amount of solute dissolves faster when it is ground into smaller particles, rather than in large pieces. The process of dissolving can be faster by grinding the solute before it is put into the solvent.

Figure 7.12 Coffee Beans Dissolves Slower

Figure 7.13 Granulated Coffee Dissolves Faster

Key Points

- A homogeneous mixture of two or more substances is called solution. Solutions are made up of two parts: solvent and solute.
- The substance that dissolves and is present in less amount in solution is called a solute.
- The substance in which the solute is dissolved and is in greater amount in solution is called a solvent.
- A solution in which water is used as solvent is known as an aqueous solution.
- A dilute solution is one in which there is a relatively small amount of solute dissolved in the solution.
- A concentrated solution that contains a relatively large amount of solute.
- A saturated solution is a solution in which the maximum amount of solute has dissolved in the solvent at a given temperature.
- An unsaturated solution a solution in which the solute has completely dissolved in the solvent leaving no remaining substance.
- Supersaturated solutions are formed when more solute is added to saturated solution at a higher temperature, so as the temperature decreases, the solute comes out of the solution, forming crystals.
- Liquids and solid have higher solubility in water at higher temperatures as compared to gases.
- 'Like dissolves like,' means that the chemical compounds with similar chemical features will dissolve one another.
- Solubility of solids and liquids hardly gets affected by changes in pressure.
- In gases solubility increase with increase in pressure.
- The process of dissolving accelerates by increasing temperature, stirring and by grinding solute particles into small pieces.

UNIT 7 SOLUTIONS

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. The mixture of solid and liquid is called a solution. What is the liquid called?
   a. Solute b. Solvent c. Suspension d. Sediment
2. A solution containing less solute than its capacity to dissolve is:
   a. Saturated b. Unsaturated c. Supersaturated d. Aqueous
3. When the more solute is dissolved in saturated solution, the solution becomes:
   a. Saturated b. Unsaturated c. Supersaturated d. Dilute
4. In aqueous solution which of the following is most soluble solute?
   a. Oil b. Sugar c. Chalk d. Sand
5. Choose the most effective factor for increasing solubility in a solution.
   a. Grinding b. Stirring c. Heating d. Increasing pressure

B. Write true or false. (Correct the statement if it is false)

a. The substance in which the substance dissolves and is in greater amount is called a solute.

_____

b. The amount of solute which dissolves in a given solvent has no upper limit.

_____

c. Dissolving the solute can be faster by stirring the mixture.

_____

d. The chances of solubility between two like substances are more challengeable than the unlike substances.

_____

e. An unsaturated solution is a solution in which the solute has completely dissolved in the solvent leaving no remaining substance.

_____

C. Short questions

1. What is the difference between saturated and unsaturated solution?
2. Bilqees was preparing her morning coffee. She adds hot water and sugar to her coffee which fully dissolves and makes it sweeter to taste.

- Is her cup of coffee considered a solution and why?
- In the above scenario which one is the solute and which one is the solvent?

3. How increase in temperature speed up the dissolving process?
4. What happens when solution becomes supersaturated?
5. In gases, solubility increases with increase in pressure. Give a daily life example.
6. How do nature of solutes have an effect on the solubility?
7. Khushi added some olive oil to a cup of water. Why a layer of oil formed at the surface of water?
8. How increase in temperature effects the solubility of gases?

D. Long question

1. What is the effect of increasing temperature on the solubility of solid in liquids?
2. Explain the formation of saturated and super saturated solution.

E. Structured response questions

1. Look at the beaker of concentrated solution:

Concentrated Diluted

Amount of Solute = 10 ml	Amount of Solute = 10 ml
Amount of Solvent = 20 ml	Amount of Solvent = 40 ml
Colour = ?	Colour = ?

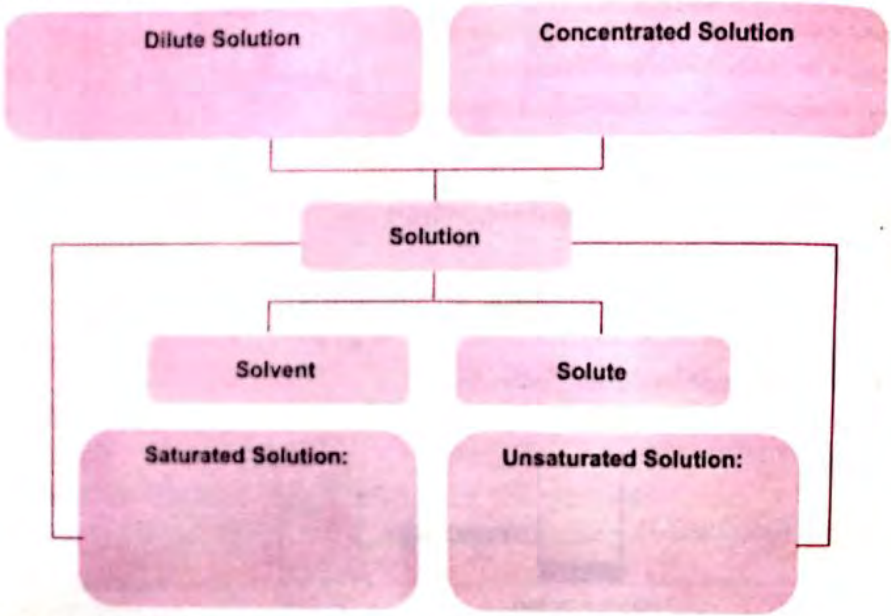
How will you change dilute solution to concentrated solution?

Diluted Concentrated

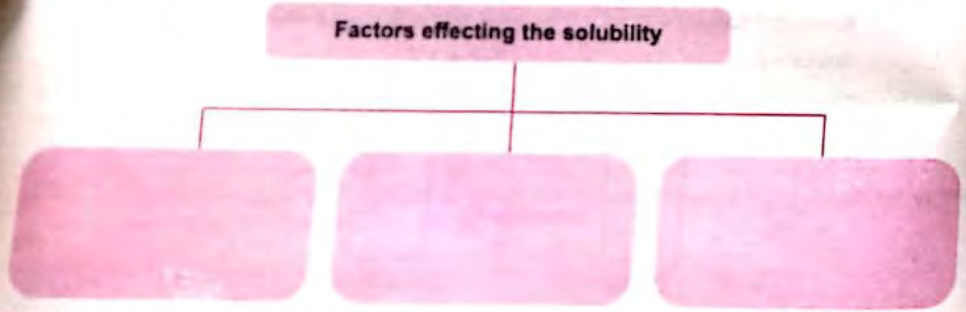
Amount of Solute = ?	Amount of Solute = ?
Amount of Solvent = ?	Amount of Solvent = ?
Colour = ?	Colour = ?

UNIT 7 SOLUTIONS

2. (a) Write the definitions in the empty boxes.



(b) Name the factors affecting the solubility and how these factors effect it.



F. Project work

- How to remove oil pollutants from water. e.g. by using sand, a cheese cloth, a spoon etc.
- Make a list of some solutions and find out their usage in daily life.

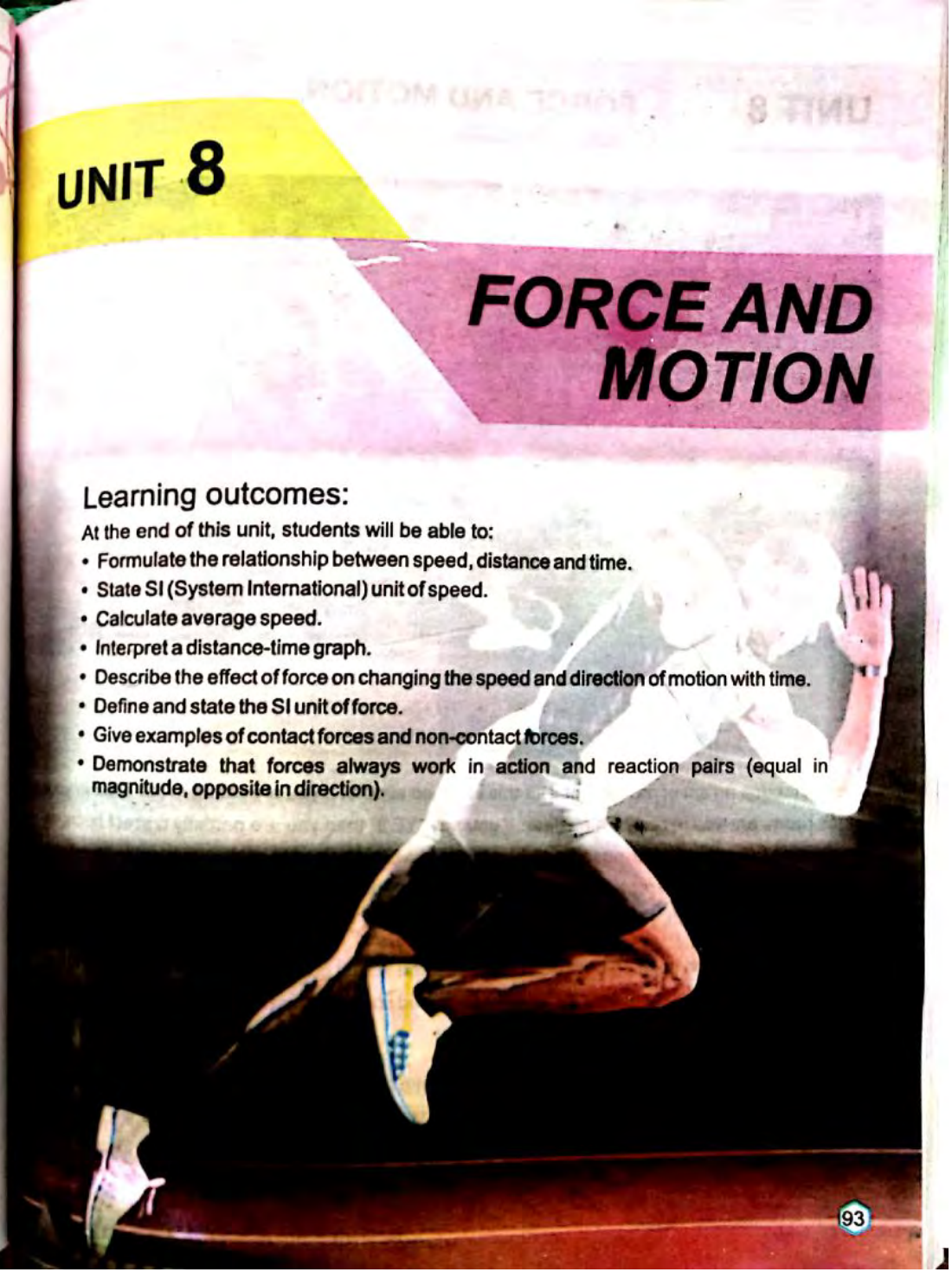
UNIT 8

FORCE AND MOTION

Learning outcomes:

At the end of this unit, students will be able to:

- Formulate the relationship between speed, distance and time.
- State SI (System International) unit of speed.
- Calculate average speed.
- Interpret a distance-time graph.
- Describe the effect of force on changing the speed and direction of motion with time.
- Define and state the SI unit of force.
- Give examples of contact forces and non-contact forces.
- Demonstrate that forces always work in action and reaction pairs (equal in magnitude, opposite in direction).



UNIT 8 FORCE AND MOTION

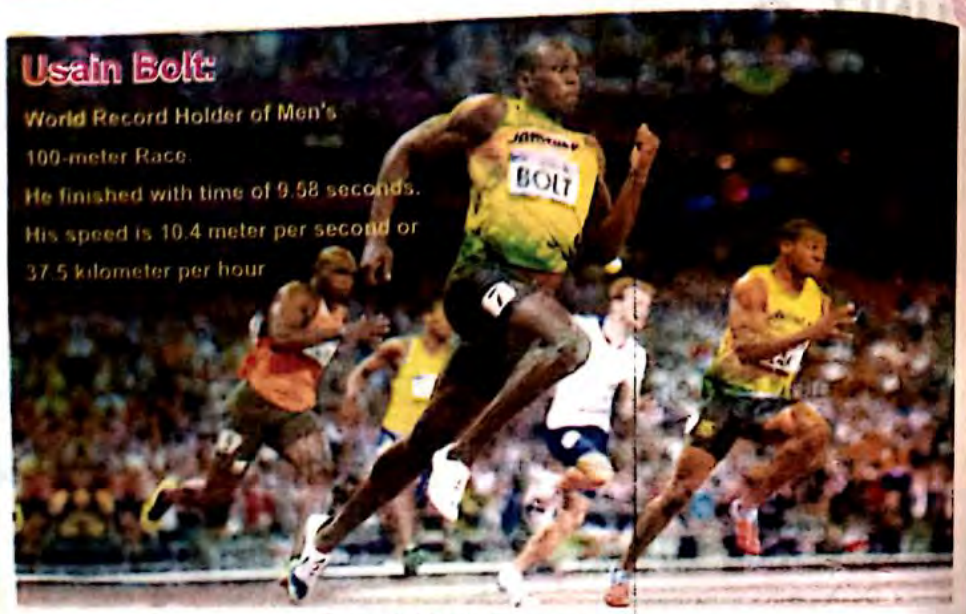


Figure 8.1 Fastest man on earth

Introduction

Motion means an act of movement. But this is not so simple. If you are sitting in the chair in your class room, are you in rest? Think dear. If you say "YES" then you are partially correct because you are not changing your position with respect to your class fellows and things in your class room. But you are not in rest if an astronaut observes you from space station because earth itself is in motion. As a result, your observer determines whether you are at rest or in motion.

If an object changes position between two points, the actual path covered by object is called its distance. The covered path may be straight or curved line. How fast it has traveled that distance is known as speed.

To move an object from rest or to stop a moving object, to speed up or slow down an object, you apply force on the object. To understand it in detail, we will discuss it in detail later in the unit.

IMAGINE THE SPEED:

Average speed of cheetah is 112 km/h

Average speed of bullet train in Japan is 500 km/h

Fastest ant Saharan Silver Ant
Average Speed is 3.1 km/h

A space rocket can hit speed of 40,000 km/h

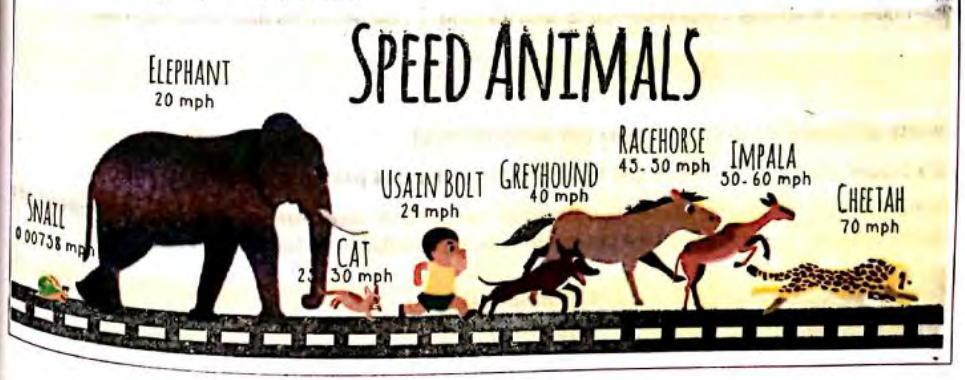


Figure 8.2 Imagine the speed

UNIT 8 FORCE AND MOTION

8.1 SPEED

Speed is how fast an object is moving. If a driver in a car and cyclist start their motion from the same point with their usual routine then you can see that car covers larger distance than cyclist in the same time. It means that car has greater speed than cyclist. Faster things covers greater distance than slower things in the same time.

Figure 8.3 Comparing speeds of cyclist and moving car

As you read on the last page that rocket can reach the speed of 40000 kilometers per hour, it means that it covers distance of forty thousand kilometers in just one hour. So, **we need to know two things to measure speed; distance and time.**

SPEED TRIANGLE

Distance = Speed x Time
Speed = Distance / time
Time = Distance / Speed

Definition: *Distance covered by an object in unit time is called its speed.*

Formula:

$$Speed = \frac{Distance}{Time}$$

- **Symbols** for speed is 'v', for distance 'S' and for time 'T'. So, we write above formula as:

$$v = \frac{S}{T}$$

Units of Speed: Its SI unit is **meter per second (m/s).**

It's bigger units are **kilometer per hour (km/h) and miles per hour (mi/h).**

When a body moves for some time then we calculate its **average speed. Average speed of a body is equal to total distance covered by body in total time taken by it.**

$$Average\ Speed = \frac{Total\ Distance}{Total\ Time}$$

INFORMATION

SI units stands for international system of units. Before SI units, there were different unit systems in use in different parts of the world e.g. length was measured in meter in America, in England foot was used and guz was used to measure length in our part of the world (Pakistan and India). Same quantity had different units in use in different parts of the world. With the developing world, it was becoming difficult for scientists and daily life business to run their work or business smoothly with different units. In short, it demanded a unanimous system of units for the whole world. Scientists held a conference on weight and measures held in Paris in 1960 and approved a world-wide system of measurements called International System of Units (SI units).

Let's understand this concept using example.

Example: You start your journey from your home in Islamabad to your village. You stop at rest area on motor way after covering 180 km. After a while you complete your remaining journey of 120 km. It took three hours to reach your village. Find your average speed.

Total distance of your journey (S) = 180 km + 120 km = 300 km

Total time taken by you (t) = 3 h

So, your average speed will be:

$$Average\ Speed = \frac{Total\ Distance}{Total\ Time}$$

$$\Rightarrow Average\ Speed = \frac{300\ km}{3h} = 100\ km/h$$

CONVERSION FORMULAE

1km = 1000 m

1 h = 60 min = 60 x 60 s = 3600 s

(From km/h to m/s)

$$1\frac{km}{h} = \frac{1000m}{3600\,s}$$

$$1\frac{km}{h} = \frac{5}{18}\frac{m}{s}$$

(From m/s to km/h)

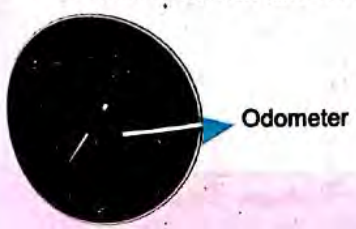
$$1\frac{m}{s} = \frac{3600\,km}{1000\,h}$$

$$1\frac{m}{s} = \frac{18}{5}\frac{km}{h}$$

DO YOU KNOW?

Speedometer of the car measures its speed at any instant of time (instantaneous speed). That's why speed on it changes from time to time

Odometer measures the distance covered by car



Odometer

Speedometer

UNIT 8 FORCE AND MOTION

STOP AND CHECK

A cyclist moves 20 km in east for 1 hour and 10 km in north for 30 minutes to reach finish line. Find his average speed in km/h.

Figure 8.4 Cyclist on track

DO YOU KNOW?

Look at this graph of a cricket match. This graph is between runs and overs of a team. Dots on the graph shows fall of wickets.

From the graphs

- Can you tell which team won the match?
- On 40th over, which Pakistani wicket number fell?
- Did India play all fifty overs?
- In which over, Pakistan completed 250 runs?

Figure 8.5 Runs-Overs Graph in a Cricket Match

8.2 DISTANCE – TIME GRAPHS

Graph: *"Graph represents relation between two or more quantities in the form of diagram."*

Graph has two perpendicular lines intersecting at the point which is called "origin". The horizontal line is called x- axis and vertical line is called y-axis.

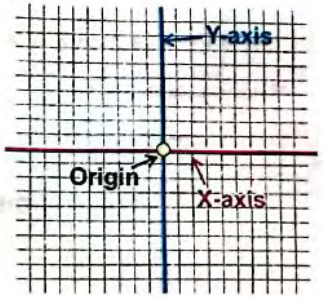


Figure 8.6 Graph with Axes

Distance – Time Graph:

In distance – time graph, distance is taken along y-axis and time is taken along x- axis.

When object is at rest (Speed = zero)

Consider a car is standing at 10 meter away from door for 5 seconds. Look at the data

Distance (meters)	10	10	10	10	10	10
Time (seconds)	0	1	2	3	4	5

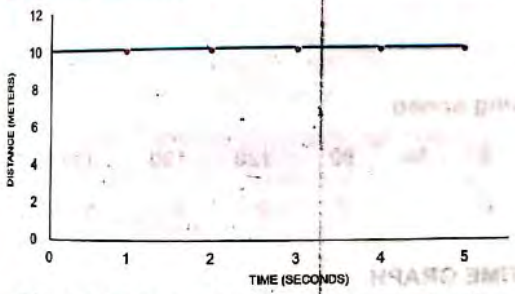


Figure 8.7 When object is at rest (speed = 0)

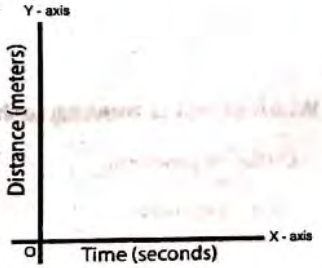


Figure 8.8 Axes of Distance Time Graph

Consider the car is moving with uniform speed. Look at this data in the table and graph

Distance (meters)	0	10	20	30	40	50
Time (seconds)	0	1	2	3	4	5

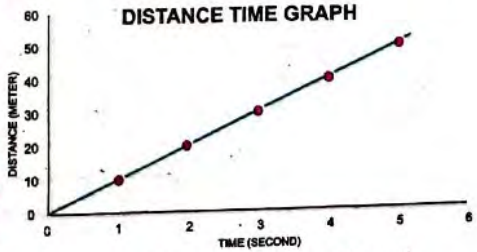


Figure 8.9 Uniform Speed

We see that car is covering equal distance of 10 meters in each second. Therefore, car is neither speeding up nor slowing down. It has constant speed.

UNIT 8 FORCE AND MOTION

When object is moving with increasing speed

Distance (meters)	0	10	30	60	100	150
Time (seconds)	0	1	2	3	4	5

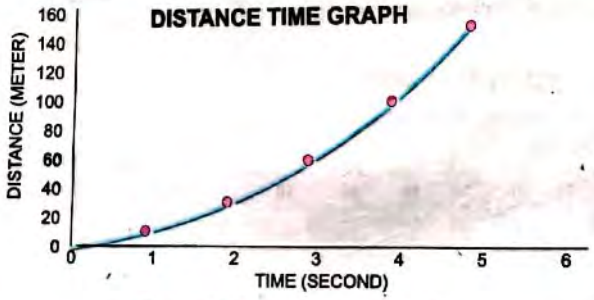


Figure 8.10 Increasing Speed

When object is moving with decreasing speed

Distance (meters)	0	50	90	120	130	135
Time (seconds)	0	1	2	3	4	5

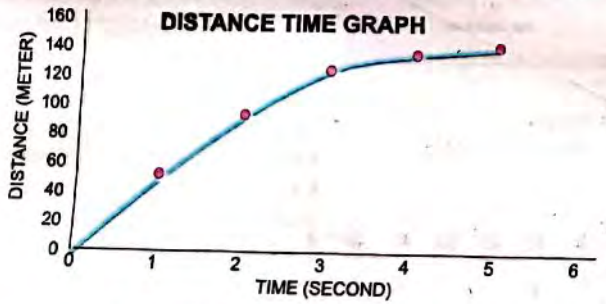


Figure 8.11 Decreasing Speed

Teaching Point: Teacher should ask different students to move between two points in the ground or in the classroom between walls. Ask other students with wrist watches to measure time of travel of students. In this way, build the concept of speed.

8.3 FORCE

When we push a trolley in a mall, we apply force on it. When we pull a string to tighten up the knot, we apply force on it. When we kick a ball to throw it in goal or when keeper stops it by hands, we apply force on it. When we push accelerator of the moving car, engine applies force due to which car speeds up. By applying brake, we slow down the moving car. We apply force to slow it down. There are many examples in which force acts on an object.

Figure 8.12 Force Changing State of Rest of Ball

Definition of Force:

"Force is an agent that pulls or push an object". It can change state of the body; rest body can be brought to motion and moving body can be brought to rest. It can speed up or slow down the moving object. It can change direction of motion of the body. It can change shape or size of the body.

Unit of Force:

Force has been given the unit after the name of great scientist " Sir Isaac Newton". So, unit of force is "newton" in SI units. It's symbol is 'N'.

Definition of newton (N) - unit of force:

"If a body of mass 1kg is pushed and its speed is increasing at rate of 1 m/s in each second then force applied on it has value of 1N."

Figure 8.13 Force Stopping the Ball

Figure 8.14 Force Changing Direction of Motion of Ball

Look at above figures. Ball falling straight down due to gravity and footballer kicks it to his front, this force changes direction of ball's motion almost perpendicularly.

Teaching Point: Apply force on ball or any other object to show that force speed up, stops and change direction of the ball.

UNIT 8 FORCE AND MOTION

8.4 CONTACT AND NON-CONTACT FORCES

Contact Force

"A force that acts only when there is physical contact between two bodies."

Kicking the football is a contact force. When a parachuter opens parachute then air resistance pushes it upward, so it is contact force. Other examples of contact forces are surface tension of liquid, air resistance, friction, upthrust of liquid, drag force, normal reaction force, muscular force etc.

Non-Contact Force

"Non-contact force is a type of force that acts on the object, without any physical contact with it."

Examples of non-contact forces are gravitational force i.e., weight of body, magnetic force between magnets and electrostatics force between charges.

Activity 8.1 Separate contact and non contact forces

8.5 FORCES AS ACTION AND REACTION PAIR

Sir Isaac Newton, in one of his laws, states that ***" Every action has equal but opposite reaction"***. Action and reaction are two forces. When a body applies action (force) on another body then second body applies an equal but opposite reaction (force) on the first body. Two equal and opposite forces acting on a body balance each other but action and reaction forces act on two different bodies so they can not balance each other.

We can understand this concept from following examples:

Throwing A Ball Against A Wall:

When you throw the ball against the wall, the force that ball applies on the wall is action. After striking the wall, ball comes back to you due to force exerted by wall on the ball is reaction.

You can see that action is on the wall but reaction is on the ball. Clearly action and reaction forces are acting on two different bodies.

Figure 8.15 Bouncing Back of Ball from Wall

Walking on The Ground:

To walk on the road, we push the ground backward as action and ground then pushes us forward due to reaction. It is how we walk on the ground.

Figure 8.16 Walking on the Ground

Teaching Point: Throw ball on the wall and help students to distinguish between action – reaction forces by this simple demonstration.

UNIT 8 FORCE AND MOTION

Balloon Rocket:

To make balloon rocket, inflate a balloon. Paste a straw and pass string through the straw. Tie both ends of the string with two supports. When air is released from the balloon as shown. Air releases with an action force in backward direction and balloon moves ahead due to reaction force as shown.

Figure 8.17 Motion of Baloon Rocket

Propulsion of Rocket:

When a rocket is fired, hot gases move out with action force and rocket moves forward due to reaction force.

There are many examples which show that action and reaction forces work in pair.

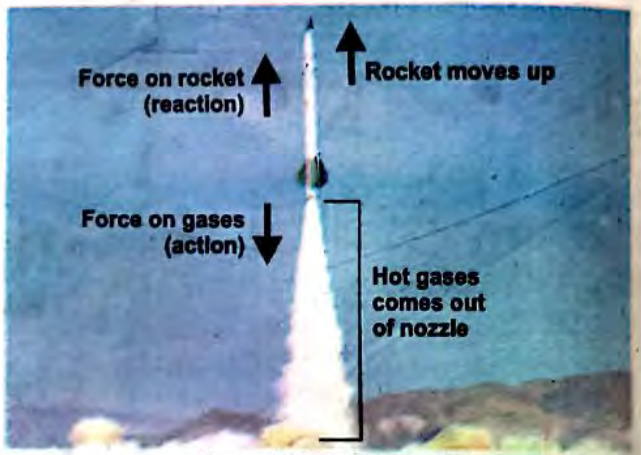


Figure 8.18 Rocket Propulsion

Now its your turn, Can you give some examples of action and reaction

Example 1:

Example 2:

Example 3:

Example 4:

Key Points

- Speed is how fast an object is moving.
- Distance covered by an object in unit time is called its speed.
- Graph represents relation between two quantities in the form of diagram.
- In distance – time graph, distance is taken along y-axis and time is taken along x- axis.
- Force is a quantity that pulls or push an object.
- In international system of units, unit of force is newton.
- Contact force that acts only when there is physical contact between two bodies.
- Non-contact force is a type of force that acts on the object, without any physical contact with it.
- Every action has equal but opposite reaction.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. SI unit of force is
   a. kilogram. b. centi-second. c. meter. d. newton.
2. By dividing distance of a moving body with time, we obtain
   a. speed. b. mass. c. gravity. d. force.
3. If a body moves for 10 seconds with speed of 30 m/s then its covered distance is:
   a. 30 m b. 3m c. 300 m d. 150 m
4. Which of the following animal has highest running speed?
   a. Horse b. Turtle c. Cheetah d. Silver ant
5. Every action has reaction equal in magnitude but
   a. opposite. b. perpendicular. c. parallel. d. anti-parallel.
6. Unit of speed is:
   a. N b. m/s c. kg m d. kg m/s
7. If a body covers equal distance in equal intervals of time then speed will be
   a. Increasing. b. decreasing. c. uniform. d. zero.

UNIT 8 FORCE AND MOTION

8. You draw distance-time graph for a moving car and get straight line parallel to time axis. Then speed of the car is

a. increasing. b. decreasing. c. uniform. d. at rest.

9. A person is swimming in a pool, swimming is an example of

a. action and reaction forces. b. friction. c. gravity. d. all of these.

10. Which of the followings is non-contact force?

a. Gravity b. Friction c. Spring force d. Tension is string

B. True and False (correct the statement if it is False):

1. Action and reaction forces never balance each other.

2. Action and reaction forces act on same body.

3. Force can change direction of motion of the body.

4. Distance-time graph of rest car is parallel to time axis.

5. Gravity is a non-contact force.

C. Short questions

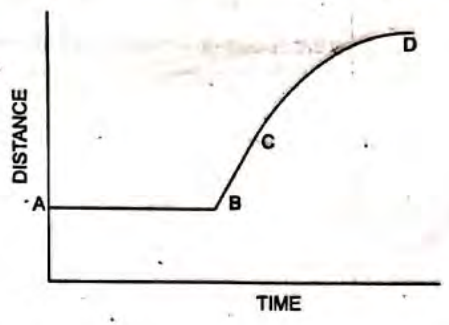
1. Define average speed. Write SI units of speed.
2. If a cyclist covers 15 kilometers distance in 1.5 hours. What is his speed in kilometer per hour (km/h) and in meter per second (m/s)?
3. Draw the distance time graph for increasing speed of the car?
4. A car is moving with uniform speed, driver apply brakes to slow it down after some time and finally stops. Sketch a distance time graph to represent this motion of the car.
5. Explain breifly, why action and reaction forces cannot cancel each other.
6. How do birds fly in the sky? Briefly explain with action reaction pair concept.
7. Define force and its SI unit.

8. Look at the distance - time Graph.

a) Which part is representing uniform motion.

b) Which part is representing decreasing speed.

c) Which part of body is at rest



D. Long question

1. Draw distance-time graph for (a) body a at rest, (b) with inform speed (c) moving increasing speed (d) decreasing speed
2. Define force and its unit. Give examples to explain different effects of forces on a body.
3. With the help of examples, show that forces act in pair.

E. Structured response questions

1. A car is travelling on the highway. Its distance and time is recorded at different intervals of time (see the table)

Time (second)	0	5	10	15	20	25	30	35	40
Distance (meter)	0	20	40	60	80	100	120	140	160

a) Draw distance-time graph for this car:

Distance-Time Graph:

b) Tell whether it has uniform speed, increasing or decreasing speed. Give reason of your selection

c) Draw the speed-time graph of this moving car.

Speed Time Graph:

2. A boy is standing on the skateboard in skating field and throws the ball as shown.

a) If there is no friction, Will the man move?

b) (If boy moves then) In which direction he will move? (in the direction of ball or opposite to it). Support your answer with reason.

c) Give an example that matches with the situation of the question?

F. Project work

Make the working model of water rocket to represent pair forces in action. (Read the material from google search and watch different youtube videos to make it)

UNIT 9

WAVES AND ENERGY

Learning outcomes:

At the end of this unit, students will be able to:

- Define a wave.
- Compare the types of waves (mechanical and electromagnetic) with daily life examples.
- Distinguish between Longitudinal and Transverse waves.
- Identify;
  - a. Water wave and Sound wave as mechanical wave
  - b. Light wave as electromagnetic wave
- Define the terms:
- Wavelength, frequency and time period of wave.
- Construct the inverse relation between time period and frequency
- Define and relate:
  - a. Pitch and frequency.
  - b. Amplitude and frequency.
- Explain the factors affecting pitch and loudness of sound.
- Compare and interpret waveforms in terms of pitch and loudness.
- Relate common phenomenon (e.g., echo, hearing thunder after seeing lightning) to the properties of sound.

UNIT 9 WAVES AND ENERGY

9.1 WAVES

"Wave is a disturbance or vibration in a medium which transfers energy from one place to another place without transferring the matter". Look at these figures showing different waves.

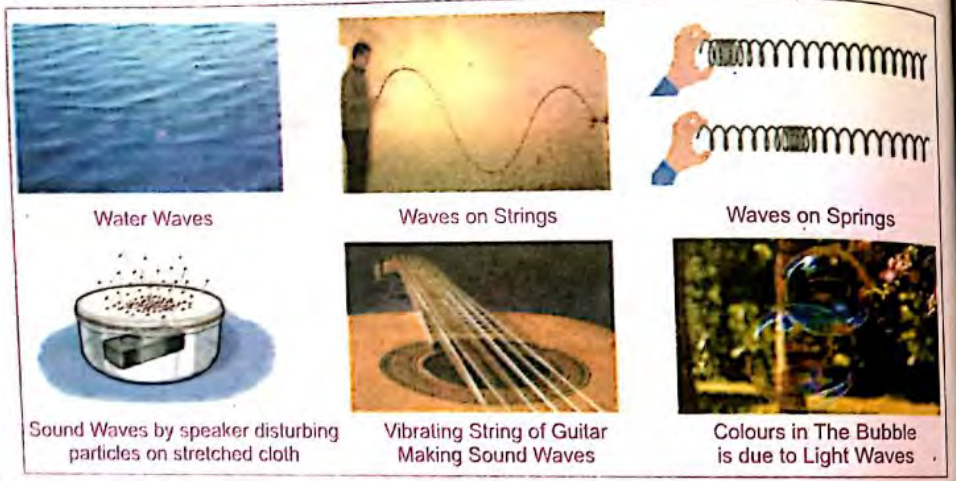


Figure 9.1 Different types of waves

If we disturb a medium e.g., (string, spring, water, air and particles of the medium) vibrate after disturbance then we have produced waves. When we drop a pebble in standing water of a pond, water disturbance i.e., water wave on its surface starts traveling away from point of disturbance. If we place a cork (light wood piece) on the water, we will see that it will vibrate on its position up and down when wave passes through it. But cork does not move with the wave (i.e. particles of medium only vibrate about mean position do not travel with the wave). Vibratory movement of the cork also shows that waves give energy to cork to vibrate it (i.e. waves carry energy).

Information:

Vibratory Motion:

It is to and fro motion of a body about it's mean position.

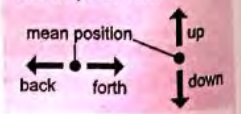


Figure 9.2 Pebble Dropped in Pond to Generate Water Waves

9.2 MECHANICAL AND ELECTROMAGNETIC WAVES

Some waves require medium and some waves do not require medium to travel. So, we can divide waves into two categories on the basis of medium.

Mechanical Waves: Waves which can only travel through a medium are called mechanical waves. For example, sound waves, water waves, seismic waves (waves due to earthquake) etc. Mechanical waves cannot pass through vacuum.

Electromagnetic Waves: Waves which can pass through vacuum as well as through medium, are called electromagnetic waves. For example, light, Infra-red waves, microwaves, x-rays etc. All electromagnetic waves travel with the speed of light in vacuum (i.e., 300000 kilometer per second).

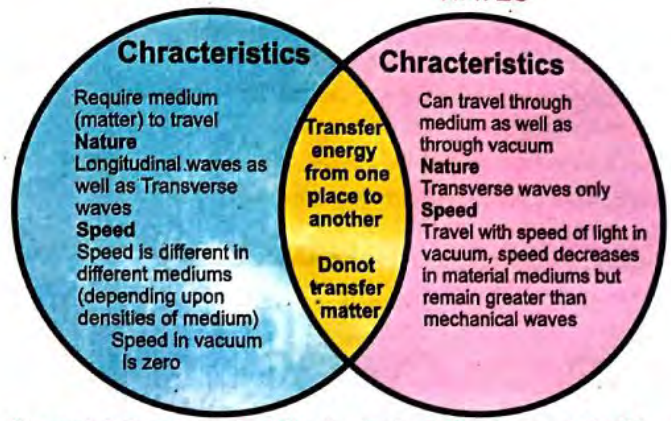


Figure 9.3 Comparison of Mechanical and Electromagnetic Waves

DO YOU KNOW?

Do explosions on the Sun produce only light, not the sound?

Huge explosions are happening at the sun continuously. Each explosion produces sound, light and heat. Light and heat from sun reaches us because light and heat travel in the form of electromagnetic waves. They do not require material medium for travel. On the other hand, sound is a mechanical wave that require material medium to travel. But there is vacuum between sun and earth. Therefore, sound is not heard on earth due to explosions on the sun.

Figure 9.4 Surface of Sun

UNIT 9 WAVES AND ENERGY

9.3 TRANSVERSE WAVES AND LONGITUDINAL WAVES

We divide waves in two types with respect to their nature. Transverse waves and Longitudinal waves.

1. TRANSVERSE WAVES:

Have you seen waves on the rope? Look at the figures. One end of the rope is tied to a wall and its other end is free. A man is wiggling the free end of the rope. Different particles of the rope are painted. When wave is moving from left to right on the rope towards the wall, the painted particles of the string do not move with the wave to the right but vibrate up and down as shown in figure 9.5 a and b. Such waves are called transverse waves.

"These are such waves in which particles of the medium vibrate perpendicular to direction of wave travel."

These waves travel in the form of crest and trough.

CREST OF WAVE: It is the portion of transverse waves above the mean position.

TROUGH OF WAVE: It is the portion of transverse waves below the mean position.

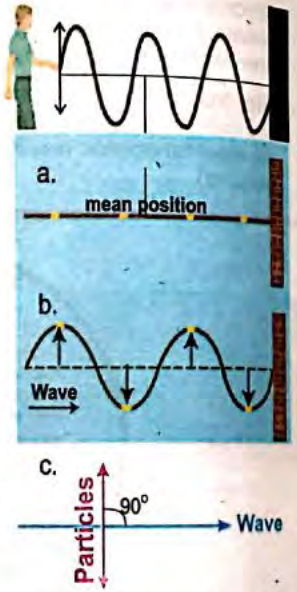


Figure 9.5 String Waves and Vibration of its Particles

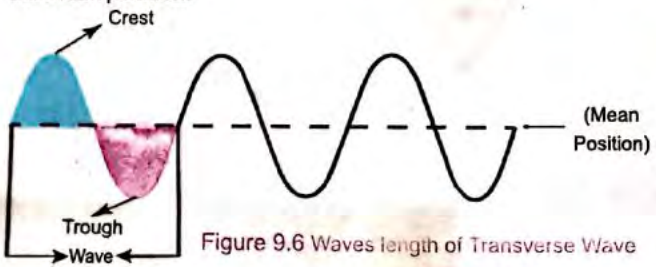


Figure 9.6 Waves length of Transverse Wave

Examples of transverse waves are string waves, water waves on the surface, slinky spring disturbed perpendicular to its alength produce transverse waves, Secondary waves (S-Waves) of earth quake etc.

STOP AND CHECK

One crest and one trough forms one wave or cycle. Can you tell that how many waves are there in figure 9.6

Teaching Point: Teachers should bring elastic string. Ask a student to hold one end of the string and teacher stretch at second end. When teacher wiggle the string, students will see waves. Help students to understand definition of waves. Show students vibration of string particles and transfer of energy.

2. LONGITUDINAL WAVES:

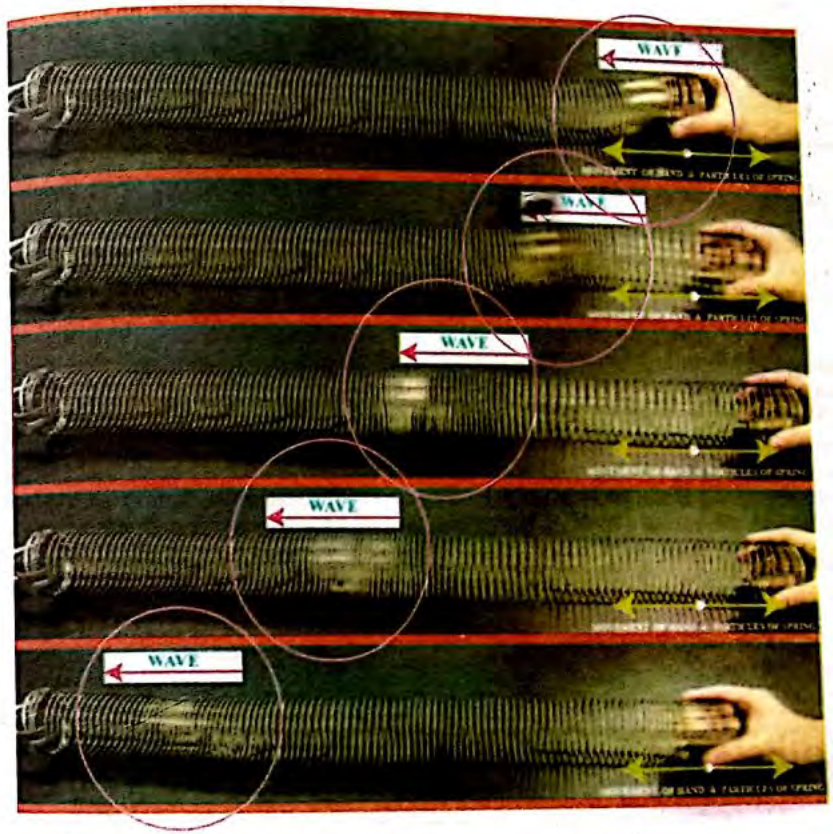


Figure 9.7 Longitudinal Waves in Spring

In above spring, when a person vibrates the spring back and forth then a disturbance i.e. wave (in the form of compression and rarefaction of loops) moves forward towards left along its length. We see that hand and particles (or loops) of the spring vibrate back and forth. It means that loops of the spring vibrate parallel to the direction of wave travel. Such waves are called longitudinal waves.

Teaching Point: Take a loose spring easily available for children play. Use it to demonstrate longitudinal waves.

UNIT 9 WAVES AND ENERGY

"Those waves in which particles of the medium vibrate parallel to direction of wave travel."

They travel in the form of compression and rarefaction.

COMPRESSION:

The portion of longitudinal wave in which particles of the medium are close to each other is called compression.

RAREFACTION:

The portion of longitudinal wave in which particles of the medium are spread out is called rarefaction.

Examples of longitudinal waves are sound waves, primary waves of earthquake, tsunami waves, slinky spring disturbed along its length produce longitudinal waves etc.

INFORMATION

Compression: It is the region of longitudinal waves of low volume, high density and having high pressure.

Rarefaction: It is the region of longitudinal waves of large volume, low density and having low pressure.

"Variation in density of medium is due to variation of pressure on its particles in longitudinal waves."

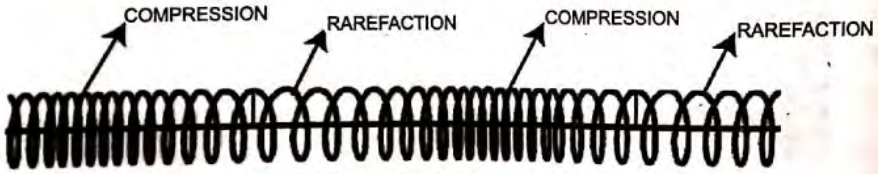
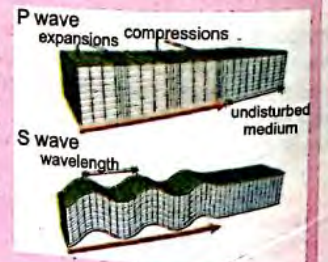


Figure 9.8 Longitudinal Waves in Spring

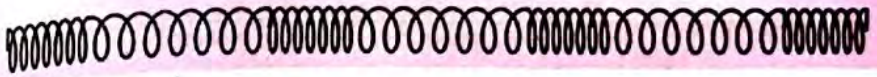
POINTS TO PONDER

Earthquakes generate both transverse and longitudinal waves. Since the longitudinal waves travel faster through Earth and reach seismographs (earthquake detectors) first, they are called primary or P-waves. Transverse waves travel much slower and are called secondary or S-waves. From the difference in the time of arrival of the two waves, seismologists can estimate the distance from the detector to the quake.



STOP AND CHECK

One rarefaction and one compression form one longitudinal wave. Can you tell that how many waves are there in the figure?



9.4 PROPERTIES OF WAVES

Wavelength: Length of one wave (or cycle) is its wavelength. It can be defined as:

"It is the distance between two consecutive crests or two consecutive troughs."

In SI units, unit of wavelength is meter (m). Although, for different waves, wavelengths might range from millimetres (mm) to kilometres (km).

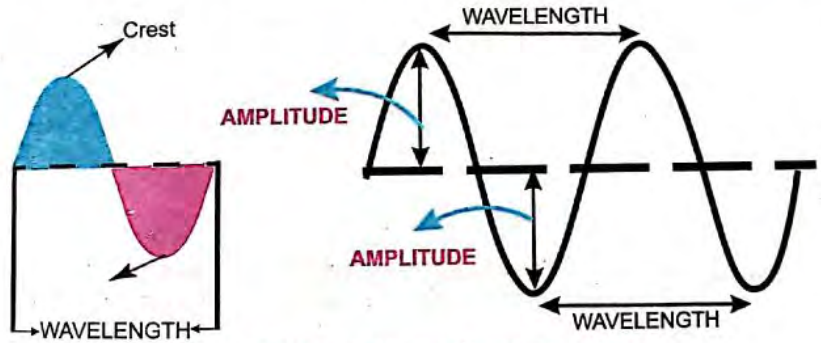
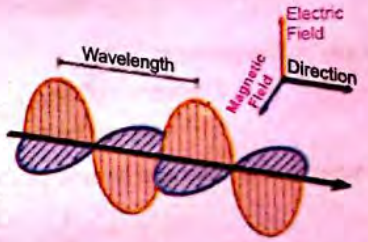


Figure 9.9 Waves length of Transverse Wave

DO YOU KNOW?

Electromagnetic waves like light do not require material medjum to travel. In these waves, instead of medium particles; electric and magnetic fields vibrate perpendicular to wave travel just like the particles in transverse waves. Therefore, electromagnetic waves are transverse waves



UNIT 9 WAVES AND ENERGY

FREQUENCY: *"Number of waves passing through a point in one second is called frequency of the wave."* In SI units, unit of frequency of waves is hertz (Hz) or number of waves per second. Its symbol is "f".

Formula:

$$\text{Frequency } (f) = \frac{\text{Number of waves passing through a point}}{\text{time taken by waves to pass through a point}} = \frac{n}{t}$$

TIME PERIOD: *"It is the time taken by a wave to pass through a point in the medium".* In SI units, its unit is second (s).

Formula:

$$\text{Time Period } (T) = \frac{\text{time taken by waves to pass through a point}}{\text{Number of waves passing through a point}} = \frac{t}{n}$$

AMPLITUDE: *"It is maximum displacement of vibrating particle of the medium from mean position when a wave is passing through it."*

Amplitude of the wave measures the energy carried by a wave. Greater the amplitude of the wave, greater will be energy carried by it and vice versa.

9.5 (A) RELATION BETWEEN FREQUENCY AND TIME PERIOD OF WAVES:

We know that

$$\text{Frequency } (f) = \frac{\text{Number of waves passing through a point}}{\text{time taken by waves to pass through a point}} = \frac{n}{t}$$

And

$$\text{Time Period } (T) = \frac{\text{time taken by waves to pass through the point}}{\text{Number of waves passing through the point}} = \frac{t}{n}$$

Multiply both equations:

$$\text{Frequency of waves } (f) \times \text{Time Period } (T) = \left(\frac{n}{t}\right)\left(\frac{t}{n}\right)$$

$$\Rightarrow (f)(T) = 1$$

Frequency of a wave and its time period are inverse of each other.

$$\Rightarrow f = \frac{1}{T} \quad OR \quad T = \frac{1}{f}$$

If waves have high frequency in a medium then it means that there are large number of waves (or cycles) in its small region. So, waves will have shorter wavelength. Therefore, short waves (more cycles) will pass through a point in small time with higher frequency and vice versa.

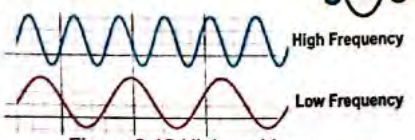


Figure 9.10 High and Low frequency waves

9.5 (B) RELATION BETWEEN AMPLITUDE AND FREQUENCY OF WAVES

AMPLITUDE: *"It is maximum displacement of vibrating particle of the medium from mean position when a wave is passing through it."*

Amplitude of the wave measures the energy carried by a wave. Greater the amplitude of the wave, greater will be energy carried by it and vice versa. In figure 9.11 (a), red waves has greater amplitude and greater energy as compared to blue waves.

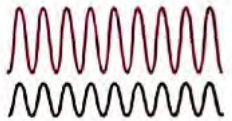


Figure 9.11 (a) Waves of different Amplitude

Frequency of Waves

"Number of waves passing through a point in one second is called frequency of the wave."

As we know that wave is a carrier of energy. Higher frequency wave means, it has greater number of waves passing a point in one second. Therefore, it carries more energy than lower frequency of waves.

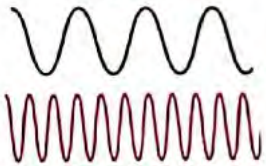


Figure 9.11 (b) Waves of different frequencies

DO YOU KNOW?

Loudness of sound depends upon amplitude of sound wave but does not depend upon its frequency. So, by increasing frequency of waves, their will be no effect on loudness of sound. (There is no as such direct relation between frequency and amplitude of the wave)

9.6 SOUND WAVES AND ITS PROPERTIES

When we beat the drum, pluck the strings of the guitar or hit anything, sound is produced. If we observe closely, we can see that surface of the drum and guitar strings will be vibrating on disturbance.

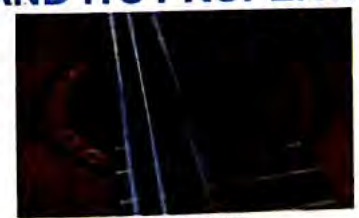


Figure 9.12 Vibrating String of Guitar

Figure 9.13 Vibrating Skin of Drum

Teaching Point: Place small pieces of paper on a table and hit table surface. Students will see that particles will vibrate on table surface. It will show that sound is produced by vibrating bodies.

UNIT 9 WAVES AND ENERGY

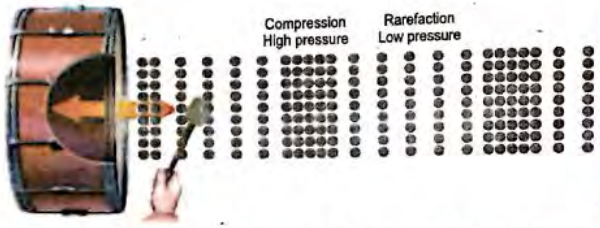


Figure 9.14 Longitudinal Nature of Sound Waves

DO YOU KNOW?

Vibrating body is compulsory for production of sound waves while medium must be required for propagation of sound.

"Sound is produced by vibrating bodies and sound waves travel away from vibrating body i.e., transfer energy from one place to another.

Sound waves are longitudinal waves. Consider the drum beaten by a drummer. Drum skin vibrates and disturb the air particles touching it. When drum skin moves towards right then it compresses the air particles by exerting pressure. These air particles hit the next particles, transfer energy to them and comes back to their previous position.

In the meantime, drum skin moves towards left, pressure on air particles decreases and they spread out. But the first disturbance keeps moving ahead due to constant collisions of air particles as shown. In this way, air particles keep on vibrating with the vibrating drum skin and sound wave keep on moving ahead. We conclude that air particles vibrate parallel to wave travel, so sound is a longitudinal wave.

DO YOU KNOW?

While we are talking, if we place our hand softly on throat, we can feel vibrations. These are our vocal cords which vibrate and produce our voice.

PITCH OF SOUND: Children and girls have shrill voice and males have grave voice usually. In figure 9.15 two sound waves of different frequencies are shown.

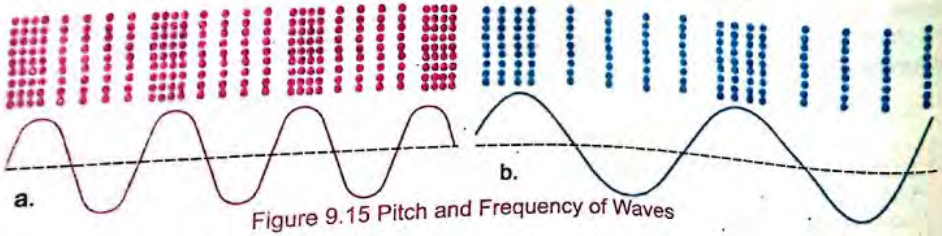


Figure 9.15 Pitch and Frequency of Waves

These are sound waves with different pitch. It can be seen that frequency of sound is greater in red graph than in blue graph. Shrill sound has greater frequency (higher pitch). Grave sound has lower frequency (lower pitch). So, we can say that figure 9.15 (a.) shows slightly higher pitch sound than the figure 9.15 (b.).

Definition: *"Pitch of sound tells us how shrill or grave sound is."*

We can also say that pitch of sound is the property of sound that helps us to distinguish between sounds of different frequencies.

Our ears can detect this difference. Sounds of different frequencies make the ear to vibrate at different frequencies, that's why we can differentiate between them.

Children and girls voices, whistling sound, chirping of birds etc. are examples of shrill sounds while male voice, lion's roar, dog's barking sound, sound of big drum etc are examples of grave sounds.

Now we know that pitch of sound is directly related with the frequency of sound.

Pitch of sound $\propto$ Frequency of sound

Experiment:

If we could increase frequency of vibration of a body then shrillness of the sound produced by it will increase and sound will be changing from low pitch (grave sound) to high pitch (shrill sound).

- Take a box with the tight rubber band around it (figure 1).
- Place two pens close to each other under the band as shown.
- Now pluck the band and listen to sound (figure 2).
- Now, increase the gap between the pens (figure 3).
- Pluck the rubber band again and observe.
- We will observe that we hear high pich or shrill sound when selected length of rubber band was small (because rubber band vibrates fast). We hear the grave sound or low pitch sound when selected length of band is large (in this case rubber band vibates slow).

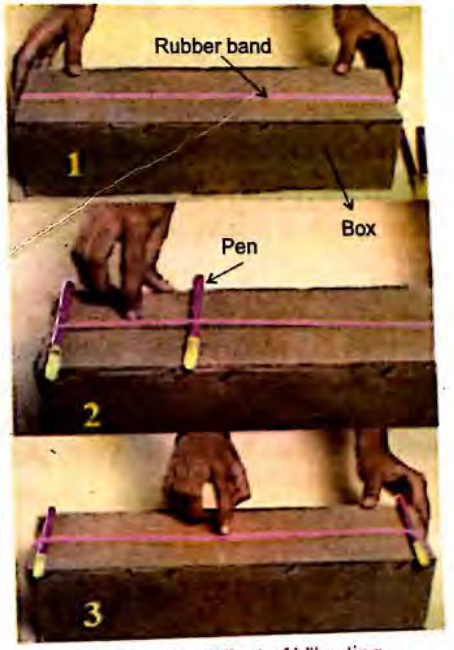


Figure 9.16 Effect of Vibrating Length on pitch of sound

Teaching Point: Teacher can use elastic string to represent wave frequency by wiggling string fast and slow. Small and large amplitude can also be demonstrated.

POINTS TO PONDER

In your childhood, you must have played with xylophone.

Which bar will produce a higher pitch sound; smaller length bar or longer length bar?

Label the bars in xylophone picture generating higher and lower pitch sounds.

Xylophone

LOUDNESS OF SOUND

"Loudness of sound is the sensation produced by sound on our ears."

Two sounds of same pitch (same frequency) may have different loudness. So, this can be defined as *"The property of sound which help us to distinguish between a soft sound and a louder sound is called loudness of sound."*

Factors Affecting Loudness of Sound

1. Amplitude of the Wave:

Loudness of sound is related with the amplitude of the wave. Louder sound has greater amplitude and soft sound has small amplitude. So, loudness of sound is directly proportional to amplitude of the wave.

A wave with a larger amplitude has had a lot of energy added to it by a person or a sound instrument. As a result, we hear a louder sound.

Loudness of sound $\propto$ Amplitude of wave

Example: If we beat the drum with greater force, its surface will vibrate with greater energy and it will produce louder sound.

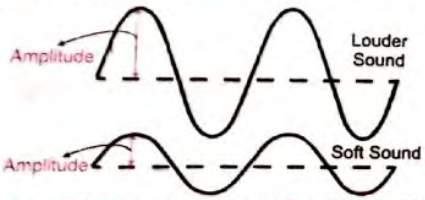
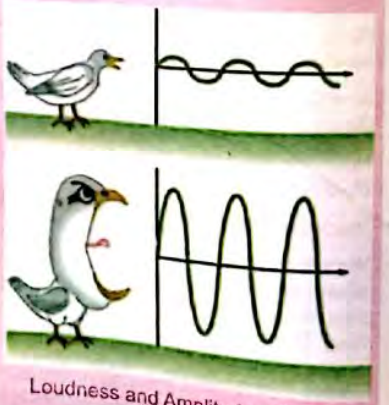


Figure 9.17 Loudness and Amplitude of Waves

INFORMATION

Take a look at the bird in the picture. It expends a lot of energy in order to make a louder sound.



Loudness and Amplitude of Waves

DO YOU KNOW?

A hearing aid is a small electronic device that you wear in or behind your ear. It makes some sounds louder so that a person with hearing loss can listen, communicate, and participate more fully in daily activities. A hearing aid devise can help people hear more in both quiet and noisy situations.

Hearing Aid Device

2. Surface area of Sound Source:

If the sound source has larger surface to vibrate, it produces louder sound.

Example:

If we strike a large drum and a small drum with same amount of force, then large drum will produce louder sound than small drum

Figure 9.18 Large and Small Drums (Dhol and Dholak in Local Languages)

3. Distance from Sound Source:

If a listener is standing near a sound source, he/she will hear louder sound than the person standing at far off place.

Example:

In school morning assembly, students standing near loudspeaker hear louder sound and students standing at the end of the line hear soft sound.

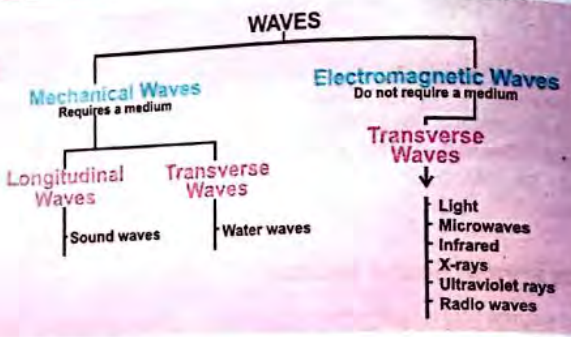
4. Sensitivity of Ear:

Loudness of sound also depends upon condition of ear. Usually, old people can not listen to soft voices.

Figure 9.19 Impaired Hearing

UNIT 9 WAVES AND ENERGY

INFORMATION



9.7 SOME COMMON PHENOMENON OF SOUND

1. ECHO

When we speak in a big empty hall or on hilly area or in an empty well, we hear our own sound again and again. This soft reflected sound is called echo.

"It is repetition of sound due to reflection of sound waves from a hard surface."

Figure 9.20 Reflection of Sound Waves

To hear echo, sound must reach our ear after 0.1 second (one-tenth of a second). Why?

The feeling of the original sound remains in our brain till 0.1 second. If reflected sound waves reach our ears before the end of 0.1 second, then our brain does not recognize the original and reflected sounds as separate sounds. They are taken as one sound by our brain.

Therefore, in order to hear two distinct sounds or an echo, the time gap between the original sound and the reflected sound or echo should be at least 0.1 second.

The minimum distance between the speaker and the reflecting surface should be at least 17 meters, then the time gap between the reflected sound and the original sound will be equal to 0.1 second.

As a result, we will be able to hear an echo.

INFORMATION

Calculation for Minimum Distance

Time in which sound persists in our brain = t = 0.1s

So time interval between original sound and reflected sound should be at least 0.1s.

Speed of sound at room temperature = v = 340 ms^{-1}

So, distance covered by sound (from source to obstacle and back to source) is:

Distance = (Speed of sound) (time)

S = vt

Distance = 340 x 0.1

Distance = 34 m

Therefore, distance between sound source and obstacle should be half of this total distance i.e., 17m.

2. HEARING THUNDER AFTER LIGHTENING

During lightening in the sky, both light and sound are produced at the same time but light reaches us earlier than the thundering sound because light is faster than sound.

INFORMATION

Speed of light is 300,000 kilometers per second and speed of sound at 0°C is 332 meters per second.

Figure 9.21 Lightening

Key Points

- Wave is a disturbance in a medium that causes particles of the medium to vibrate.
- Waves transfer energy from one point to another point without transferring matter.
- Waves which can only travel through a medium are called mechanical waves.
- Waves which can pass through vacuum as well as through medium, are called electromagnetic waves.
- Transverse waves are such waves in which particles of the medium vibrate perpendicular to the direction of wave travel.
- Longitudinal waves are such waves in which particles of the medium vibrate parallel to direction of wave travel.
- Sound is produced by vibrating bodies.
- Pitch of sound tells us how shrill or grave the sound is.
- Loudness of sound as the sensation produced by sound on our ears.
- Echo is repetition of sound due to reflection of sound waves from a hard surface back to speaker.

UNIT 9 WAVES AND ENERGY

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. hertz (Hz) is the unit of:
   a. Mass b. Energy c. Loudness d. Frequency
2. To hear echo, minimum distance between sound source and obstacle should be:
   a. 71 m b. 17 m c. 17 cm d. 0.17 m
3. Which of the followings is a longitudinal wave?
   a. X-rays b. Waves on stretched rope
   c. P-seismic waves d. S-seismic waves
4. Which has highest pitch of sound?
   a. Lion roar b. Whistling sound c. Train horn d. Traffic noise
5. If a wave has three crests and three troughs then what is its frequency?
   a. 3 Hz b. 1 Hz c. 5 Hz d. 6 Hz
6. Sound waves cannot pass through:
   a. Solids b. Liquids c. Gases d. Vacuum
7. Which of the following animal has the lowest pitch of sound?
   a. Sparrow b. Dog c. Cat d. Mosquito
8. If frequency of sound is doubled but amplitude of this sound wave is kept constant, then
   a. loudness and pitch both increase. b. loudness and pitch both decrease.
   c. loudness increases and pitch remains same.
   d. loudness remains same and pitch increases.
9. Which of following is a longitudinal wave?
   a. Sound wave b. Water waves on surface of ocean
   c. Light d. String wave
10. Product of frequency and time period of a wave is:
    a. 1 b. $\frac{1}{T}$ c. $\frac{1}{f}$ d. 0

B. True and False (correct the statement if it is False):

1. In waves, matter is also transported along with energy.
2. Sound is a form of energy that travels through a medium as transverse wave.
3. High pitch sound means grave sound.
4. If you are standing near a loudspeaker then you hear sound waves of large amplitude.
5. Red light has greater speed in air than speed of sound in steel.

C. Short questions

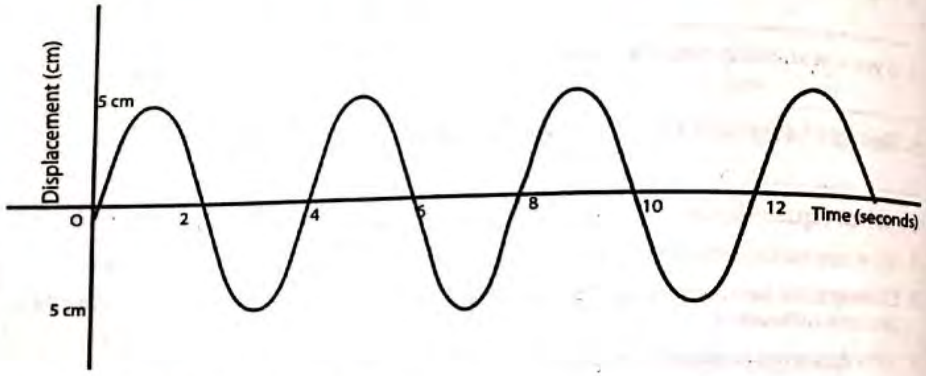
1. Give atleast two differences between mechanical waves and electromagnetic waves.
2. Differentiate between transverse waves and longitudinal waves. Give at least one similarity and one difference.
3. Why do we not hear sound caused by explosions on the sun?
4. Define the following terms: crest, trough, rarefaction and compression
5. If 100 waves (or cycles) of water are passing through a point in the river in 20 seconds, calculate frequency and time period of these waves.
6. Waves are produced in stretched string continuously. A crest passes through a point on it in 1.5 seconds, what is frequency of waves?
7. How can a body produce sound? Explain briefly.
8. What is pitch of sound? How is it related with the frequency of sound?
9. What is loudness of sound? Name the factors on which loudness of sound depend.
10. A mobile phone is vibrating in your hand and another mobile is viberating on a table. Which will be producing louder sound and why?
11. How can you hear echo?
12. In a cricket ground, batsman hits four in a test match. You notice that hitting sound of the bat is heard slightly after you see the bat actually hitting the ball. Why is it so?

D. Long questions

1. Define the following terms for wave; crest, trough, compression, rarefaction, wavelength, amplitude
2. Show that frequency and time period of waves are inverse of each other.
3. What is Pitch of sound? On what factors it depends?
4. What is loudness of sound? On what factors it depends?

E. Structured response questions

1. Waves are produced in water pool. A graph is plotted between instantaneous displacement of particles of the medium and time as shown.



a. How many crests and troughs are there?

b. What is amplitude of the wave?

c. What are displacements of particles of the wave at time 4 seconds and 11 seconds?

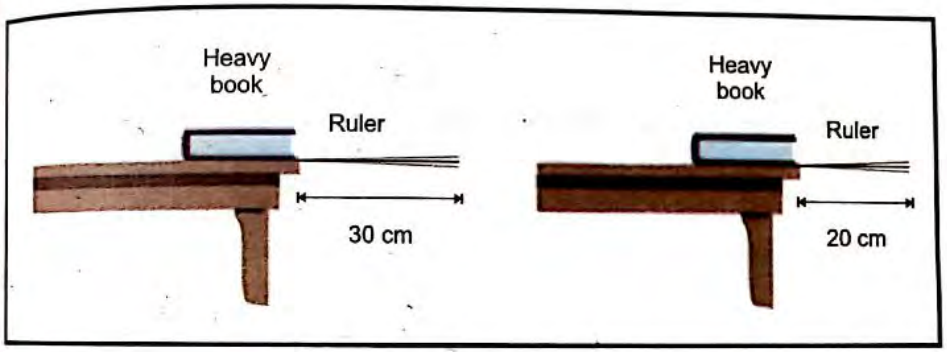
d. How many waves are there?

e. What is time period of the wave?

f. What is frequency of the waves?

g. If there are 3.5 waves in distance of 7 meters then find the wavelength for these waves?

2. Consider the diagrams, one end of each ruler is made fixed by placing under heavy books and their other ends are free to vibrate. When the free end of each ruler is plucked with same force then:



a. Which ruler will produce louder sound? And why?

b. Which ruler will produe sound of high pitch?

3. Draw the wave form/ graphs to differentiate between the situations given below:

i. You talking to a friend and you shouting during the football match

ii. Whistle sound and male voice of same loudness

F. Project work

Take a small piece of card stock, place small nails at varying distances apart, and connect them with rubber bands. These bands should be arranged so that they produce notes ranging from low to high pitch.

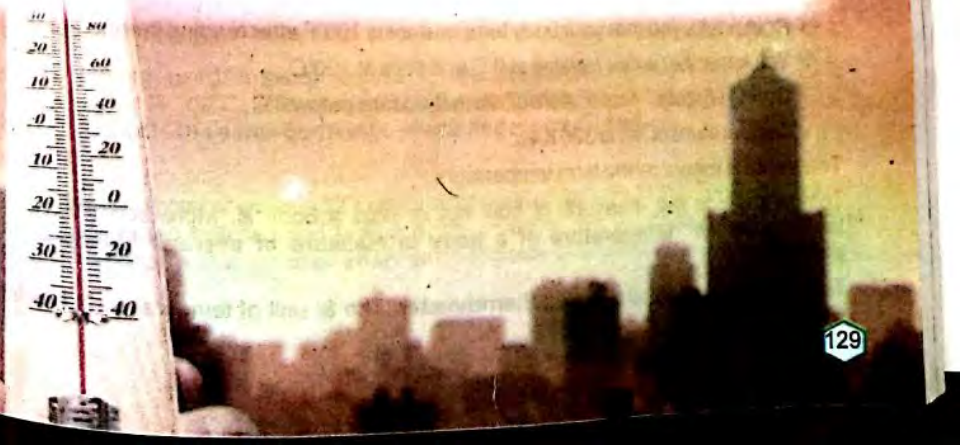
UNIT 10

HEAT AND TEMPERATURE

Learning outcomes:

At the end of this unit, students will be able to:

- Define the terms heat and temperature on the basis of Kinetic Molecular Theory.
- Describe the expansion of the three states of matter on heating, and contraction on cooling, in terms of particles.
- Predict the effects of heat gain and heat loss.
- Compare all three scales of temperature (including inter-conversion of temperature scales).
- Explain why metals are good thermal conductors and fluids are poor conductors of heat using the particle model.
- Construct the concept of heat conduction, convection and radiation by applying particle theory including daily life examples.
- Identify the effects of thermal expansion and contraction with their applications in daily life.
- State and explain the practical methods of thermal insulation used for constructing buildings.



UNIT 10 HEAT AND TEMPERATURE

10.1 INTRODUCTION

In your previous class, you have learnt some basic information about kinetic theory of particles. We can extend this theory as:

- Matter consists of tiny particles called atoms and atoms combine to form molecules.
- There are three states of matter; solid, liquid and gas.
- According to kinetic molecular theory, particles in solids only vibrate about their mean position but do not leave their position
- While in fluids i.e., liquids and gases, particles flow. Particles in gases are more free to move than liquids.
- We know that particles have kinetic energy due to their motion and potential energy due to attraction between them. Particles in gases have greater kinetic energy as compared to liquids and solids. Particles in solids have smallest kinetic energy.
- *The total kinetic energy and potential energy of all the particles in a substance is called* ***thermal energy.***

INTERESTING FACT:

You have often observed that if we place a pot having water in it on stove, water will be seemed to be static. When we start heating it, we see that water currents move in it and even steam flows out when it boils. From this observation, we conclude that kinetic energy of molecules increases by heating. By adding more heat to a substance, its particles move faster, therefore their kinetic energy and temperature increases.

Figure 10.1 Boiling Water

10.2 TEMPERATURE

- Doctor tells you that your body temperature is 100°F after reading thermometer
- You know that water freezes at 0°C and boils at 100°C
- During winters, temperature of Islamabad falls below 0°C.
- Temperature of lab is 320 K etc.

Then what is meant by the term temperature.

Temperature is the measure of how hot or cold a body is. More scientifically, we define temperature as **"temperature of a body is measure of average kinetic energy of its particles".**

Temperature is measured using **thermometer.** The SI unit of temperature is **kelvin (K)** while

other famous units are **degree centigrade (°C)** and **degree fahrenheit (°F).**

Unit of temperature kelvin is mostly used for scientific calculations, while degree Fahrenheit is usually used for clinical purposes and degree centigrade is used for normal daily life temperatures (for weather).

STOP AND CHECK

A full glass of hot water has temperature of 40°C. If we pour half of water in pot, what will be the temperature of remaining half glass of water?

10.3 TEMPERATURE SCALES

There are three temperature scales.

- Kelvin scale
- Celsius scale
- Fahrenheit scale

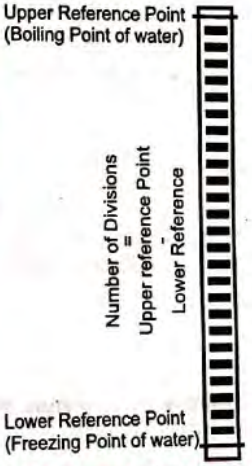


Figure 10.2 Temperature Scale

Formation of scales:

To form a temperature scale, two fixed or reference points are marked; lower reference point and upper reference point. Freezing point of water (melting point of ice) is taken as lower reference point while boiling point of water is taken as upper reference point. Gap between these reference points on scale is divided into divisions of equal lengths. Number of divisions is equal to difference between upper and lower reference points values.

Kelvin Scale:

On this scale, freezing point of water is 273 K and boiling point of water is 373 K. Therefore, it has 100 equal divisions between the freezing points and boiling points.

Celsius Scale:

It is the most commonly used temperature scale. On this scale, freezing point of water is 0°C and boiling point of water is 100°C. This scale has 100 equal divisions just like kelvin scale. **So, a change of one kelvin is the same as change of one degree centigrade.**

Fahrenheit Scale:

On this scale, freezing point of water is 32°F and boiling point of water is 212°F. This scale has 180 equal divisions between freezing and boiling points of water. **So, a change of one degree Fahrenheit is less than a change of one degree centigrade or one kelvin.**

UNIT 10 HEAT AND TEMPERATURE

CONVERSION OF TEMPERATURES BETWEEN DIFFERENT SCALES

(a) From Celsius to Kelvin Scale

$T(K) = T(C) + 273$

Here T(K) is the temperature on Kelvin scale and T(C) is the temperature on Celsius scale/ centigrade scale.

(b) From Celsius to Fahrenheit Scale

$T(F) = 1.8\,T(C) + 32$

Here T(F) is the temperature on Fahrenheit scale and T(C) is the temperature on Celsius scale.

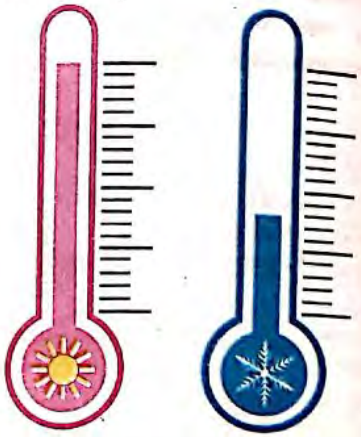


Figure 10.3 Thermometer

Example: Temperature of healthy person is 37°C. What is this temperature on kelvin and fahrenheit scales?

Using the formula

T(K) = T(C) + 273

Putting the values, we get

T(K) = 37 + 273

T(K) = 310 K

Now, use the formula to convert it into degree fahrenheit:

T(F) = 1.8 T(C) + 32

Putting the values, we get

T(F) = 1.8 (37) + 32

T(F) = 66.6 + 32

T(F) = 98.6 °F

DO YOU KNOW?

The lowest temperature on the Kelvin scale is 0 K. This is called absolute zero. Absolute zero (-273°C) is the temperature at which all molecules stop moving. It is not possible to reach absolute zero because molecules are always moving.

DO YOU KNOW?

The Kelvin scale is mostly used in scientific calculation because it has only positive values in it, while other two scales have positive as well as negative values in it.

Teaching Point: Teacher can bring thermometers in the class to familiarize students with different temperature scales.

COMPARISON OF TEMPERATURE SCALES

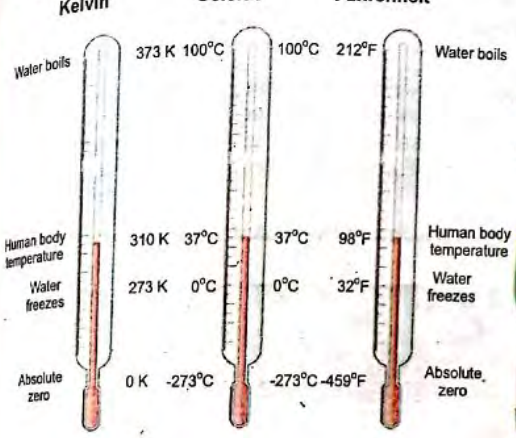


Figure 10.4 Comparison of temperature scales

DIFFERENT TYPES OF THERMOMETERS

Figure 10.5 Different types of thermometers

10.4 HEAT

Heat is a form of energy that flows from hotter body to colder body.

At the start of this chapter, we discussed that when a water in a pot is heated, its temperature rises due to increase in kinetic energy of the water particles. It means that when temperature of a body increases then it absorbs heat and when its temperature falls then it loses heat. A body at higher temperature will have greater amount of heat in it and vice versa.

Figure 10.6 Water Molecules at Different Temperature

Heat will flow faster between objects which have greater temperature difference.

UNIT 10 HEAT AND TEMPERATURE

Amount of heat in a body also depends upon amount of matter in it. Each particle of the body absorbs heat. A half cup of hot tea has half the amount of heat in it than a full cup of tea at same temperature.

If two bodies at different temperatures are touched to each other, heat will continue to flow from hot body to cold body until they attain same temperature i.e. thermal equilibrium. For example, if cold milk is mixed in hot coffee then hot coffee will lose heat and its temperature will decrease. Cold milk will absorb the heat and its temperature will increase. Heat will flow until mixture of coffee and milk attains thermal equilibrium.

SI unit of energy is **joule (J)**, named after the scientist James Prescott Joule who was an English physicist and mathematician.

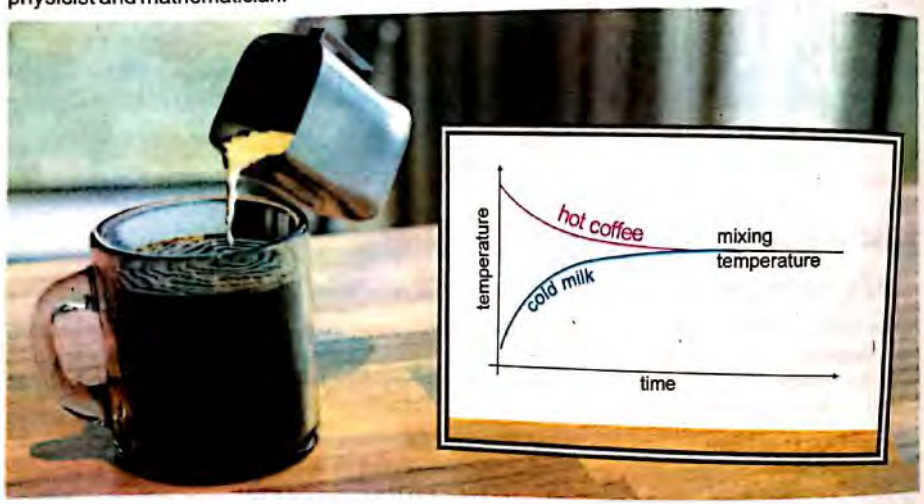


Figure 10.7 Mixing of Cold Milk in Hot Coffee

STOP AND CHECK

A full glass of hot water has temperature of 40°C and it has 200J of heat. If we pour half of water in another glass, what will be new amount heat in the remaining half glass of water?

Teaching Point: Ask students to find good and bad conductors around them in daily life.

10.5 THERMAL EXPANSION

When a substance is heated, its length, area, volume, shape or density change, this is called its thermal expansion. All three states of matter (solid, liquid and gas) expand on heating and contract on cooling. Thermal expansion is different for different states (e.g., solid, liquid or gas) of the same substance. Usually, gases expand more than liquids and liquids expand more than solids.

THERMAL EXPANSION IN SOLIDS

In solids, particles vibrate about their mean position but do not leave their positions. When solid substance is heated, its particles gain heat energy. Vibrational kinetic energy of the particles increases and they vibrate with greater amplitude. Therefore, gap between the neighbouring atoms increases and hence, increases size of the substance. It is how solids expand on heating.

If hot solid is placed in air, it will lose heat to surroundings. Vibrational K.E. of particles and amplitude of solid will decrease. Particles will come close to each other and hence, solid will contract.

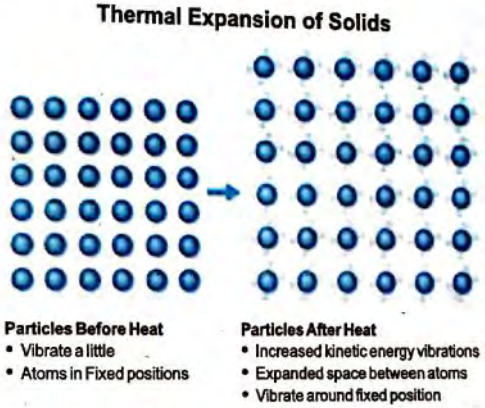


Figure 10.8 Thermal Expansion in Solid

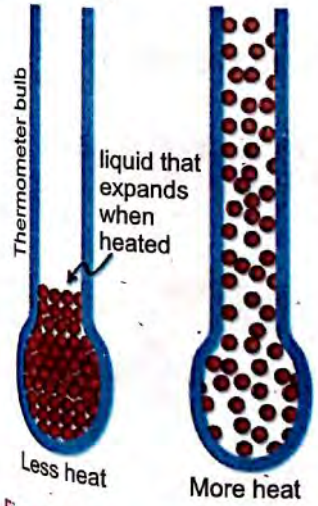


Figure 10.9 Thermal Expansion in Fluids

THERMAL EXPANSION IN FLUIDS (LIQUIDS AND GASES)

In fluids (liquids and gases), the particles are at large distance from each other than the particles in solids. When fluid is heated, its particles start moving with greater K.E., push each other and hence it expands.

Similarly, when the hot liquid is placed in air then liquid will lose heat to its surroundings. Vibrational kinetic energy and amplitude of particles of liquid will decrease and it will contract.

UNIT 10 HEAT AND TEMPERATURE

10.6 EFFECTS OF THERMAL EXPANSION AND CONTRACTION WITH THEIR APPLICATIONS IN OUR DAILY LIFE

All substances expand on heating and contract on cooling (with some exceptions). This property of matter is used in different ways in our daily life. Let's explore some of its examples

Liquid in Thermometer: When a person with high fever puts thermometer in his/her mouth, metallic thermometer bulb and mercury will get heat. Mercury rises in the capillary tube and stops after reaching thermal equilibrium with body of the person. Then, we take reading of the temperature from the Fahrenheit scale of the thermometer.

Figure 10.10 Thermometer

Opening the Bottle Lid with Hot Water: If you are unable to open the stuck lid of glass jar, just place the lid under hot water for few seconds. Metal lid will expand and lose enough to open easily.

Figure 10.11 Opening of Lid with Hot Water

Gaps in Railway Tracks:

Gaps are left in the railway tracks, so that it could expand and contract easily in summers without buckling.

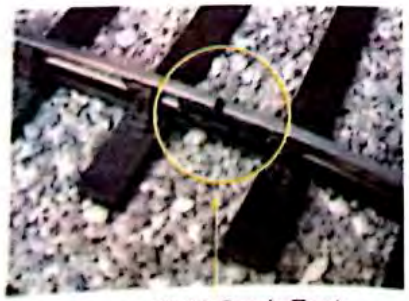


Figure 10.12 Gap in Track

Figure 10.13 Buckled Track due to thermal expansion

Expansion Joints in Bridges:

Bridges have long span but it is divided into small sections with expansion joints between them as shown in the figure. Due to these, expansion joints, bridge can expand and contract easily during summer without any damage to bridge.

Figure 10.14 Expansion Joints in Bridges

STOP AND CHECK

Two electric wires (blue wire and red wire) are tied to poles as shown. Which wire may break during winters?

10.7 TRANSFER OF HEAT

Heat is always transferred from hot objects to cold objects due to temperature difference. There are three different methods to transfer heat:

- Conduction
- Convection
- Radiation

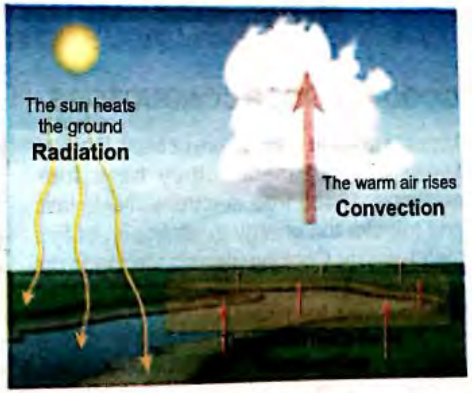


Figure 10.15 Methods of Transfer of Heat

10.8 CONDUCTION

If you place a spoon on flame and hold its other end, you cannot hold it longer because it will be heated up after few seconds. Now you would know that why handles of fry-pan are made up of wood or plastic. Food cooks easily in metallic pots. In all these examples, heat is transferred due to conduction.

"Conduction is the method of transfer of heat from hot body to cold body by the vibrations of particles."

Conduction also takes place from hot part of the body to its cold part. In solids, its particles are very close to each other. When one end of metal rod is heated then particles at that end begins to vibrate more energetically. They collide with neighbouring particles and transfer a part of heat energy to them. In this way, energy transfers to its other end.

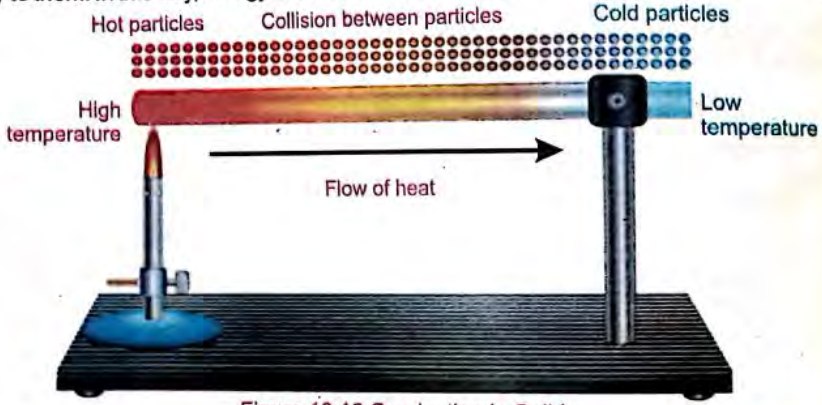


Figure 10.16 Conduction in Solids

GOOD AND POOR CONDUCTORS

Metals are good conductors of heat. Do you know, why? In metals, they have free electrons. These free electrons move fast and transfer the energy to other part of the metal quickly. Cooking utensils are made up of metals because metals conduct heat fast and cooks the food easily.

Figure 10.17 Cooking Food through Conduction

Non-Metals e.g., wood, plastic, wool, fur etc.do not conduct heat easily, they are poor conductors of heat (also are called insulators). In non-metals, electrons are bound (they are not free to move in material).

In comparison of three states of matter, solids are good conductors of heat than liquids and

gases. Air which is mixture of gases is one of the best insulators.

We wear wool sweater and wool clothes to keep our body warm because wool sweaters trap the air inside it. Air being insulator donot allow heat to conduct easily. Heat is not lost by our body and we remain warm. Birds fluff out to trap air in wings to remains warm in winters.

Figure 10.18 Fluffy Bird

10.9 CONVECTION

You must have observed that

- Water currents moving on the surface of boiling water,
- Hot air balloons rising high in the sky etc.

All theses examples show transfer of heat by convection.

"Transfer of heat by actual movement of molecules from hot place to cold place is known as convection."

Convection can take place in fluids (liquids and gases) only. When cold water is heated in the pot then water touching the bottom of the pot first receives heat. It expands and becomes less dense. The cold water (denser) flows downward and hot water (lighter) rises up. This process continues and circulating flow of water is established (called convectional currents). This will warm the whole water in the pot. We see that this is the method of transfer of heat due to actual movement of particles from bottom to top.

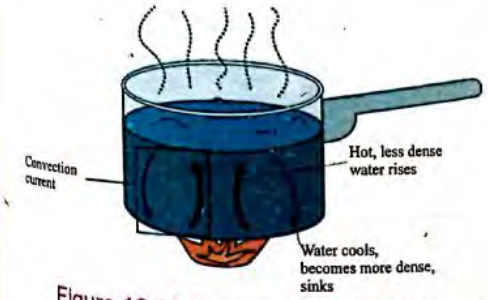


Figure 10.19 Heating by Convection

INTERESTING FACT:

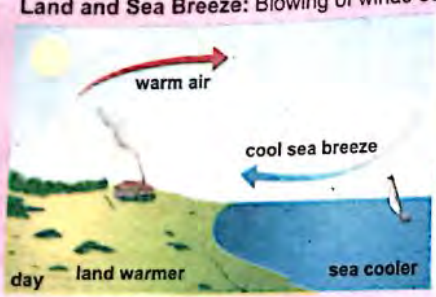
During a hot day, air near earth surface becomes hot. Its molecules gain greater kinetic energy, so it expands and becomes lighter. This hot air rises straight up. This upward moving air due to convection is called **thermal.** Thermals helps birds to fly for long time without fluttering their wings. Eagles, hawks and vultures are called best thermal climbers.

Eagle - Thermal Climber

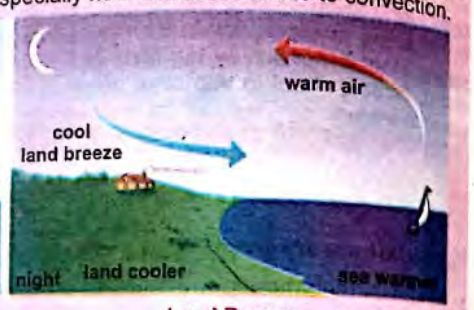
UNIT 10 HEAT AND TEMPERATURE

INFORMATION:

Land and Sea Breeze: Blowing of winds especially near sea areas is due to convection.



Sea Breeze



Land Breeze

10.10 RADIATION

When we sit next to an electric heater, the heat from it does not reach us by conduction because air is very poor conductor of heat. It neither reaches us by convection because heated air rises up.

The heat from Sun reaches us from millions of kilometers in empty space. Neither conduction nor convection can take place in vacuum as no material is present for the transfer of heat.

In both these observations, heat reaches us by radiation of heat. Therefore, we define radiation of heat as:

Heating By Radiation

"The transfer of heat from a hot place to a cold place with or without having a material medium in between, in the form of electromagnetic waves is called radiation."

In radiation, energy is transferred without involving matter.

All electromagnetic waves (radio waves, I.R., visible light, ultra violet, x-rays and gamma rays) carry energy but **infra-red** (I.R.) carry the most amount of heat energy.

Radiation method is used to warm the green house even in winters.

10.11 THERMAL INSULATION FOR CONSTRUCTING BUILDINGS

Heat enters the buildings from all sides but most amount of heat enters through roof. All three processes conduction, convection and radiation transfer heat into buildings. Different methods can be adopted to lower this transfer of heat and maintain the temperature of the building.

1. False ceiling below the roof is done with air trapped between ceiling and roof. Air being good insulator reduces the heat flow from roof to room.
2. By laying down reflectors or shining silvered surfaces on the top of the roof. White washing

the roof top on start of summer season. These methods will reflect most of heat energy.

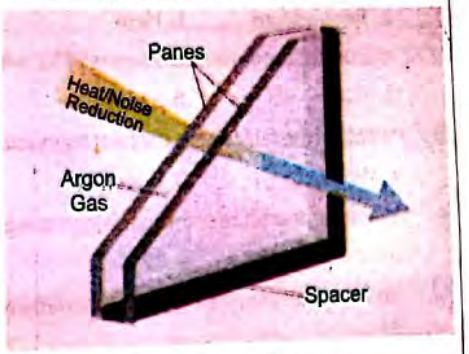
3. Thickness of the walls may be increased so heat will take longer to conduct through it.
4. Nowadays, wall insulating panel are attached with the front walls just like the false ceiling methodology.
5. Double glazed windows and doors are installed to reduce the heat transmission. These window panes have air or argon gas between glass sheets that provides good insulation.

These are the basic methods which are now commonly used to insulate buildings which help to maintain the temperature inside the building.

False Ceiling

Silver and White Colours - Good Reflector

Wood Paneling of Walls



Double Glazed Window

Figure 10.20 Different Thermal Insulations

UNIT 10 HEAT AND TEMPERATURE

Key Points

- The total kinetic energy and potential energy of all the particles in a substance is called thermal energy.
- "Temperature of a body is measure of average kinetic energy of its particles".
- The three temperature scales are:
  Kelvin scale, Celsius scale and Fahrenheit scale.
- Heat is a form of thermal energy that flows from hotter body to colder body.
- Heat will continue to flow from hot body to cold body until they attain same temperature i.e. thermal equilibrium.
- When a substance is heated, its length, area, volume, shape or density change, this is called its thermal expansion.
- Heat is always transferred from hot objects to cold objects due to temperature difference. There are three different methods to transfer heat; conduction, convection and radiation.

END OF UNIT ASSESSMENT:

A. MCQs (Choose the correct option)

1. "J" is the symbol for unit joule, it is the unit of:
   a. Temperature b. Heat c. Power d. Voltage
2. If your class room temperature is 27°C, what is its value in kelvin scale?
   a. 27 K b. 373 K c. 300 K d. 246 K
3. Which of the following is the best conductor?
   a. Wood b. Water c. Metal d. Plastic
4. Which temperature of the followings is representing melting point of ice?
   a. 0K b. 32°C c. 273K d. 0°F
5. Mercury thermometer is used to measure temperature of a body. Which process is used in it?
   a. Convection b. Radiation c. Thermal expansion d. Insulation

6. Which of the followings is the worst conductor?
   a. Metal b. Wood c. Wool d. Air
7. Conduction of heat best takes place in
   a. solids. b. fluids. c. gases. d. vacuum.
8. Materials that trap air like fur, wool and saw dust are heat:
   a. Insulators b. Conductors c. Reflectors d. Convectional devices
9. The heat transfer that occurs due to a density difference in fluids is
   a. conduction. b. radiation. c. convection. d. insulation.
10. Huge amount of heat is being generated on sun. This heat reaches from sun to earth by
    a. radiation only. b. convection only.
    c. convection and radiation. d. conduction, convection and radiation.

B. True and False (correct the statement if it is False):

1. Heat and temperature are two same things.
2. Only Radiations can pass through vacuum.
3. On heating, solids expand more than liquids.
4. At hot end of a metal rod, its particles vibrate faster than its colder end.
5. In double glazed windows, heat can flow from room to outside but heat cannot enter from outside to room.

C. Short questions

1. Define these terms; thermal energy, temperature and heat. Write their SI units.
2. Temperature of hot iron rod is 1000°C. Convert this temperature into kelvin and degree fahrenheit.
3. Why base of cooking utensils is made up of steel but handles are made up of plastic?
4. If you put a dented ping pong ball in hot water, its dented part gets the proper shape. How does it happen?

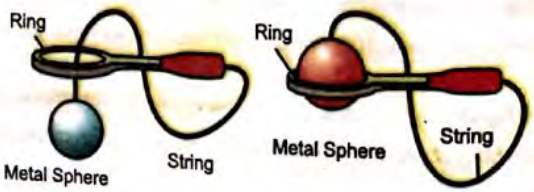
5. How can gliders fly very high without any engines? Give reason.
6. Why most materials become less dense as their temperature is increased?
7. Why exhaust fans are connected near the room ceiling?
8. Briefly explain the expansion joints use in the bridges.
9. How false ceiling helps to keep room at lower temperature than outside during the summer?

D. Long questions:

1. Differentiate between heart and temperature on the basis of Kinetic molecular theory.
2. Solids are good conductors but gas are not. Explain in detail on the basis of kinetic molecular theory.
3. What is conduction? how heat is transferred by conduction? Why metals are good conductor of heat?
4. What is convection? How he is transferred by convection?

E. Structured response questions:

1. You are asked to design a temperature scale. Lets call it "atto" temperature scale with unit symbol "°A". If melting point of ice on it is 25°A and boiling point of water is 125°A.
   a. Draw and lable the diagram with values on lower and upper reference point.
   b. Find the number of divisions on it. Also draw on the scale.
   c. Which one is greater, 1°A or 1K?
2. Consider the apparatus shown in the figure, the metal ball can pass easily through the ring.

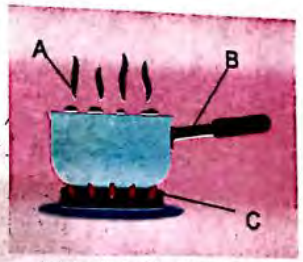


a) Before heating b) After heating

When metal ball is heated and we try to pass it through the ring again, it will not pass. Why?

3. Water is boiling in a pot as shown in the figure.
   a. Identify which letter A/B/C is representing each of following processes:
   Conduction, Convection and Radiation

A_____
B_____
C_____



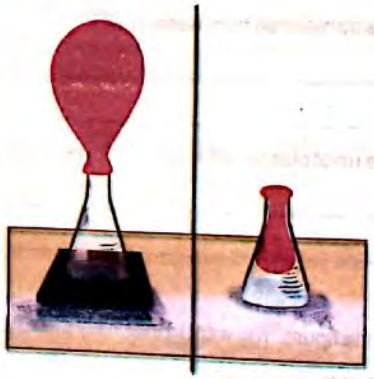
Water is boiling in the pot

   b. Explain how heat is transferred from stove to the base of pot?
   c. Explain how heat is transferred from water to air?
   d. Pot handle is made up of plastic, will it get hot? If yes, justify your answer.

4. A building is shown in the figure. You want to thermally insulate it.
   a. How would you insulate its rooftop?

b. What steps would you take to insulate it from inside?

5. A balloon is fixed on the mouth of a glass bottle which has a little amount of water, when this glass bottle is placed on hot plate balloon is inflated. Explain why?



F. Project work

Make a cooler that could keep ice without melting for long time.

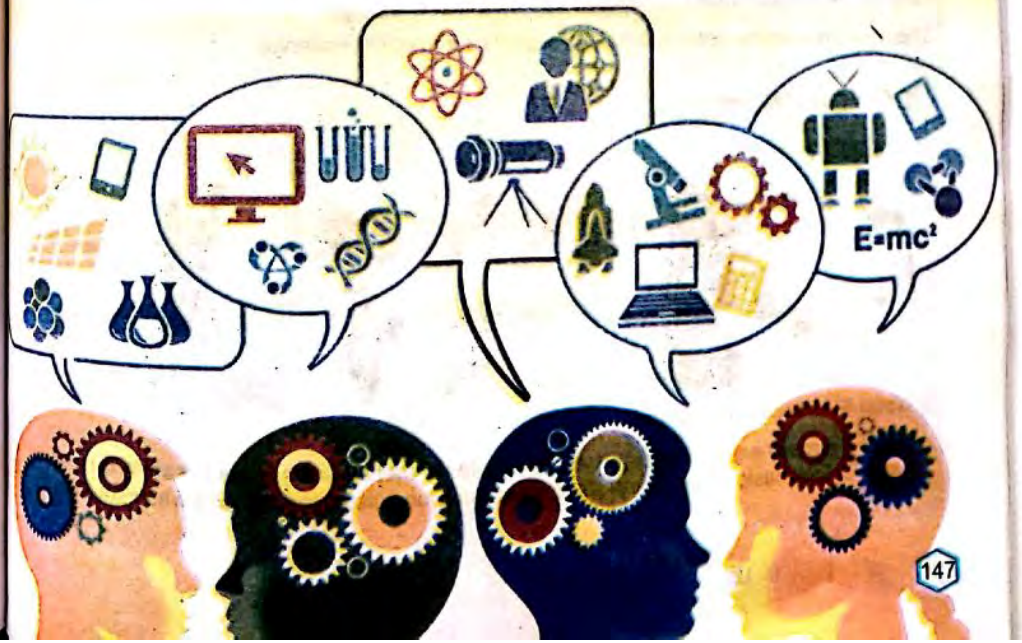
UNIT 11

TECHNOLOGY IN EVERYDAY LIFE

Learning outcomes:

At the end of this unit, students will be able to:

- Design a model to demonstrate drip and sprinkler irrigation system for conservation of water
- Use different techniques for preserving foods like orange juice, apple jam and pickles
- Make a simple stethoscope
- Make a sanitizer using suitable substances



UNIT 11 TECHNOLOGY IN EVERYDAY LIFE

Water Conservation

Water conservation means to carefully use water in order to avoid any wastage.

Why is it important to conserve water? The data shown below can help us answer the question.

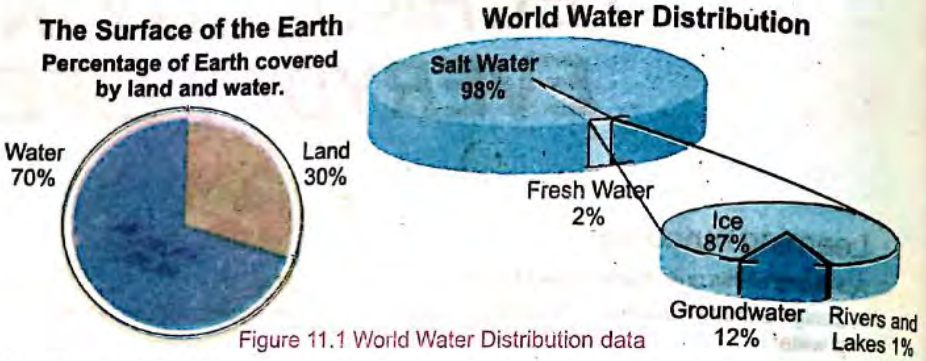


Figure 11.1 World Water Distribution data

Water is essential to life. Drinking, bathing, cleaning, cooking, washing are a few examples where water is used for domestic purposes. What about industry and agriculture? Is water needed for Agriculture and industry think about it?

Increasing population is increasing the water demand, if we will not use this precious resource carefully we will face water shortages.

There are areas in the world where water scarcity is already a challenge.

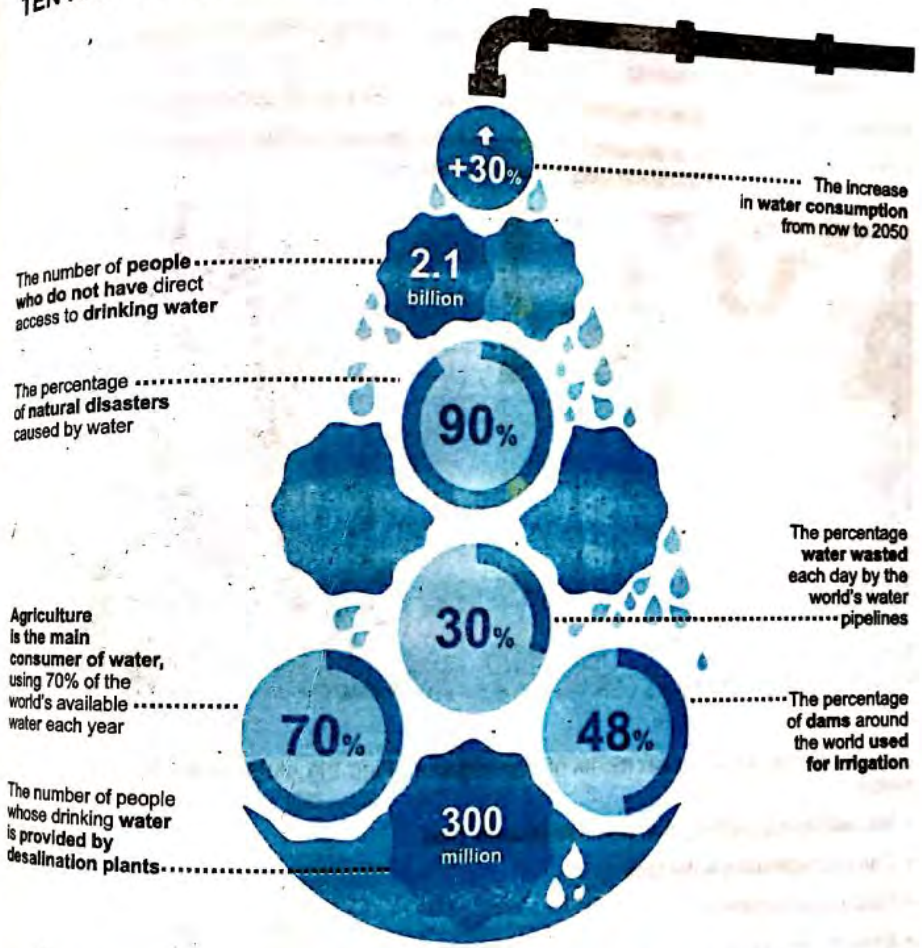
DO YOU KNOW?

Water Shortage in Pakistan

There are many areas in Pakistan where people do not have an access to safe and clean water for their basic needs. They have to travel for a long distance to reach a water source.

According to the World Bank, UNICEF, United Nations water report some important water shortage facts are given in the diagram below. Read every point and discuss it with your friends.

TEN FACTS ABOUT WATER SCARCITY



Sources: the World Bank, Unicef, United Nations World Water Report, the American Society of Civil Engineers, the International Desalination Association, International Commission on Large Dams, Global Water Intelligence

Figure 11.2 Facts about Water Scarcity

UNIT 11 TECHNOLOGY IN EVERYDAY LIFE

11.1 MAKE A MODEL FOR DRIP AND SPRINKLER IRRIGATION SYSTEM

Use a dictionary to find the meanings of sprinkle and drip or look at the photographs below to infer the meaning.

Both sprinkle and drip irrigation system is a way to save water without getting wasted.

In this process, the water is allowed to be dripped or sprinkled so that it reaches directly to the roots, otherwise, most of the water gets wasted in evaporation.

Figure 11.3 Sprinklers

Figure 11.4 Drip Irrigation

You can also make your own model of drip irrigation. Find the clues below to construct your model.

- You will need something that works like a water pipe
- Can you replicate a water tank
- Find a good adhesive
- Easy house plants
- What should be in your tool kit

Teaching Point: Take students to a field trip or show a video of drip irrigation system in Pakistan. Suggested Video Link: https://www.youtube.com/watch?v=8VN0-6baKr9Yw

your model can look like something that is shown below

Figure 11.5 Models showing Drip Irrigation

Be more creative and try to make a sprinkler too. Can you now make a drip system for your garden? Don't forget to make a blue print first.

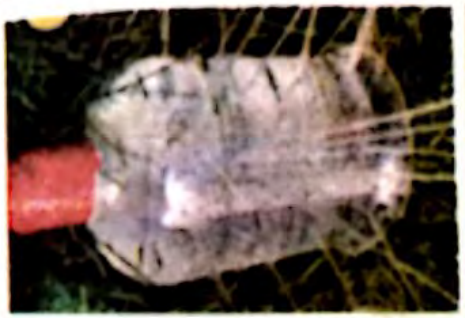


Figure 11.6 Sprinklers

DO YOU KNOW?

Drip irrigation can reduce water use by 30 to 70 percent as compared to conventional sprinkler.

11.2. PRESERVATION OF FOOD

Preserving food means preventing it from spoilage, which can be achieved by many methods.

Humans have been preserving food for thousands of years. Some historian even believe that it started from the cave man. Eventually mastering in the field led mankind settle down from nomadic wanderers into farmers. Food preservation can be found in every culture on the planet. Our long history of preserving food has come to a wide variety of time-tested ways to keep food around longer.

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UNIT 11 TECHNOLOGY IN EVERYDAY LIFE

The most common methods of preserving food at home today are canning, freezing and drying, however there are other ways to preserve food too.

Canning

The food is heated at a specified temperate for a certain time (pasteurising) and then vacuum sealed in special glass jars. Canning works for most foods including fruits, vegetables, meats and seafood.

Freezing

Fruits, vegetables, meats, seafood, nuts, grains, dairy and eggs can be frozen, however foods must be chilled to at least -18 Celsius.

Drying

Drying is the process of dehydrating (removing moisture) foods until there is not enough moisture to support growth of microorganism. Fruits, vegetables, meats, seafood, grains, legumes and nuts can be dried.

Figure 11.7 Drying

Figure 11.8 Fermenting

Fermenting

Many foods can be fermented, which means that good bacteria is encouraged to grow against the bad bacteria in order to preserve the food. Examples of fermented products are sauerkraut (from cabbage), cured sausage, and yogurt (from milk).

Pickling

In Pickling the food is soaked in a solution containing salt and acid (vinegar or lemon juice) this can be done with a wide variety of foods.

Figure 11.9 Pickling

Dry Salting

This is an old-fashioned method which was used in the early twentieth century as an alternative to canning.

Figure 11.11 Curing

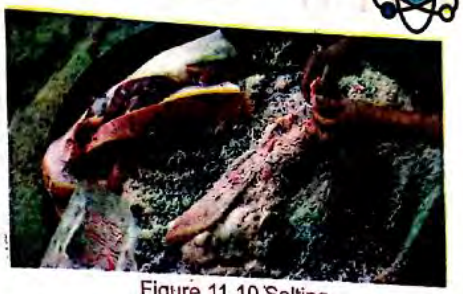


Figure 11.10 Salting

Curing

Curing is a complex method of preservation which requires a special technique. Curing is similar to pickling salt, acid and nitrates is used. It is used specifically for meat and fish.

DO YOU KNOW?

Louis Pasteur, French chemist and microbiologist, was the first to find out that heating at a certain temperature makes the food microbe free. The technique of pasteurization was named after him.

Selected food	Preservation Method	Ingredients	Equipment	Method	Results
Pickles	Pickling	• Vegetables of your choice • Vinegar / lemon juice • Salt	Clean and dried Jar with a lid	• Wash and cut the vegetables • Dry them • Place them in the jar • Add vinegar in the jar till all the vegetables are completely soaked • Seal the jar till it is air tight • Leave it for 10 days in a dry place	Decolouration in the vegetables Change of taste and flavour It will last for months
Apple jam	Pasteurization				
Orange juice	Sugar 55% by weight				

UNIT 11 TECHNOLOGY IN EVERYDAY LIFE

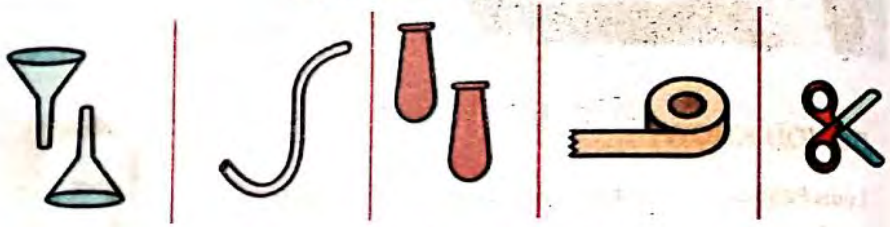
11.3 STETHOSCOPE

A stethoscope is an instrument which is used by doctors to listen to heart beat of their patients.

We can make our simple stethoscope by using some very simple materials which are easily found.

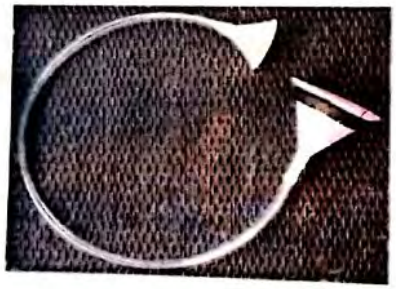
Figure 11.12 Stethoscope

MATERIALS NEEDED



Two small funnels | One two feet-long plastic tube (colorless) | Two medium-sized balloons | Electrical tape or regular duct tape | A pair of scissors

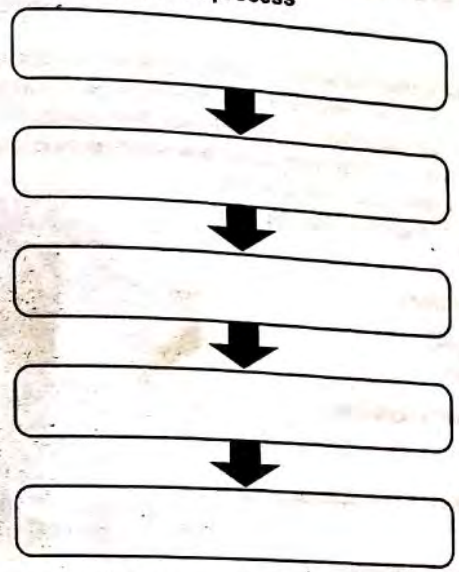
Your stethoscope will look like this



You can experiment with different sizes of funnels and vary the length of the tubing to create your own stethoscope.

After your construction write down the steps you followed in the form of a flow chart

How flow charts help us to understand a process



A self-made stethoscope is a way to learn about how heart rates are different for different people. For example, you can also count the number of times your heart beats in one minute and compare it with your friends.

Will you make this stethoscope?

What kind of sounds will you listen to with your stethoscope?

11.4. SANITIZER

Figure 11.13 Sanitizer

UNIT 11 TECHNOLOGY IN EVERYDAY LIFE

People are nowadays using hand sanitizers in order to prevent themselves from germs and stay protected from corona virus. Soaps and water help to remove germs whereas a sanitizer kills the germs from our skin without damaging it. What do you think sanitizers are made of? Can we make our own sanitizer instead of buying an expensive sanitizer from the market? Yes we can, it contains two essential ingredients one that kills germs and the other which is good for skin. So here we go

How to make hand sanitizer?

1. ⅔ cup of rubbing alcohol
2. ⅓ cup of aloe vera gel
3. 5-10 drops of essential oil (optional)

Directions:

- Mix Ethanol with aloe vera in a bowl and mix it thoroughly
- Blend in a few drops of essential oil
- After mixing them all, pour them in a bottle for use Research and complete the table below:

Ingredients	Used for
Ethanol	
Aloe vera gel	
Essential oil	

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. The percentage of fresh water on earth is not more than only
   a. 2% b. 30% c. 20% d. 25%
2. Drip irrigation system is useful for agriculture because it allows water to:
   a. Spread equally b. Reach the roots directly c. Sprinkles water d. Evaporates

3. Which one is not a way to preserve food?
   a. Freezing b. Pickling c. Curing d. Garnishing
4. The best way to preserve vegetables is:
   a. Salting b. Drying c. Curing d. Pickling
5. The instrument used by doctors for listening to heart beats is called:
   a. Stethoscope b. Microscope c. Periscope d. Ophthalmoscope
6. Which of the following is used for making a working model of a stethoscope?
   a. Funnels, plastic tube, balloons and duct tape b. Funnels and duct tape only
   c. Tubing and duct tape only d. Balloons and duct tape only
7. Use of hand sanitizer helps in:
   a. Killing germs from the skin and keeping it safe
   b. Removing germs c. Keeping skin safe d. Keeping skin moisturized
8. In Pickling food is soaked in:
   a. Water b. Oil c. Solution of salt and acid d. Solution of sugar and acid
9. The process of food preservation in which bacteria is allowed to grow against the harmful bacteria is called:
   a. Fermentation b. Dry salting c. Pickling d. Canning
10. Pasteurization means:
    a. Freezing at a certain temperature to keep food microbe free
    b. Heating at a certain temperature to keep food microbe free
    c. Drying at a certain temperature to keep food microbe free
    d. Heating to change the colour of the food

B. Long questions

1. What is preservation of food? Describe any five ways in which food can be preserved.
2. Why is water conservation a challenge in Pakistan? Why is it important to conserve water? Suggest a few ways in which we can conserve water at an individual, community and national level.
3. Write the steps to make a stethoscope in the school.

C. Structured response questions

1. Imagine you and your friends are going camping for one week at a destination where electricity and shops are not available. Your stay can extend for 15 days to a month. Make a table to list:
   a. The food items you will need keeping in mind the nutritional requirements.
   b. Method of preservation used.
   c. Also mention the days it will be safe for consumption.

2. Using the same technique you applied for making a stethoscope, make string telephone.
   a. What is common in both projects?
   b. Using the same technique what else can you make?
3. You made a hand sensitizer
   a. What is the difference in hand wash with soap and using a hand sanitizer?
   b. Make a poster to promote self-hygiene and cleanliness.

D. Project work

"My water foot print"

Calculate average use of water at direct and virtual level. (Water used indirectly for making food, electricity and products used)

a. Collect data over five days.
b. Calculate the average water consumption to have an estimation of your water footprint.
c. Compare your water footprint with your class fellows and suggest how you can s a v e water.
d. Start a water conservation drive in your school, you may display posters or distribute awareness brochures.

Table for direct water use

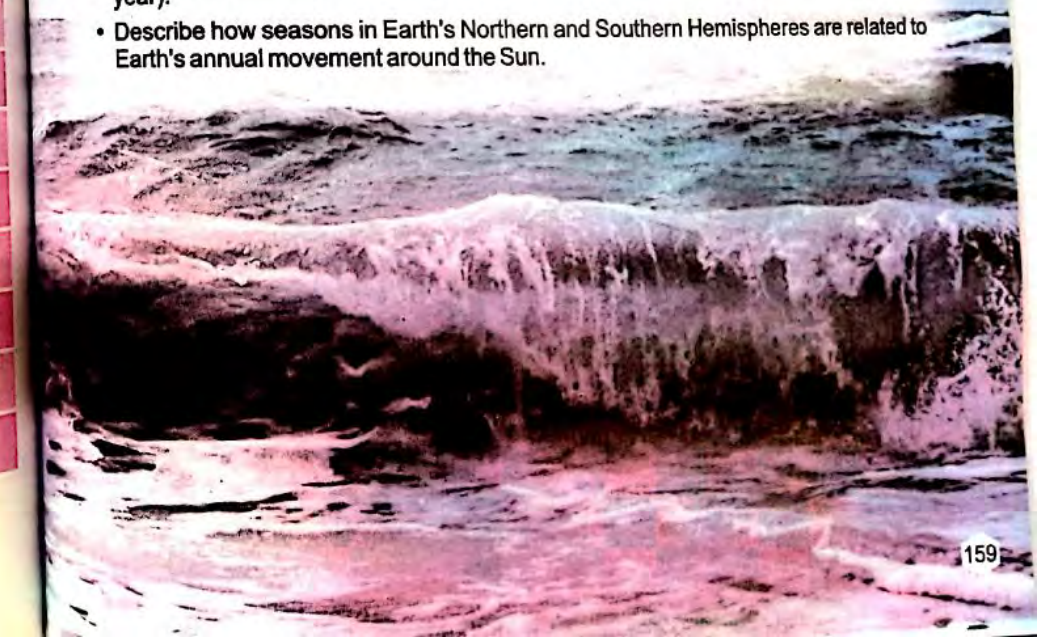
Water used for	Day1	Day2	Day3	Day4	Day5	Average
Drinking						
Teeth brushing						
Face wash						
Bathing						
Gardening						
Washing clothes						
Others						

UNIT 12 EARTH AND SPACE

Learning outcomes:

At the end of this unit, students will be able to:

- Recognize that the force of gravity keeps planets and moons in their orbits.
- Differentiate between mass and weight, using examples of weightlessness experienced by astronauts on the Moon.
- Recognize that tides are caused by the gravitational pull of the Moon.
- Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).
- Describe how seasons in Earth's Northern and Southern Hemispheres are related to Earth's annual movement around the Sun.



UNIT 12 EARTH AND SPACE

12.1 FORCE OF GRAVITY KEEPS PLANETS AND MOONS IN THEIR ORBITS

What is force of gravity?

It is the force of attraction that exists between two material objects. This force of gravity is prominent for massive objects like planets. Sun has huge mass, therefore, it has strong gravity. Sir Isaac Newton gave famous Newton's law of gravitation.

Figure 12.1 Solar System

Gravity of Sun and Its Planets:

Because of its massiveness, the sun possesses a lot of gravity. As a result, the planets are affected by the sun's gravitational pull. This gravitational force isn't strong enough to pull planets into the sun. However, it is enough to move the planets around itself in their orbits.

Let's say the sun's gravity suddenly ceases; these planets will immediately travel straight in the direction of speed. Planets are therefore forced to move in orbits by gravity.

DO YOU KNOW?

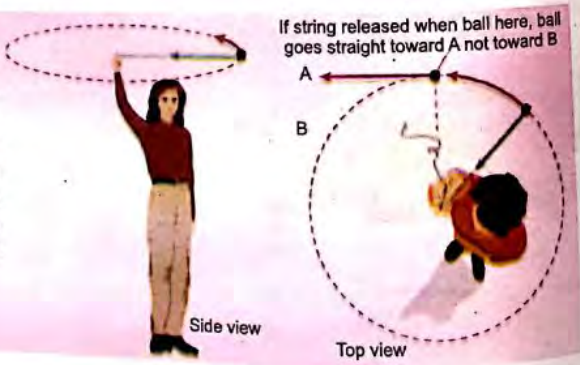
Inertia: Every object wants to maintain in one of two states: rest or uniform motion. This property of object is called Inertia.

Examples: (a) Because of its mass, a large stone is difficult to move. (b) When fans are turned off, they continue to rotate for a long time due to inertia, but eventually cease due to air resistance.

Our solar system's planets have a lot of inertia, so they keep circling around the sun.

INFORMATION:

Centripetal Force: There is a force which moves the body into a circle. It is called centripetal force. It is the same force which moves a stone tied to string in a circle when it is whirled. Stone wants to go straight but this force moves it in circle.



Earth and Moon:

Moon is the natural satellite of our earth. Just like sun, earth also applies force of gravity on the moon to revolve it around itself. Due to which moon revolves around the earth as shown in the figure 12.2.

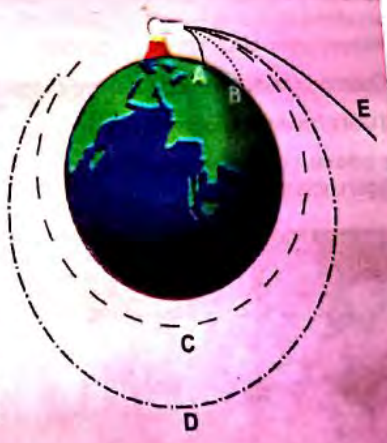
Figure 12.2 Earth and Moon

INFORMATION:

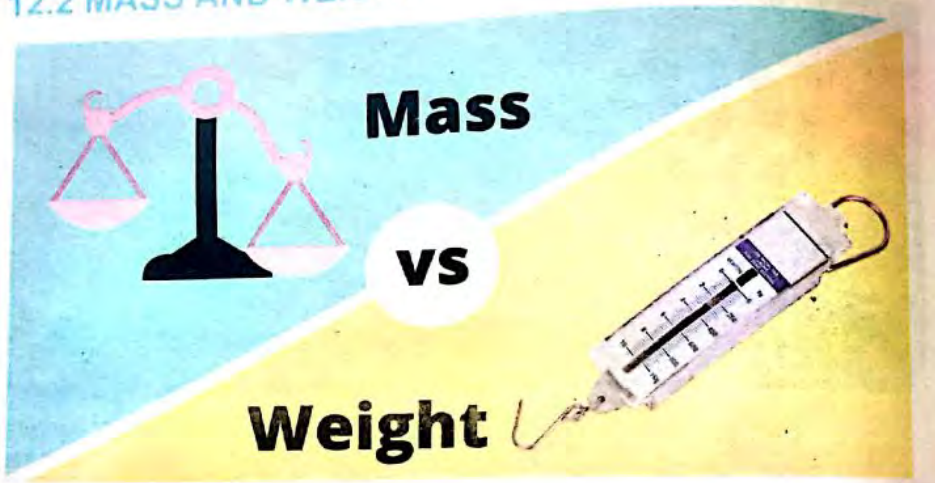
In this picture, a canon fired a ball with low speed, the ball has fallen at point "A" on Earth's surface.

When the speed is increased the ball will fall on point "B" on Earth's surface.

If the speed of the ball is further increased as shown in "C", it will start orbiting the earth without falling on earth. On further increasing the speed, it orbits at higher altitude as shown in "D". Now this ball is called satellite, as it orbits the earth. Likewise, Moon and satellites revolve around the earth. In the same way, Earth also revolves around the sun.



12.2 MASS AND WEIGHT



MASS: All things in nature are composed of particles i.e., atoms and molecules. The total amount of matter in the body is the measurement of its mass.

"Quantity of matter in a body is called its mass."

SI unit of mass is kilogram (kg).

Its smaller units are gram (g) and milligram (mg). Its bigger unit is ton.

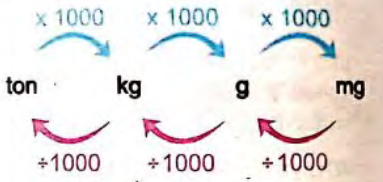


Figure 12.3 Conversion of Units

Vegetable is Measured in kg Jewelry is Measured in grams Tablets in mili gram

Figure 12.4 Imagine masses

Mass of the body is measured by physical balance. Different types of balances are shown in the following figures.

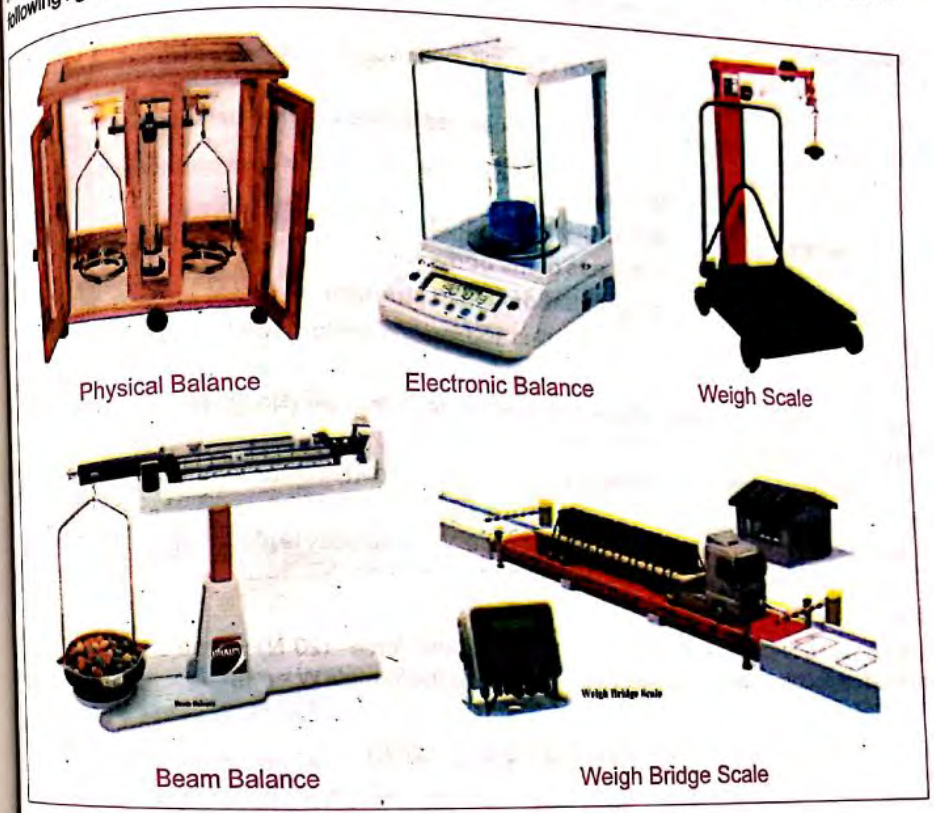


Figure 12.5 Different types of Balances

Mass of watermelon is 10 kg on earth, if it is taken to moon. Will its mass be different?

We ask this question in another way, will the mass of the body change if it is shifted from earth to moon?

Answer is NO. Because changing the location of the body, there will be no change in amount of matter in it.

Teaching Point: Teacher should bring different things, heavier and lighter in the class to discuss their masses and weights. Help students to understand gravitational field strength (g)

UNIT 12 EARTH AND SPACE

WEIGHT: "The force with which earth attracts anything towards its center is called weight of the body on earth."

It is force, so it is measured in newton (this unit is named after the name of great scientist "Sir Isaac Newton"). Its SI unit symbol is "N".

The device with which weight of a body is measured is called **spring balance or force meter.**

Where

W = m x g

W = Weight of the body

m = mass of the body

g = gravitational field strength

(also called acceleration due to gravity)

Figure 12.6
Spring Balance

On surface of earth, value of g is 9.8 newton per kilogram (N/kg). For ease of calculation, we take it 10 N/kg.

Gravitational field strength (g) is the gravitational force of earth on the body of mass 1kg.

It means, earth attracts 1 kg body with force of 10 N. If 2 kg body is placed at same place, what will be force applied by earth on it? Think and tell.....

It will be 20 N.

Look dear, 10 N force is applied on 1 kg then double force (20 N) will be applied on double mass (2 kg). We can calculate it by the formula W = mg.

$\{W = mg = (2kg)(10\ N/kg) = 20\ N\}$

You are asked to measure weight of watermelon of mass 10 kg on earth.

$W = m \times g$

$\rightarrow W = 10\ kg \times 10\ \frac{N}{kg}$

$\rightarrow W = 100\ N$

Like other heavenly objects, moon also has gravity. Mass of moon is 6 times less than mass of earth. Therefore, gravity field strength on surface of moon is also 6 times less than that of earth.

Gravitational field strength on moon's surface = $\frac{1}{6}$ (Gravitational field strength on earth's surface

$\rightarrow g_{Moon} = \frac{1}{6}(g_{Earth})$

$\rightarrow g_{Moon} = \frac{1}{6}(10) = 1.6\ \frac{N}{kg}$

It means, moon attracts 1 kg mass with the force of only 1.6 N.

Now you calculate the weight of watermelon of 10 kg on moon?

$W_{moon} = m \times g_{moon}$

$\rightarrow W_{moon} = 10\ kg \times 1.6\ \frac{N}{kg}$

$\rightarrow W_{moon} = 16N$

From above examples, we see that force with which earth attracts watermelon is 100N while moon attracts the same watermelon with only 16 N.

JUMPING ON MOON: When you jump up on the earth, you are pulled back by earth after reaching some height. But if you jump up on moon, you will rise 6 times more height than that on earth because of less gravity.

DO YOU KNOW?

On moon, gravity is 6 times less than that of earth. But gravity on moon is not zero. So, there is not weightlessness on moon. In space, far from massive objects like moon, earth or sun, gravity will be zero.

Figure 12.7
Jumping on Earth and on Moon

12.3 TIDES AND GRAVITATIONAL PULL OF MOON

"Tides are the rise and fall of water level in the oceans, rivers, lakes etc.

Hide tides: High tides are seen in the ocean when the sea level rises to its maximum level.

Low tides: When water level falls to its lowest point, it is known as low tide.

Figure 12.8 Compare the High and Low Tides

UNIT 12 EARTH AND SPACE

Gravitational pull of moon and earth, spinning of earth are the causes of tides on ocean.

The Moon has its own gravitational field, which attracts everything on Earth, including oceans, land, structures, and people. The gravitational attraction of the Moon has a major impact on ocean water. The oceans are drawn toward the Moon's gravity, resulting in high tide on the Earth's side closest to the Moon. High tides on the far end of the earth is due to flow of water against the week gravitational pull of moon because of inertia.

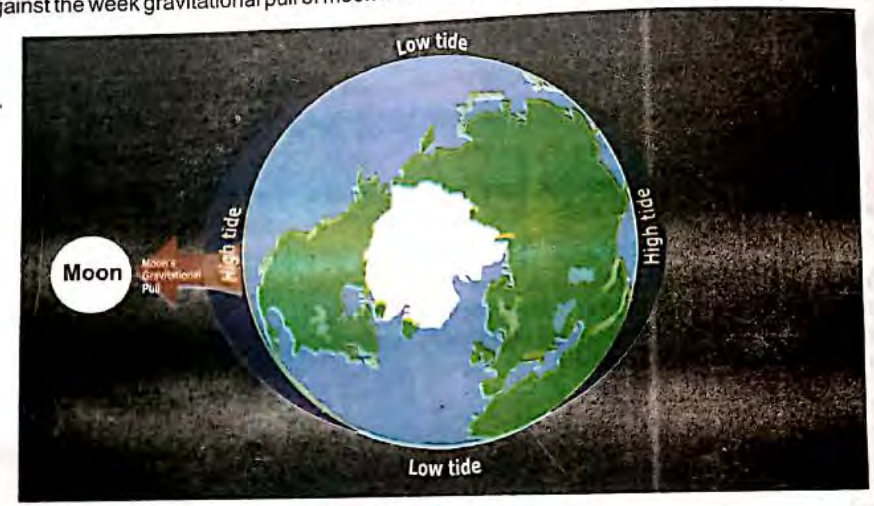


Figure 12.9 Earth's Tides

Tides can also be dangerous. High tides can cover the whole area of the beach. Lifeboats are often needed to rescue people because high tides can trap the people on the beach.

12.4 REVOLUTION OF EARTH AROUND SUN, SEASONS AND CONSTELLATION

Earth not only spins around its tilted axis but also revolves around Sun. Spinning motion of earth involves day and night while revolution of earth around sun involves change in seasons. First, we understand some basic terms.

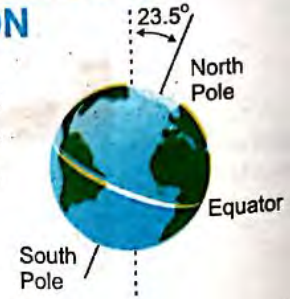


Figure 12.10 Poles of Earth

- Earth has two poles; North Pole and South Pole.
- An equator is an imaginary line around the middle of a planet. It is halfway between the North Pole and the South Pole (at 0 degree latitude).

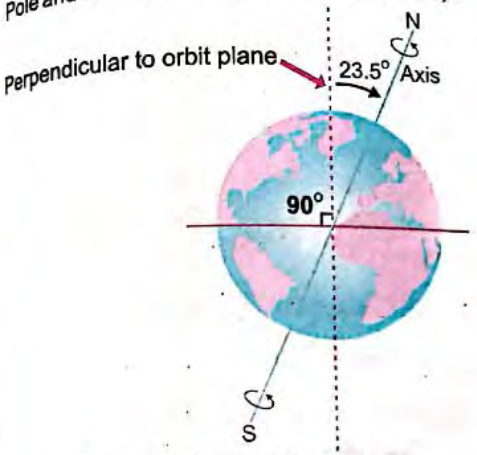


Figure 12.11 Tilt of Earth's axis

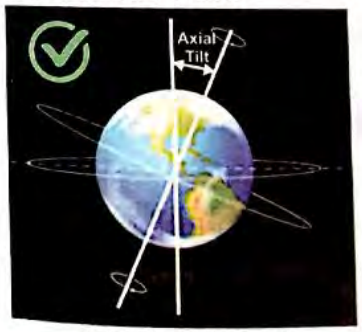
DO YOU KNOW?

Longitude and Latitude of Earth and their Angles

- **Axis** is the line around which earth spins.
- **The axial tilt** is defined as the angle between the direction of the north pole and the perpendicular to the orbital plane.

Earth's Axis Tilt:

Look at the figures, actually earth is tilted at some angle from the perpendicular of the orbital plane. Axial tilt of the earth is 23.5°.



Axial Tilt of the Earth

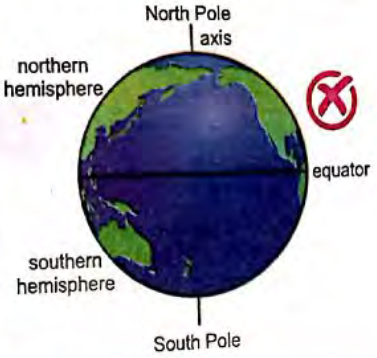


Figure 12.12 Correct Orientation of Earth

Teaching Point: Teacher should bring earth globe with axial tilt to explain the concept of axial tilt, equators, hemispheres. It can be used to explain change in seasons on earth.

UNIT 12 EARTH AND SPACE

Earth revolves around the sun with this axial tilt. Earth's tilted axis causes the seasons. Some people think that Earth is nearest to sun when there is summer on earth and farthest when there is winter on earth. Distance of earth from the Sun affects the temperature on earth but not significant. For example, you are standing facing an electric heater. You will feel significantly high temperature on your face side than the back side. If your face is opposite to the heater then you will feel significantly low temperature on your face although distance from heater is not changed yet. The same reason is for the summer and winter seasons on the Earth.

Figure 12.13 Facing Heat Source means high temperature

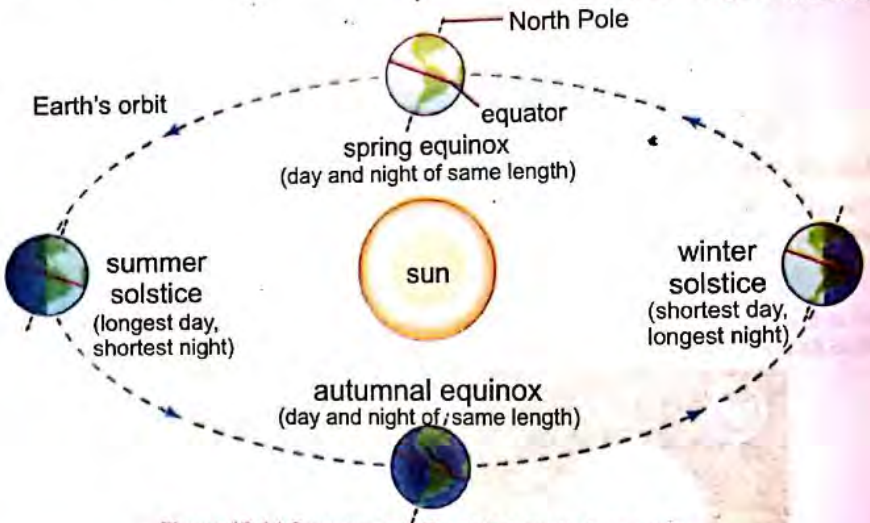


Figure 12.14 Seasons and Revolving Earth Around Sun

During the orbital motion of earth around sun, when the axis of the Earth is towards the sun then summer season is there for that part of earth. When the axis of the Earth is away from the sun then winter season is there for that part of earth. In between these two times, it is spring and autumn.

Constellation:

A constellation is a group of stars that appears to form a pattern or picture like Orion the Great Hunter, Leo the Lion, or Taurus the Bull. Constellations are easily recognizable patterns that help people locate or position themselves using the night sky. If observed through the year, the

constellations shift gradually to the west. This is caused by motion of Earth around our Sun. In the summer, viewers are looking in a different direction in space at night than they are during the winter. Due to axial tilt of the earth, angle of the view to each constellation changes with the motion of earth, that's why they appear at different positions in different months of the year.

Figure 12.15 Constellation (Orion the Great Hunter, Leo the Lion)

12.5 RELATION OF EARTH'S HEMISPHERE WITH ANNUAL ROTATION AROUND THE SUN

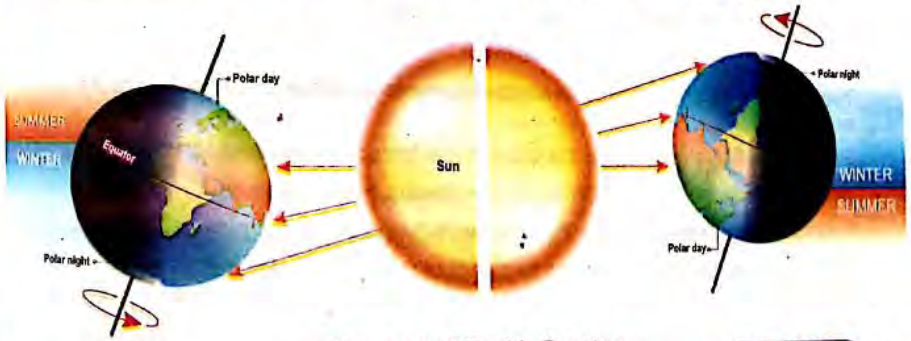


Figure 12.16 Earth's Seasons

There are two main hemispheres of the earth, northern hemispheres and southern hemispheres. Due to tilt of the earth, different parts of the Earth receives maximum direct Sun rays. So, when the tilted axis of the earth is towards the Sun, then Northern Hemisphere receives most of direct sun rays. So, it will be summer in the Northern Hemisphere while it will be winter in Southern Hemisphere.

Figure 12.17 Earth's Hemisphere

And when the South Pole tilts toward the Sun (Tilted axis is away from the Sun) then Southern Hemisphere receives maximum direct sun light. Therefore, it will be summer in Southern Hemisphere and winter in the Northern Hemisphere.

UNIT 12 EARTH AND SPACE

Now you know that when it is winter in Pakistan (Country in Northern Hemisphere) then it is summer in Australia (Southern Hemisphere). In between summer and winter on Northern Hemisphere, it is fall or autumn in northern Hemisphere as shown. And in between winter

Earth's Orbit, Axial Tilt and the Seasons

Figure 12.18 Seasons and Revolving Earth Around Sun

Key Points

- It is the gravity that is forcing planets to move in orbits.
- Quantity of matter in a body is called its mass.
- The force with which earth attracts anything towards its center is called weight of the body on earth."
- Gravitational field strength (g) is the gravitational force on body of mass 1kg.
- Tides are the rise and fall of water level in the oceans, rivers, lakes etc.
- A constellation is a group of stars that appears to form a pattern or picture.
- Earth is tilted at some angle from the perpendicular of the orbital plane.
- There are two main hemispheres of the earth, northern and southern hemispheres.
- When it is summer in the Northern Hemisphere, it will be winter in Southern Hemisphere.

END OF UNIT ASSESSMENT

A. MCQs (Choose the correct option)

1. SI unit of weight is:
   a. Newton b. Kilogram c. Meter per second d. Pascal
2. If 20 kg mass is lifted from earth to moon, what is its mass on moon?
   a. 20 kg b. 2 kg c. 4 kg d. 3.2 kg

3. If value of g on a planet is 25 N/kg then what is weight of 2 kg body on it?
   a. 25 N b. 50 N c. 75 N d. 150 N
4. If it is spring in southern hemisphere of earth then which weather is in northern hemisphere?
   a. Summer b. Winter c. Spring d. Autumn
5. Which of following is involved in producing tides in ocean?
   a. Gravitational pull of moon on earth b. Gravitational pull of sun on Earth
   c. Rotation of earth d. All of these

B. Write true or false. (Correct the statement if it is false)

1. Weight is quantity of matter in a body.

_____

2. Seasons on earth are related to spinning motion of earth.

_____

3. Spring balance is a device to measure weight of a body.

_____

4. Axial tilt of earth is about 23.5°.

_____

5. When it is summer in northern hemisphere then it is spring in southern hemisphere.

_____

C. Short questions

1. Differentiate between mass and weight of body.
2. What is difference in value of gravitational field strength on earth and on moon?
3. If mass of the body is 50 kg, then calculate its weight on earth and on moon.
4. Define the following terms; axis of earth, hemisphere, equator.
5. What is constellation? Why does a constellation position change during a year?
6. Briefly explain, how axial tilt is used in season change on earth?
7. "If there was no axial tilt then there would have been no change in seasons on earth". Support or oppose this statement with reason.
8. How does Sun hold planets in their orbits?
9. If the gravity between earth and moon suddenly disappears, what will happen to moon which is revolving around earth?

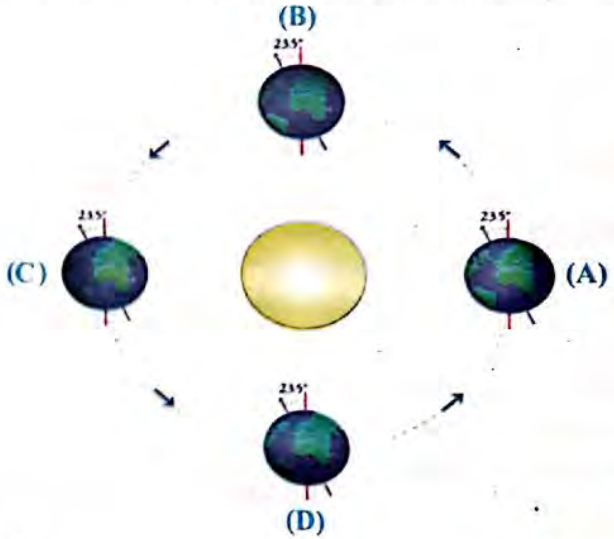
D. Long questions:

1. How does gravity help to keep the planets in their orbits around sun?
2. Differentiate between mass and weight of a body.
3. What is the axial tilt of the Earth? Describe its role in the earth's day and night. What role does it play in the earth's seasonal change?
4. Describe how seasons in earth's hemispheres are related to Earth's annual movement around the sun?

E. Structured response questions

1. Draw equator, axial tilt, spinning axis of earth, longitude and latitude, southern and northern hemisphere.

2. Label the diagram with different seasons in southern hemisphere



F. Project work

Make a working model of tilted earth rotating around Sun which would be helpful in explaining the season in different parts of the world during a year

GLOSSARY

Unit 1

Aerial parts: the parts of plants above ground e.g. Stem, leaves, flowers etc.
Cellular respiration: the release of energy in living organisms which occurs when food molecules are broken down
Chlorophyll: is the green pigment in plants responsible for photosynthesis
Compost is a type of fertilizer that is made from rotting plants
Cuticle: an outer, shiny, protective covering on green parts of the plant
Dermal tissue or **epidermis** covers the plant
Ground tissue fills the soft parts of plant
Phloem: tiny tubes in a plant that carry food from the leaves to other parts of the plant
Photosynthesis: the process by which plants prepare their own food using water and carbon dioxide, in the presence of sunlight and chlorophyll
Respiration: the process by which living things release energy from food
Root hair: a single celled, hair-like structure near the tip of a root for absorption of water and minerals
Stomata: many tiny pores in the epidermis of leaves and green stems
Tap root: a main root of tap root system that grows vertically downwards
Transpiration: the loss of water from the leaf stomata
Vascular bundle: a part of transport system in plants which contains xylem and phloem
Vascular tissue: transports water, minerals and food to different parts of the plant
Wilting: the drying out, drooping, and withering of plant leaves due to less water supply and more transpiration
xylem: tiny tubes in a plant that carry water and dissolved minerals from the roots to all parts of the plants

Unit 2

Aerobic respiration: the process of cellular respiration in the presence of oxygen
Alveoli: tiny, balloon shaped air sacs where exchange of gases takes place between blood and air
Anaerobic respiration: the process of cellular respiration in the absence of oxygen
Artery: the blood vessel which takes blood away from heart

Blood: the red coloured fluid in blood vessels
Breathing: the physical process of exchange of gases
Bronchi: two main branches of trachea that enter into each lung
Bronchioles: tiny branches of bronchi within the lungs
Circulatory system: the system of heart, blood vessels and blood responsible for exchange of gases
Exhalation: or breathe out is the movement of air from lungs to surrounding
Inhalation: or breathe in is the movement of air from surrounding to lungs
Larynx: a voice box at the upper part of trachea.
Lungs: a pair of spongy, air-filled, breathing organs located in the chest.
Mucus: a slippery, thick, sticky liquid that covers and protects different body parts e.g. Stomach, nose, lungs and intestines.
Nasal cavity: a cavity inside nose.
Nostrils: two holes in your nose through which you breathe, smell and sneeze.
Pulse: the regular beating of blood through arteries.
Respiratory system: the system of lungs and air passage ways for breathing and exchange of gases at alveoli
Trachea: a wind pipe that connects larynx and bronchi.
Valve: a flap to maintain one-way flow of blood in heart and veins
Vein: the blood vessel which takes blood towards heart

Unit 3

Adaptive immunity: is an immunity that occurs after exposure to an antigen either from a pathogen or a vaccination
Antibodies: are specific proteins produced by B cells which can defend body against pathogens
B cells: are part of 3rd line of defence which kill pathogens by antibodies
Covid-19: is a virus that can cause mild to severe respiratory illness
Dengue fever: is a tropical disease caused by a virus carried by mosquitoes. The virus can cause fever, headaches, rashes, and pain throughout the body
Immune response: is the way the body defends itself against harmful substances
Immune system: is the basic defence system of the body that protects us from harmful pathogens and diseases
Innate: or nonspecific, immunity is the defence system with which you were born.
Passive immunity: occurs when we are protected from a pathogen by immunity gained from someone else
T cells: are part of 3rd line of defence which kill virus infected and cancer cells of the body
Typhoid: is a bacterial infection that can lead to a high fever, diarrhoea, and vomiting. It can be fatal
Vaccination: is a simple, safe, and effective way of protecting people against harmful diseases, before they come into contact with them.
Viral hepatitis: is an inflammation of your liver that's caused by a virus

Unit 4

Combustion: the burning of fuel, where it reacts with oxygen to create heat and light.
Ductility: ability to be pulled into a wire
Flammable: ability to react with air and catch fire
Malleable: ability to be rolled in a sheet
Matter: anything that has mass and occupy space.
Metal: elements which are good conductor of heat and electricity.
Physical change: a change in which no new substance is formed.
Physical property: a characteristics of matter which can be observed or measured.
Rusting: it is a process in which iron combines with water and oxygen to form rust.
Tarnishing: to tarnish is to become dull or discoloured due to traces of hydrogen sulphide in the air.
Thermal: conductivity: the ability to transfer heat

Unit 5

Atom: an atom is an electrically neutral particle. It is the smallest constituent unit of matter that possess the properties of an element.
Atomic number: the number of protons in the nucleus of an atom is called its atomic number or proton number and is represented by the letter "Z".
Electron: negatively charged particle revolves around the nucleus in their fixed path called shell.
Electronic configuration: distribution of electrons into various shells around the nucleus of an atom is called the electronic configuration.
Mass number: mass number is the sum of the number of protons and neutrons in the nucleus of an atom. It is represented by the symbol "A".
Neutron: neutral particle found in the nucleus.

Proton: positive particle found in nucleus.
Shell: the fixed path in which electrons revolve is called a shell.

Unit 6

Anions: a negatively charged ion.
Cations: a positively charged ion.
Ions: an atom or molecule with a net electric charge due to the loss or gain of one or more electrons.
Valency: the combining power of an element.

Unit 7

Aqueous solution: a solution in which the solvent is water.
Concentrated solution: a solution which contains a large amount of solute in a solution.
Dilute solution: a dilute solution in which there is a relatively small amount of solute dissolved in the solution
Saturated solution: a solution in which the maximum amount of solute has been dissolved.
Solute: the substance dissolved in a solvent in forming a solution.
Solution: a homogenous mixture of two or more substances is called solution.
Solvent: the substance which is able to dissolve other substances.
Super saturated solution: a solution (with more solute than the saturated solution) that contains more undissolved solute than the saturated solution
Unsaturated solution: a solution (with less solute than the saturated solution) that completely dissolves, leaving no remaining substances.

Unit 8

Average speed: Average speed of a body is equal to total distance covered by body in total time taken by it.
Contact force: a force that acts only when there is physical contact between two bodies.
Force: force is the agency which changes or tends to change the state or motion of the body. It can change direction of motion of the body.
Friction: friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other.
Graph: diagramatic way of representing the relation between two or more quantities.

Gravitational force: it is the force of attraction that exist between two objects.
Inertia: every body wants to maintain its state either of rest or of uniform motion.
Newton: it is the unit of force.
Non-contact force: it is the force that acts on the object, without any physical contact with it.
speed: distance covered by an object in unit time is called its speed.

Unit 9

Amplitude: amplitude is measure of the displacement of the wave from its rest position.
Frequency: the number of waves passing through certain point in unit time is called frequency.
Light waves: light is a type of electromagnetic waves that is visible to the eye.
Longitudinal waves: those wave in which the disturbance is parallel to the direction of propagation is termed as a longitudinal wave.
Sound waves: sound waves are waves created by difference in pressure of air longitudinally.
Transverse wave: those wave in which the disturbance is perpendicular to the direction of propagation of wave vibrations of particles of medium.
Wave speed: the distance travelled by wave in unit time is termed as wave speed.
Wave: any disturbance that transmits energy through matter or empty space is called wave.
Wavelength: wavelength is the measure of the distance between two successive wave peaks.

Unit 10

Conduction: conduction is heat transfer through stationary matter by physical Contact.
Convection: convection is heat transfer by the macroscopic movement of fluid.
Heat: heat is thermal energy transferred from a hotter object to a colder object.
Radiation: radiation is energy transferred by electromagnetic waves.
Temperature scales: the scale which is made for the measurement of temperature are termed as temperature scales.
Temperature: temperature is the quantity that indicates how hot or cold an object is, relative to some standard.
Thermal expansion: the change in size or volume of an object with change m temperature is called thermal expansion.

ACKNOWLEDGMENTS

Unit 1

Unit opener: Pinterest, Fig 1.1: slideshare.net, Fig 1.2: Green Man Lawn Care, Do you know: Digital Desert, Interesting Facts: youtube.com, Fig 1.8: Unacademy, Activity: Activity Box, Fig 1.9: NASA Climate Kids, Fig 1.10: oasisacademy, Try it out: USGS, Activity: Collins Connect, Fig 1:11: Pearson, Fig 1.12: SlidePlayer, Exercise: ABC Science,

Unit 2

Fig 2.1: LinkedIn, Arab NewsPk, Fig 2.5: thesuttonacademy, Try it out: Mobrite, Fig 2.6, 2.7: Shutterstock, Fig 2.8: Toppr, Fig 2.9: Byju's, Activity: The Health Board, Exercise: Cleveland Clinic, amazonaws, Quizlet, Brainly

Unit 3

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Unit 4

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Unit 5

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Unit 6

Fig 6.1: Myloview, Fig 6.4: Expii, Fig 6.5: Ibchem, Fig 6.6: SlidePlayer

Unit 7

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Unit 8

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Unit 9

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Unit 10

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Unit 11

Fig 11.3: bubish, Fig 11.4: malibucompost, Fig 11.5, 11.6: youtube, Fig 11.7: facebook, Fig 11.8: gestion, Fig 11.9: hornbeam, Figure 11.11: myfermentation

Unit 12

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USEFUL LINKS

Unit 1

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Unit 2

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Unit 3

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Unit 7

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UNIT 8

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INDEX

ABOUT THE AUTHORS

Ms. Ruqayya Shaikh

Ruqayya Shaikh did her M.Sc and M.Phil in Animal Sciences from Quaid-i-Azam University, Islamabad. She started her professional career as a Zoology lecturer at Islamabad College for girls, F-6/2, Islamabad. At present she is working as Associate professor in the same institute. She has been teaching G. Science to secondary school classes, Biology to SSC, HSSC and BS classes for the last two decades. Recently she certified in instructional leadership, College of Education, University of Massachusetts, USA.

She was the part of the General science Curriculum development team, Grade 4-8, under National Curriculum council. She worked as text book reviewer for General science Grade 4, General Science Grade 5, Biology HSSC I and Biology HSSC II. She served as FBISE Biology course committee member. The author conducted a number of teacher training programs. She is the author of General Science: grade 6 and grade 7 books; Biology SSC I and II by NBF. For queries about biology related Units of grade 6 and grade 7 contact at

ruqayyashaikhauthor@gmail.com

Mian Imran Khaliq

Mian Imran Khaliq has done M. Sc Physics from University of Sargodha and M. Phil in Applied Physics from FUUAST, Islamabad. He is currently serving as an Assistant Professor at IMCB, G-10/4, Islamabad. Previously, he served as a Lecturer (Physics) at Punjab College, Cantt Campus, Rawalpindi and OPF College Islamabad. He has written Physics books for SSC, HSSC and Entry test preparation for different university exams. His famous books are "An Essay Approach to Physics and "Conceptual Physics" (for entrance test exams).

He worked as text book reviewer for General Science Grade 4 and General Science Grade 5. He is member of Physics course committees of Federal Directorate of Education and FBISE. He conducted different training sessions at different levels as teacher trainer. For queries about physics related Units of grade 7 contact at mianimrankhaliq@gmail.com

Ms. Sidra Qasim

Sidra Qasim did her M.Sc in Chemistry from Government College Lahore University. She progressed her career by joining Beaconhouse School system as a teacher to currently holding the status of headmistress for the last 9 years. Alongside her successful reign of headship, she received her CPEd- cerificiate in professional development from Plymouth university London and DTDT course by the International University of Cambridge. She completed her E foundation (IT course) as well as middle management course, both for a duration of 8 months respectively. She is certified in project based learning PBL- teach thought by attending a total of 5 courses, 4 courses in Lahore and 1 in Dubai. She is currently a part of a Beaconhouse School uninterrupted training program, dealing with new methologies of teaching and schooling against the pandemic situation. She has recently worked with the Government of Pakistan for Single National Curriculum for middle school general science. She is a highly motivated, skilled and steadfast professional, who has rigorously worked in the field of education for the past 23 years and current time. For queries related to science Units contact: sidra.qasim@bh.edu.pk

Ms. Gul-e-Zehra

Ms. Gul-e-Zehra did her M.Sc in organic chemistry and M.Ed from Agha Khan University Institute for Educational Development Karachi in Science Teaching and Learning under STEP Project. She started her Professional career from Pak-Turk International Schools and colleges as Section Head and Science teacher in 2002. Later, in 2005, she joined her current job as Senior Teacher Chemistry at Islamabad Model College for Girls G-6/1-4. She has been teaching Science to secondary classes and Chemistry to SSC and HSSC for last fifteen years. She worked as an author, professional development trainer, researcher. She also worked as a head of Professional Development Department in Fatimiyah Education Network, Karachi.

For queries about chemistry related Units of grade 7 contact at gulezehra87@gmail.com.

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6.	Activities, projects and additional work is suggested for reinforcement of concepts.	
7.	Assessment achievements are thought provoking and comprise cognitive, psychomotor and effective skills.	
8.	The textbook is easy to be covered within academic year.	

Page No.	Observation/comments	Suggested amendment along with rationale

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