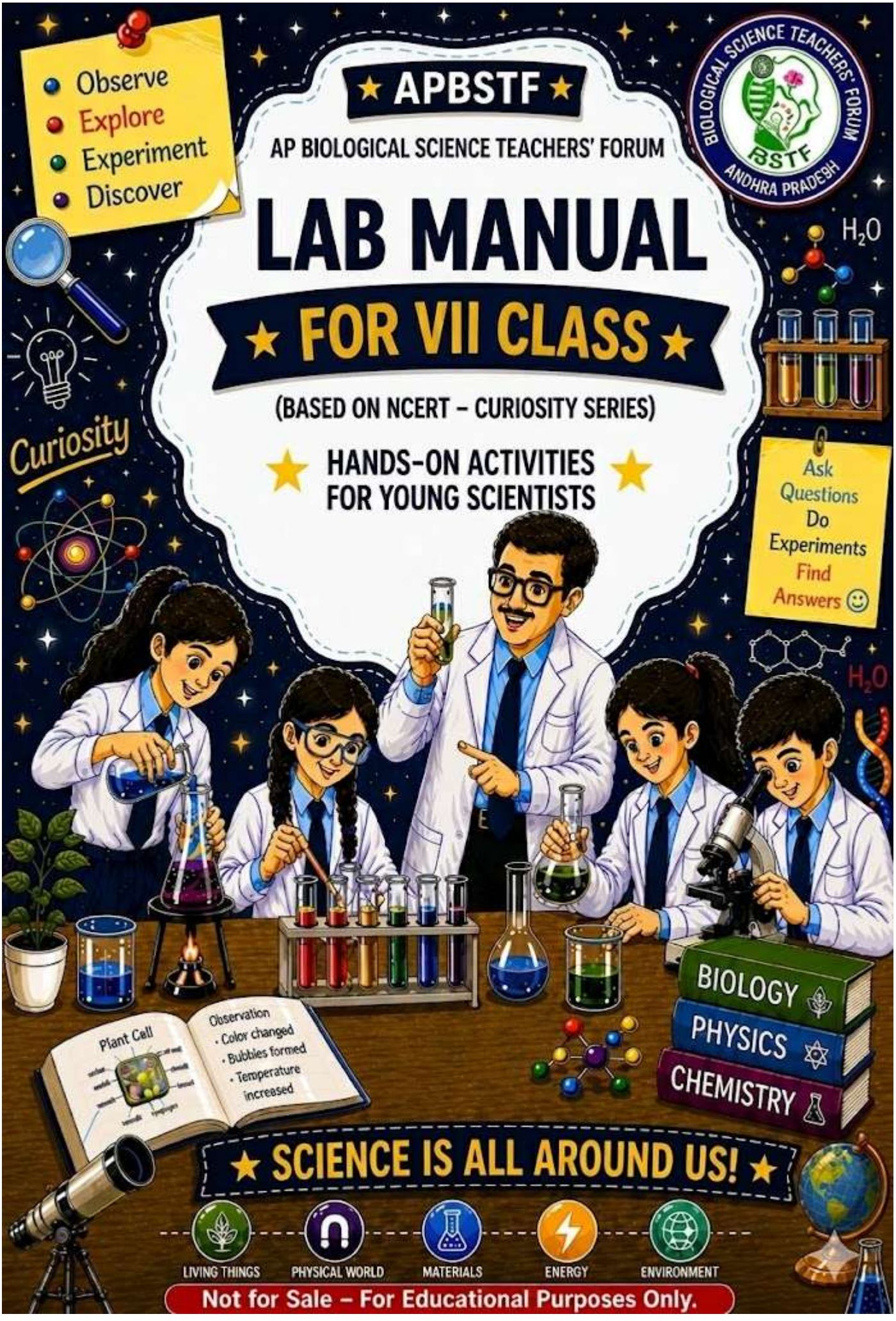
Observe
Explore
Experiment
Discover
APBSTF
AP BIOLOGICAL SCIENCE TEACHERS' FORUM
BIOLOGICAL SCIENCE TEACHERS' FORUM
BSTF
ANDHRA PRADESH
LAB MANUAL
FOR VII CLASS
(BASED ON NCERT – CURIOSITY SERIES)
HANDS-ON ACTIVITIES
FOR YOUNG SCIENTISTS
Curiosity
Ask
Questions
Do
Experiments
Find
Answers
Plant Cell
Observation
• Color changed
• Bubbles formed
• Temperature increased
BIOLOGY
PHYSICS
CHEMISTRY
SCIENCE IS ALL AROUND US!
LIVING THINGS
PHYSICAL WORLD
MATERIALS
ENERGY
ENVIRONMENT
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BSTF
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★ APBSTF ★

ANDHRA PRADESH BIOLOGICAL SCIENCE TEACHERS' FORUM

LAB MANUAL

★ FOR CLASS VII ★

(Based on NCERT – CURIOSITY SERIES)

- Observe
- Explore
- Experiment
- Discover

S.No	Chapter No & Name	Activity No & Activity	Type of Activity
1	1. Ever-Evolving World of Science	1.1 Question the Answer	Creative Activity
2	 2. Exploring Substances: Acidic, Basic and Neutral	2.1 Testing with Litmus Paper	Experiment
3		2.2 Taste and Touch Test	Observation
4		2.3 Preparing Red Rose Extract	Experiment
5		2.4 Testing with Rose Extract	Experiment
6		2.5 Preparing Turmeric Paper	Experiment
7		2.6 Testing with Turmeric Paper	Experiment
8		2.6(b) Onion as Indicator	Experiment
9		2.7 Neutralisation	Experiment
10	 3. Electricity – Circuits and Their Components	3.1 Exploring a Torchlight	Observation
11		3.2 Observing an Electric Cell	Observation
12		3.3 Battery Formation	Experiment
13		3.4 Incandescent Lamp	Observation
14		3.5 LED Observation	Observation
15		3.6 Making a Lamp Glow	Experiment
16		3.7 Making an LED Glow	Experiment
17		3.8 Making a Simple Switch	Model Activity
18		3.9 Testing the Switch	Experiment
19		3.10 Drawing Circuit Diagrams	Drawing Activity
20		3.11 Conductors and Insulators	Experiment
21	 4. The World of Metals and Non-Metals	4.1 Malleability	Experiment
22		4.2 Sonority	Experiment
23		4.3 Conduction of Heat	Experiment
24		4.4 Conduction of Electricity	Experiment
25		4.5 Rusting Experiment	Experiment
26		4.6 Burning Magnesium	Demonstration
27		4.7 Burning Sulfur	Demonstration
28		4.7(b) Properties of Sulfur	Demonstration
29		4.8 Sulfur in Water	Experiment
30	 5. Changes Around Us: Physical and Chemical	Activity 1 Melting of Ice	Experiment
31		Activity 2 Burning of Candle	Experiment
32		Activity 3 Rusting of Iron	Experiment
33		Activity 4 Vinegar + Baking Soda	Experiment
34		Activity 5 Heating Copper Sulphate	Experiment
35		Activity 6 Burning Magnesium	Experiment
36		Activity 7 Breaking Chalk	Experiment
37	 6. Adolescence: A Stage of Growth and Change	6.1 Changes During Growing Up	Activity
38		6.2 Emotional Changes	Activity
39		6.3 Nutritional Needs	Activity
40		6.4 Social Media Awareness	Project
41	 7. Heat Transfer in Nature	7.1 Conduction in Metal Strip	Experiment
42		7.2 Convection in Air	Experiment
43		7.3 Convection in Water	Experiment
44		7.4 Heating of Soil vs Water	Experiment
45		7.5 Water Seepage	Experiment
46	 8. Measurement of Time and Motion	8.1 Water Clock	Construction
47		8.2 Simple Pendulum	Experiment
48		8.3 Wall Clock Study	Observation
49		8.4 Speed Calculation	Activity
50	 9. Life Processes in Animals	9.1 Action of Saliva on Starch	Experiment
51		9.2 Breathing Model	Model Activity
52		9.3 CO_2 in Exhaled Air	Experiment
53	 10. Life Processes in Plants	10.1 Role of Sunlight & Water	Experiment
54		10.2 Starch Test (Iodine Test)	Experiment
55		10.3 Chlorophyll Necessity	Experiment
56	 11. Light: Shadows and Reflections	11.1 Formation of Shadows	Experiment
57		11.2 Pinhole Camera	Model Activity
58		11.3 Reflection by Mirror	Experiment
59	 12. Earth, Moon and the Sun	12.1 Drawing Constellations	Drawing Activity
60		12.2 Pole Star Identification	Observation
61		12.3 Orion & Sirius Identification	Observation
62		12.4 Identifying Venus	Observation

★ SCIENCE IS ALL AROUND US! ★

VII CLASS SCIENCE: CURIOSITY

CHAPTER 1. THE EVER-EVOLVING WORLD OF SCIENCE

Activity 1.1: Question the Answer

Aim: To develop the skill of asking creative and interesting questions.

Materials Required: Notebook, pencil.

Procedure:

1. Read the given answers carefully.
2. Think of different situations for each answer.
3. Frame a creative question for each answer.
4. Write your questions in the notebook.

Observation:

1. Different students create different questions.
2. Questions can be creative and fun.

Conclusion:

Asking good questions is an important part of science learning.

Answer: Because the cat's teeth were crooked.
Question: _____?

Answer: Just add some milk.
Question: _____?

Answer: Don't panic, I have my towel.
Question: _____?

Answer: 42
Question: _____?

(Please ask a more interesting, and not obvious questions like "What is 32+10?", or even "What is the answer to life, the universe, and everything?")

CHAPTER 2. EXPLORING SUBSTANCES: ACIDIC, BASIC, AND NEUTRAL

Activity 2.1: Exploring Substances: Acidic, Basic, and Neutral

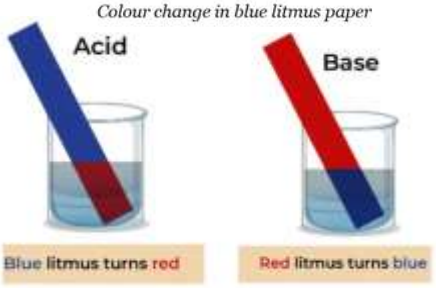
Aim: To test different substances and find out whether they are acidic, basic, or neutral.

Materials Required: Litmus paper (red and blue), Dropper, Distilled water, Lemon juice, Soap solution, Sugar solution, Vinegar, Baking soda solution.

Colour change in blue litmus paper

Procedure:

1. Take a few drops of each substance in separate test tubes.
2. Dip red litmus paper into the substance and note the change.
3. Dip blue litmus paper into the same substance and note the change.
4. Record the observations carefully.



Observation:

1. Lemon juice turns blue litmus red. Soap solution turns red litmus blue.
2. Sugar solution does not change the color of either litmus paper.
3. Vinegar turns blue litmus red.
4. Baking soda solution turns red litmus blue.

Observation Table:

Substance	Effect on Red Litmus	Effect on Blue Litmus	Nature of Substance
Lemon juice	No change	Turns red	Acidic
Soap solution	Turns blue	No change	Basic
Sugar solution	No change	No change	Neutral
Vinegar	No change	Turns red	Acidic
Baking soda solution	Turns blue	No change	Basic

Result:

1. Lemon juice and vinegar are **acidic**.
2. Soap solution and baking soda solution are **basic**.
3. Sugar solution is **neutral**.

Colour change in red litmus paper

Inference:

1. Acidic substances turn blue litmus red.
2. Basic substances turn red litmus blue.
3. Neutral substances do not change the color of litmus paper. Colour change in red litmus paper.

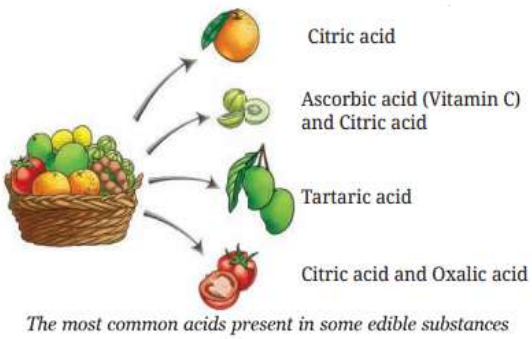
Activity 2.2: Taste and Touch Test

Aim: To identify substances as acidic, basic, or neutral by their taste and touch.

Materials Required: Lemon juice, Vinegar, Soap solution, Baking soda solution, Sugar solution, Clean spoons and fingers (for safe touch).

Procedure:

1. Take a small amount of each substance separately.
2. Taste carefully (only edible ones like lemon juice, vinegar, sugar solution).
3. Touch gently with clean fingers (for soap solution and baking soda solution).
4. Note the taste and feel of each substance.



The most common acids present in some edible substances

Observation:

1. Lemon juice: Sour taste.
2. Vinegar: Sour taste.
3. Soap solution: Slippery to touch.
4. Baking soda solution: Slippery to touch.
5. Sugar solution: Sweet taste.

Result:

1. Sour taste indicates **acidic substances** (lemon juice, vinegar).

2. Slippery touch indicates **basic substances** (soap solution, baking soda solution).
3. Sweet taste indicates **neutral substance** (sugar solution).

Inference:

1. Acids usually taste sour.
2. Bases usually feel slippery.
3. Neutral substances may taste sweet or have no special taste.

Activity 2.3: Preparing Red Rose Extract

Aim: To prepare an extract from red rose petals and use it as a natural indicator.

Materials Required: Fresh red rose petals, Mortar and pestle (or bowl and spoon), Beaker or glass, Distilled water, Filter paper or clean cloth.

Procedure:

1. Collect a few fresh red rose petals.
2. Crush the petals using a mortar and pestle (or spoon) to make a paste.
3. Add a little distilled water and mix well.
4. Filter the mixture using filter paper or a clean cloth.
5. Collect the red-colored liquid in a beaker. This is the rose extract.

Red roses

Red rose petals immersed in hot water

Observation:

1. The liquid obtained is red in color.
2. When tested with acidic substances (like lemon juice), the color changes.
3. When tested with basic substances (like soap solution), the color changes differently.

Result:

1. **Red rose** extract can act as a **natural indicator**.
2. It shows different colors in acidic and basic solutions.

Inference: Natural substances like rose petals can be used to prepare indicators. They help us identify whether a solution is acidic or basic without using chemical indicators.

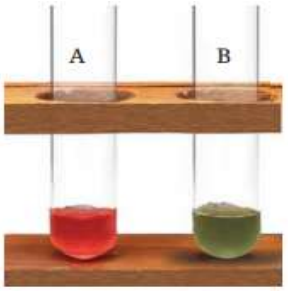
Activity 2.4: Testing with Red Rose Extract

Aim: To test different substances using red rose extract as a natural indicator.

Materials Required: Red rose extract (prepared in Activity 2.3), Lemon juice, Vinegar, Soap solution, Baking soda solution, Sugar solution, Dropper, Test tubes.

Procedure:

1. Take small amounts of each substance in separate test tubes.
2. Add a few drops of red rose extract to each test tube.
3. Observe the color change, if any.
4. Record the observations.



The changes in colour of the red rose extract on adding lemon juice (A) and soap solution (B)

Observation Table:

Substance	Color after adding Rose Extract	Nature of Substance
Lemon juice	Turns reddish / pink	Acidic
Vinegar	Turns reddish / pink	Acidic
Soap solution	Turns greenish / bluish	Basic
Baking soda solution	Turns greenish / bluish	Basic
Sugar solution	No change	Neutral

Result:

1. Acidic substances (lemon juice, vinegar) turn rose extract reddish/pink.
2. Basic substances (soap solution, baking soda solution) turn rose extract greenish/blue.

3. Neutral substances (sugar solution) show no change.

Inference:

Red rose extract can be used as a natural indicator. It changes color in acidic and basic solutions but remains unchanged in neutral solutions.

Activity 2.5: Preparing Turmeric Paper

Aim: To prepare turmeric paper and use it as a natural indicator.

Materials Required: Turmeric powder, White paper strips, Water , Brush or dropper, Soap solution (for testing later).

Procedure:

1. Mix turmeric powder with a little water to make a paste.
2. Apply the paste evenly on strips of white paper using a brush.
3. Allow the paper strips to dry completely.
4. The dried strips are now turmeric paper.
5. Test by putting a drop of soap solution on the turmeric paper.

(a) Turmeric paste *(b) Turmeric paper strips*

Observation:

1. The turmeric paper is yellow in color.
2. When a drop of soap solution is placed, the yellow color changes to reddish-brown.

Result:

1. Turmeric paper can be used as a **natural indicator**.
2. It changes color in the presence of basic substances.

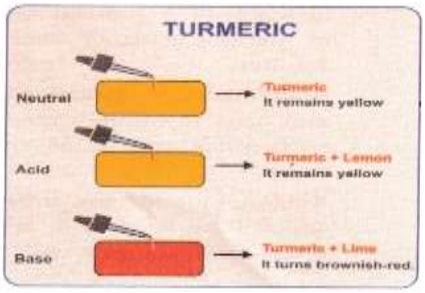
Inference: Turmeric paper remains yellow with acids and neutral substances.It turns reddish-brown with bases.

Activity 2.6: Testing with Turmeric Paper

Aim: To test different substances using turmeric paper as a natural indicator.

Materials Required: Turmeric paper (prepared in Activity 2.5), Lemon juice, Vinegar, Soap solution, Baking soda solution, Sugar solution, Dropper, Test tubes.

Procedure:



1. Take strips of turmeric paper.
2. Place a drop of each substance on separate strips.
3. Observe the color change, if any.
4. Record the observations.

Observation Table:

Substance	Effect on Turmeric Paper	Nature of Substance
Lemon juice	No change (remains yellow)	Acidic
Vinegar	No change (remains yellow)	Acidic
Soap solution	Changes to reddish-brown	Basic
Baking soda solution	Changes to reddish-brown	Basic
Sugar solution	No change (remains yellow)	Neutral

Result:

1. Acidic substances (lemon juice, vinegar) show no change in turmeric paper.
2. Basic substances (soap solution, baking soda solution) turn turmeric paper reddish-brown.
3. Neutral substances (sugar solution) show no change.

Inference:

Turmeric paper acts as a natural indicator.

It detects bases by changing color to reddish-brown, but shows no change with acids or neutral substances.

Activity 2.6 (b): Onion as an Olfactory Indicator

Aim: To test the use of onion as an olfactory (smell-based) indicator for identifying acidic and basic substances.

Materials Required: Fresh onion, Mortar and pestle (or grater), Cloth or filter paper, Lemon juice, Soap solution, Vinegar, Baking soda solution, Sugar solution.

Procedure:

1. Crush fresh onion to obtain its strong smell.
2. Place the onion extract or onion paste on a clean cloth or filter paper.
3. Add a few drops of lemon juice, vinegar, soap solution, baking soda solution, and sugar solution separately.
4. Smell each sample carefully and note the changes.

Observation Table:

Substance	Effect on Onion Smell	Nature of Substance
Lemon juice	Smell remains same	Acidic
Vinegar	Smell remains same	Acidic
Soap solution	Onion smell disappears	Basic
Baking soda solution	Onion smell disappears	Basic
Sugar solution	Smell remains same	Neutral

Result:

1. Onion smell remains unchanged with acidic and neutral substances.
2. Onion smell disappears with basic substances.

Inference: Onion acts as an olfactory indicator. It helps to identify bases by the disappearance of its smell, while acids and neutral substances do not affect the smell.

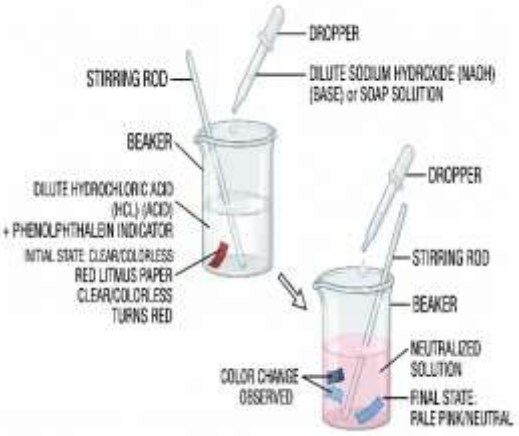
Activity 2.7: Neutralisation Experiment

Aim: To observe what happens when an acid and a base react together.

Materials Required: Dilute hydrochloric acid (HCl) or lemon juice (acid), Dilute sodium hydroxide (NaOH) or soap solution (base), Beaker, Dropper, Litmus paper or phenolphthalein indicator.

Procedure:

1. Take a small amount of acid (like lemon juice or dilute HCl) in a beaker.
2. Add a few drops of indicator (litmus or phenolphthalein).
3. Slowly add the base (like soap solution or dilute NaOH) drop by drop using a dropper.
4. Stir gently and observe the color change.
5. Continue adding until the indicator shows no acidic or basic effect.



Observation:

1. Initially, the solution shows acidic nature (red litmus or pink with phenolphthalein).
2. On adding base, the color gradually changes.
3. At a certain point, the solution shows no effect on indicator (neutral).

Result:

1. Acid and base react together to form a neutral solution.
2. This reaction is called **Neutralisation**.

Inference: **Neutralisation** is the reaction between an acid and a base to form salt and water. It removes the effect of both acid and base.

CHAPTER 3. ELECTRICITY - CIRCUITS AND THEIR COMPONENTS

Lab Activities (Hands-on): 3.3, 3.6, 3.7, 3.8, 3.9, 3.11

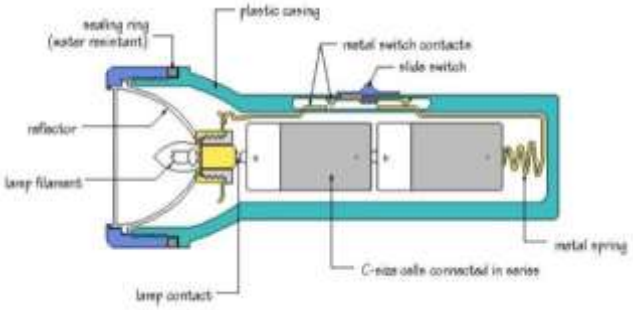
Activity 3.1: Exploring a Torchlight

Aim: To study the internal parts of a torch and understand how they help in producing light.

Materials Required: A torchlight, Two dry cells (torch cells), Screwdriver (if needed to open the torch).

Procedure:

1. Open the torch carefully and observe its internal parts.
2. Identify the **bulb**, **cells**, **switch**, and **connecting wires**.
3. Note how the cells are placed - the **positive terminal** of one cell touches the **negative terminal** of the next.
4. Observe how the switch connects or disconnects the circuit.
5. Reassemble the torch and turn it on.



Observation:

Part of Torch	Function
Cells	Provide electrical energy.
Bulb	Converts electrical energy into light.
Switch	Opens or closes the circuit.
Metal Strip/Wires	Conduct electricity between components.

Result:

1. The torch glows when the circuit is complete (Switch **ON**).
2. The torch does not glow when the circuit is open (Switch **OFF**).

Inference:

1. A torch works on a simple electric circuit.
2. When the switch is ON, current flows from the cells through the bulb, making it glow.
3. When the switch is OFF, the circuit breaks and the bulb goes OFF.

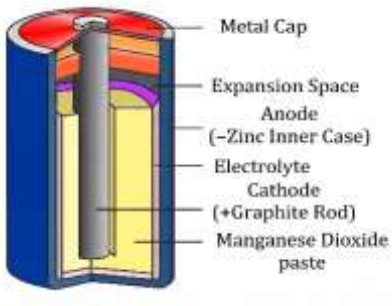
Activity 3.2: Observing an Electric Cell

Aim: To observe the structure and identify the parts of an electric cell.

Materials Required: One dry cell (torch cell), Magnifying glass (optional).

Procedure:

1. Take a dry cell and observe its outer covering.
2. Identify the **positive terminal (+)** - A small metal cap on one end.
3. Identify the **negative terminal (–)** - A flat metal base on the other end.
4. Note the markings and symbols printed on the cell.
5. Observe the direction of current flow when connected in a circuit.



Observation:

Part of Cell	Description / Function
Positive Terminal (+)	Small metal cap; current flows out from here.
Negative Terminal (–)	Flat metal base; current enters here.
Outer Covering	Protects the chemicals inside the cell.
Label / Markings	Show voltage and brand information.

Result:

1. An electric cell has two terminals - positive and negative.
2. Current flows from the positive terminal through the circuit and returns to the negative terminal.

Inference:

An electric cell is a source of electrical energy. It converts chemical energy into electrical energy, enabling current to flow in a circuit.

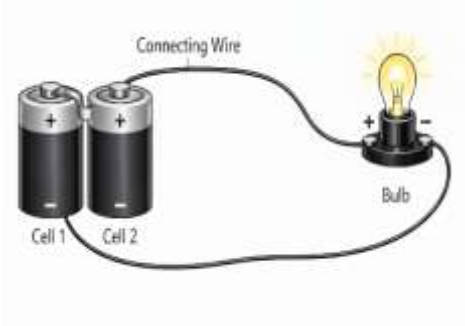
Activity 3.3: Battery Experiment with Torch Cells

Aim: To understand how a battery is formed by combining two or more cells and how it helps in lighting a bulb.

Materials Required: Two dry cells (torch cells) **,** Connecting wires**,** A small electric bulb**,** Cell holder or tape.

Procedure:

1. Observe the two ends of a dry cell — the **positive terminal (+)** and the **negative terminal (–)**.
2. Connect the **negative terminal** of the first cell to the **positive terminal** of the second cell using a wire or tape.
3. Attach connecting wires from the free terminals of the two cells to the bulb holder.
4. Observe the bulb.



Observation:

1. When the cells are connected correctly (positive to negative), the bulb glows.
2. If the cells are connected incorrectly (positive to positive or negative to negative), the bulb does not glow.

Result:

1. Two or more cells joined together form a **battery**.
2. The battery provides more energy than a single cell.

Inference:

1. A battery is formed by connecting cells in series - the positive terminal of one cell to the negative terminal of the next.
2. This arrangement increases the total potential difference and helps the bulb glow brighter.

Activity 3.4: Observing an Incandescent Lamp

Aim: To observe the structure and working of an incandescent lamp (bulb).

Materials Required: Incandescent lamp (electric bulb), Magnifying glass (optional)

Procedure:

1. Take an electric bulb and observe it carefully.
2. Identify the **glass covering**, **metal base**, and **filament** inside the bulb.
3. Note how the filament is connected to the two terminals at the base.
4. Connect the bulb to a circuit and observe what happens when current flows.

Observation:

1. The bulb has a thin **filament** inside.
2. When current passes, the filament glows and produces light.
3. The glass covering protects the filament.

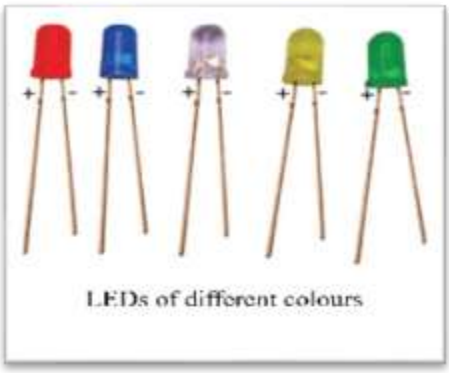
Result: The incandescent lamp produces light because the filament gets heated to a high temperature when current flows through it.

Inference: An incandescent lamp converts **electrical energy into heat and light energy**.

Activity 3.5: Observing an LED

Aim: To observe the structure and working of a Light Emitting Diode (LED).

Materials Required: LED**,** Magnifying glass (optional).



Procedure:

1. Take an LED and observe its structure.
2. Identify the **two legs**:
   - Longer leg → **Positive terminal (+)**
   - Shorter leg → **Negative terminal (–)**
3. Note the transparent plastic covering that protects the LED.
4. Connect the LED in a circuit and observe what happens when current flows.

Observation:

1. The LED glows when connected correctly (positive to positive, negative to negative).
2. If connected in reverse, the LED does not glow.
3. The LED emits light of a specific color (red, green, yellow, etc.).

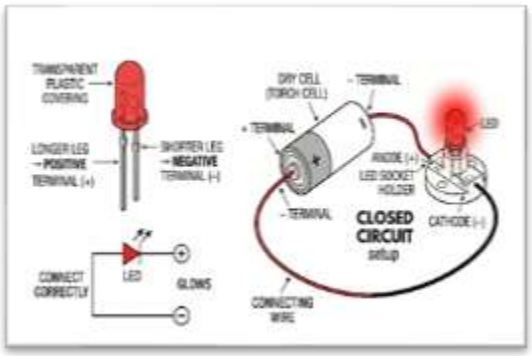
Result: The LED produces light only when current flows in the correct direction.

Inference: An LED is a **unidirectional device**. It converts **electrical energy directly into light energy** and is more efficient than incandescent lamps.

Activity 3.6: Making a Lamp Glow with a Cell

Aim: To construct a simple circuit using a cell and a lamp, and observe how the lamp glows when the circuit is complete.

Materials Required: One dry cell (torch cell), One small electric bulb (lamp), Connecting wires, Tape or bulb holder.



Procedure:

1. Identify the **positive terminal (+)** and **negative terminal (–)** of the cell.
2. Connect one end of a wire to the positive terminal of the cell.
3. Attach the other end of this wire to one terminal of the bulb.
4. Connect another wire from the second terminal of the bulb to the negative terminal of the cell.
5. Observe the bulb.

Observation:

1. When both terminals of the bulb are connected properly to the cell, the bulb glows.
2. If the connections are loose or incomplete, the bulb does not glow.

Result: The lamp glows when the circuit is complete, showing that electric current flows from the cell through the bulb.

Inference:

1. A simple circuit consists of a cell (source of energy), connecting wires (path for current), and a bulb (device that uses electricity).
2. The circuit must be closed for the lamp to glow.

Activity 3.7: Making an LED Glow

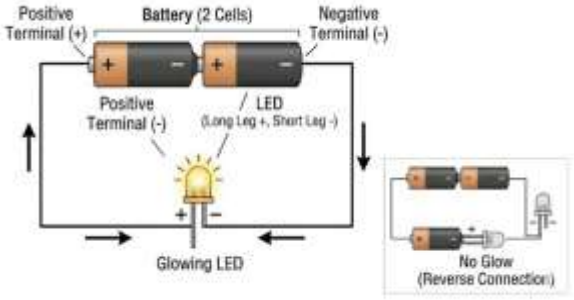
Aim: To make an LED glow by connecting it correctly in a simple electric circuit.

Materials Required: One LED (Light Emitting Diode), Two dry cells (torch cells), Connecting wires, Tape or cell holder.

Procedure:

1. Observe the LED carefully — it has **two legs**:
   - The **longer leg** is the **positive terminal (+)**.
   - The **shorter leg** is the **negative terminal (–)**.
2. Connect the positive terminal of the LED to the positive terminal of the battery using a wire.
3. Connect the negative terminal of the LED to the negative terminal of the battery.

4. Fix the connections properly with tape if needed.
5. Observe the LED.



Observation:

1. When the LED is connected correctly, it glows.
2. If the connections are reversed, the LED does not glow.

Result:

1. The LED glows only when connected in the correct direction.
2. This shows that LED is a **unidirectional device** (it allows current to flow only in one direction).

Inference:

1. LEDs can be used as indicators in circuits.
2. They glow when current flows in the correct direction, helping us understand the flow of electricity.

Activity 3.8: Making a Simple Switch Activity

Activity 3.9: Testing the Switch

Aim: To construct a simple switch and test how it controls the flow of electricity in a circuit.

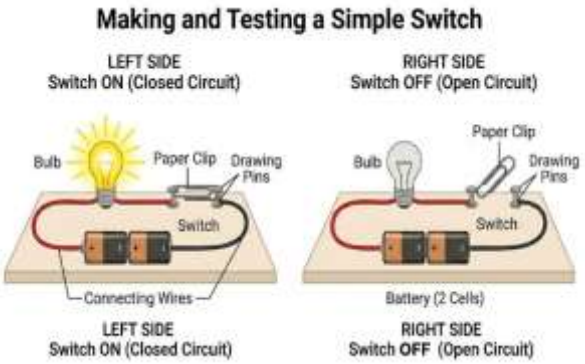
Materials Required: Small piece of thermocol or wooden board, Two drawing pins or screws, A paper clip or thin metal strip, Connecting wires, A small bulb, Two dry cells (torch cells).

Procedure (Construction of Switch — Activity 3.8):

1. Fix two drawing pins on a wooden board about 2 cm apart.
2. Place a paper clip or thin metal strip so that one end is fixed under one pin and the other end can move freely to touch or leave the second pin.
3. Connect wires to both pins.
4. This arrangement acts as a simple switch.

Procedure (Testing the Switch — Activity 3.9):

1. Connect the switch in a simple circuit with a bulb and two cells.
2. When the paper clip touches both pins, the circuit is complete.
3. When the clip is moved away, the circuit breaks.
4. Observe the bulb in both cases.



Observation:

1. When the clip touches both pins, the bulb glows.
2. When the clip is moved away, the bulb does not glow.

Results:

1. The switch allows or stops the flow of current in the circuit.
2. It controls the working of the bulb.

Inference: A switch is a device that can **open or close a circuit**. It is used to control electrical appliances safely and conveniently.

Activity 3.10 — Drawing Circuit Diagrams

Aim: To learn how to represent electric circuits using standard symbols in a circuit diagram.

Materials Required: Pencil and ruler, Notebook or graph paper, Knowledge of standard circuit symbols (cell, battery, bulb, switch, connecting wire, LED, resistor, etc.)

Procedure:

1. Recall the standard symbols used in circuit diagrams:

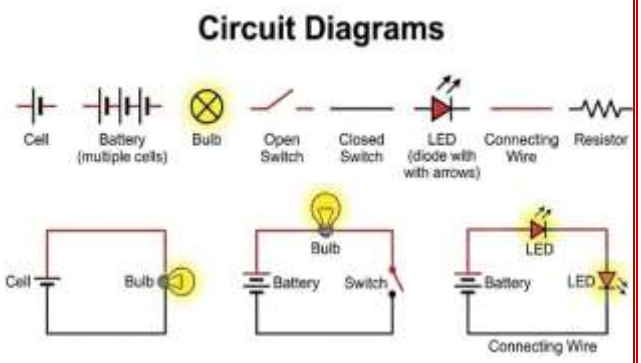
- **Cell** → one long line (positive) and one short line (negative).
- **Battery** → two or more cells joined together.

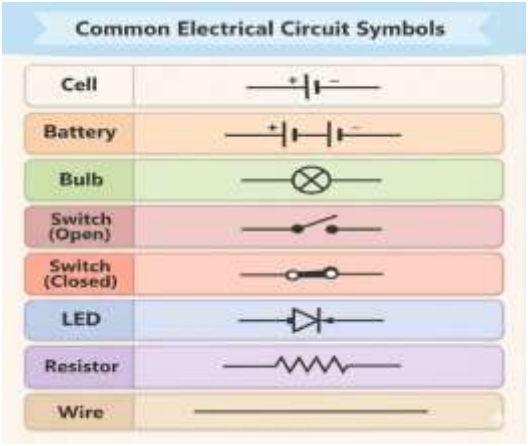
- **Bulb** → a circle with a cross inside.
- **Switch (open)** → a break in the line with a dot and angled line.
- **Switch (closed)** → a straight line connecting the dots.
- **Connecting wires** → straight lines.
- **LED** → a diode symbol with arrows showing light.

2. Practice drawing simple circuits:

- A cell connected to a bulb.
- A battery connected to a bulb with a switch.
- A battery connected to an LED.

3. Label each diagram clearly.





Observation:

1. Circuit diagrams use **symbols instead of pictures**.
2. They make circuits easier to understand and communicate.

Result: Students can represent electrical circuits neatly and universally using circuit symbols.

Inference: Circuit diagrams are a **simplified representation** of real circuits. They help in designing, analyzing, and communicating electrical connections without drawing actual components.

Activity 3.11: Identifying Conductors and Insulators

Aim: To identify materials that allow electricity to pass through them (conductors) and those that do not (insulators).

Materials Required: Electric cell, Small bulb, Connecting wires, Various materials for testing (Iron nail, Copper wire, Aluminium foil, Plastic scale, Rubber band, Pencil (graphite), Eraser, Wooden piece.

Procedure:

1. Make a simple circuit using a cell, bulb, and connecting wires.
2. Leave a small gap between two wires in the circuit.
3. Place each test material between the gap one by one.
4. Observe whether the bulb glows or not.

Observation:

Material Tested	Bulb Glows?	Type of Material
Iron nail	Yes	Conductor
Copper wire	Yes	Conductor
Aluminium foil	Yes	Conductor
Plastic scale	No	Insulator
Rubber band	No	Insulator
Pencil (graphite)	Yes (dim glow)	Conductor (poor)
Material Tested	Bulb Glows?	Type of Material
Iron nail	Yes	Conductor

Result:

1. Materials that allow current to pass through them are **conductors**.
2. Materials that do not allow current to pass are **insulators**.

Inference: Conductors help in making electrical connections, while insulators protect us from electric shocks by preventing current flow.

CHAPTER 4. THE WORLD OF METALS AND NON-METALS

Lab Activities (Hands-On): 4.1, 4.2, 4.3, 4.4, 4.5, 4.8

Demo Activities: 4.6, 4.7 (Teacher Demonstrates)

Activity 4.1: Malleability (Hammering Copper, Iron, Coal, Sulfur, Wood)

Aim: To test which materials can be beaten into thin sheets (malleability).

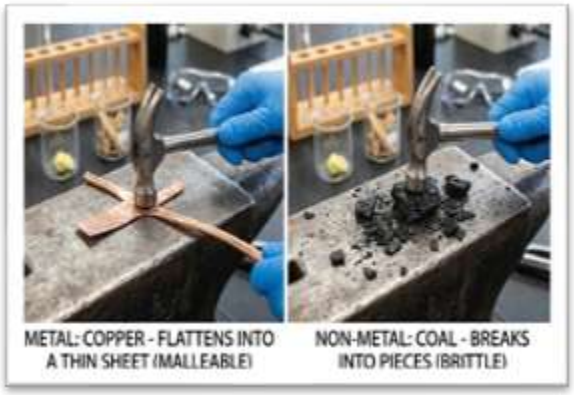
Materials Required: Small pieces of copper, iron, coal, sulfur, and wood Hammer, Hard surface.

Procedure:

1. Place each material on a hard surface.
2. Hammer each gently and observe changes.

Observation:

Material	Change on Hammering	Malleable?
Copper	Flattens into thin sheet	Yes
Iron	Flattens into thin sheet	Yes
Coal	Breaks into pieces	No
Sulfur	Crumbles	No
Wood	Splinters	No



Result: Metals like copper and iron are malleable; non-metals are not.

Inference: Malleability is a property of metals - they can be hammered into sheets without breaking.

Activity 4.2: Sonority (Dropping Metal Spoon, Coin, Coal, Wood)

Aim: To test which materials produce a ringing sound when struck.

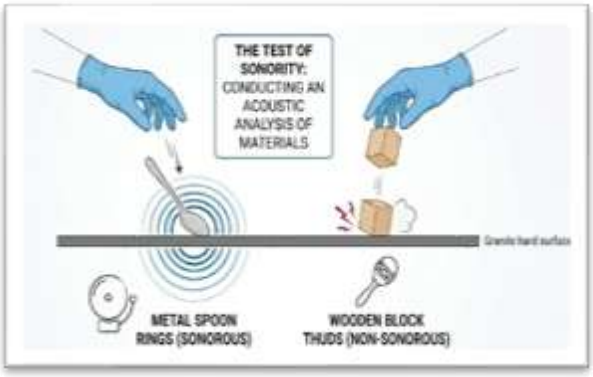
Materials Required: Metal spoon, Coin, Piece of coal, Wooden block.

Procedure:

1. Drop each material on a hard surface.
2. Listen to the sound produced.

Observation:

Material	Sound Produced	Sonorous?
Metal spoon	Ringing sound	Yes
Coin	Ringing sound	Yes
Coal	Dull sound	No
Wood	Dull sound	No



Result: Metals produce a ringing sound; non-metals do not.

Inference: Sonority is a characteristic property of metals.

Activity 4.3: Conduction of Heat (Metal vs Wooden Spoon in Hot Water)

Aim: To compare heat conduction in metals and non-metals.

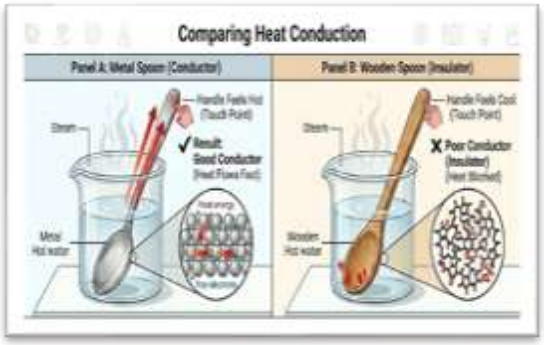
Materials Required: Metal spoon**,** Wooden spoon, Beaker with hot water.

Procedure:

1. Place both spoons in hot water.
2. Wait for a few minutes and touch the handles.

Observation:

Spoon Type	Handle Feels Hot?	Conductor Type
Metal spoon	Yes	Good conductor
Wooden spoon	No	Poor conductor



Result:

Metals conduct heat; non-metals do not.

Inference:

Metals are good conductors of heat, while wood is an insulator.

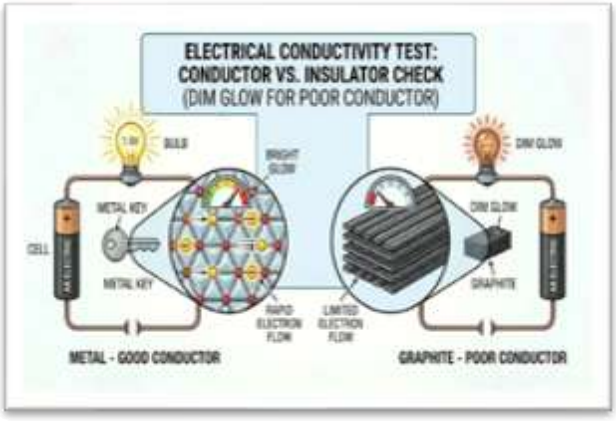
Activity 4.4: Conduction of Electricity (Tester Circuit)

Aim: To design and test a simple circuit to check electrical conductivity of materials.

Materials Required: Electric cell, Bulb**,** Wires, Various test materials (metal, plastic, wood, graphite).

Procedure:

1. Connect the cell, bulb, and wires to form a circuit.
2. Leave a small gap to insert test materials.
3. Place each material in the gap and observe the bulb.



Observation:

Material	Bulb Glows?	Conductivity
Metal	Yes	Good conductor
Plastic	No	Insulator
Wood	No	Insulator
Graphite	Dim glow	Poor conductor

Result: Metals conduct electricity; non-metals generally do not.

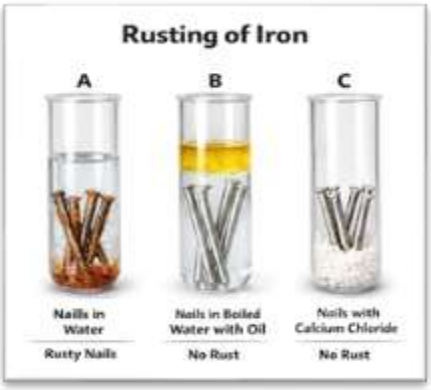
Inference: Electrical conduction is a property of metals.

Activity 4.5: Rusting Experiment (Iron Nails in 3 Conditions)

Aim: To study the conditions necessary for rusting of iron.

Materials Required: Three test tubes, Iron nails, Water, Oil, Calcium chloride (drying agent).

Procedure:



1. Place iron nails in three test tubes:
   - **Test Tube A**: Nails in water.
   - **Test Tube B**: Nails in boiled water with oil layer on top (to prevent air contact).
   - **Test Tube C**: Nails with calcium chloride (to absorb moisture).
2. Leave the test tubes for a few days.
3. Observe changes in the nails.

Observation:

Test Tube	Condition	Result
A	Nails in water (air + moisture present)	**Rust forms**
B	Boiled water + oil (no air)	**No rust**
C	Calcium chloride (no moisture)	**No rust**

Result: Rusting occurs only when **both air and moisture** are present.

Inference: Rusting is a chemical reaction of iron with oxygen and water.

Activity 4.6: Burning Magnesium Ribbon (Demonstration by Teacher)

Aim: To observe the burning of magnesium in air.

Materials Required: Magnesium ribbon**,** Tongs**,** Burner.


Burning of magnesium ribbon

Procedure:

1. Teacher cleans the magnesium ribbon and holds it with tongs.
2. Ribbon is ignited in a flame.
3. Observe the burning.

Observation:

1. Magnesium burns with a dazzling white flame.
2. A white powder (magnesium oxide) is formed.

Result: Magnesium reacts with oxygen to form magnesium oxide.

Inference: Metals react with oxygen to form oxides, many of which are basic in nature.

Activity 4.7: Burning Sulfur in Air (Demonstration by Teacher)

Aim: To observe the burning of sulfur in air.

Materials Required: Sulfur powder, Burner, Watch glass.

Procedure:

1. Teacher ignites sulfur powder in a watch glass.
2. Observe the flame and fumes.

Observation:

1. Sulfur burns with a blue flame.
2. A gas (sulfur dioxide) is produced.

Result: Sulfur reacts with oxygen to form sulfur dioxide.

Inference: Non-metals react with oxygen to form acidic oxides.

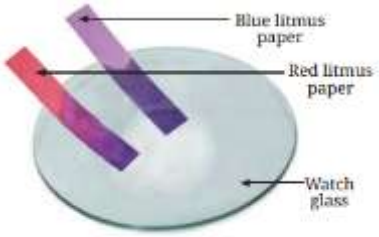
Activity 4.7: B) Properties of Non-Metals (Sulfur) (Demonstration by Teacher)

Aim: To observe the behaviour of sulfur in water and test the nature of its oxide.

Materials Required: Sulfur powder, Glass tumbler, Water, Bunsen Burner, Litmus paper (red and blue).

Procedure:

1. Take some sulfur powder in a glass tumbler.
2. Add a little water and observe.
3. Burn a small amount of sulfur carefully.
4. Pass the fumes into water.
5. Test the solution with blue and red litmus paper.



Testing the nature of magnesium oxide

Observation:

1. Sulfur does not dissolve or react with water.
2. On burning, sulfur produces a gas with a pungent smell.
3. Blue litmus turns red.
4. Red litmus shows no change.

Result: Sulfur is a non-metal and its oxide is acidic in nature.

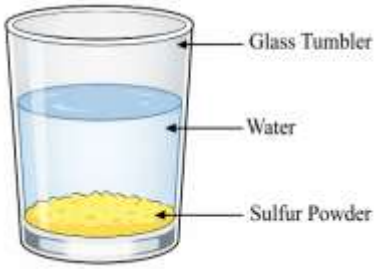
Inference: Non-metals are dull, soft, non-sonorous, and poor conductors of heat and electricity. Their oxides are acidic and change blue litmus to red.

Activity 4.8: Sulfur in Water

Aim: To observe the reaction of sulfur with water.

Materials Required: Sulfur powder, glass tumbler, water.

Procedure:



1. Take some sulfur powder in a glass tumbler.
2. Add a small amount of water.
3. Observe carefully.

Observation:

1. Sulfur does not dissolve in water.
2. No reaction takes place.

Result: Sulfur does not react with water.

Inference: Sulfur is a non-metal and non-metals generally do not react with water.

CHAPTER 5. CHANGES AROUND US: PHYSICAL AND CHEMICAL

Activity 1: Melting of Ice

Title: Melting of Ice - A Physical Change

Aim: To show that melting of ice is a physical change.

Materials Required: Ice cubes, Beaker.

Procedure:

1. Take a few ice cubes in a beaker.
2. Leave them at room temperature.
3. Observe the change as ice melts into water.

Observation:

1. Ice changes into water.
2. No new substance is formed.

Result: Melting of ice is a **physical change**.

Inference:

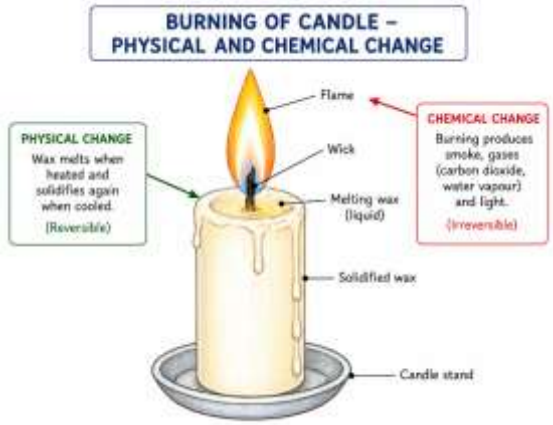
1. Physical changes are reversible.
2. The substance remains the same (**H_2O**).

Activity 2: Burning of a Candle

Title: Burning of Candle - Physical and Chemical Change

Aim: To show that burning of a candle involves both physical and chemical changes.

Materials Required: Candle, Matchbox.



Procedure:

1. Light a candle.
2. Observe the melting wax and the burning flame.

Observation:

1. Wax melts and solidifies again (physical change).
2. Burning produces smoke and gases (chemical change).

Result: Burning of a candle shows both **physical** and **chemical** changes.

Inference:

1. Melting is reversible.
2. Burning is irreversible and produces new substances.

Activity 3: Rusting of Iron

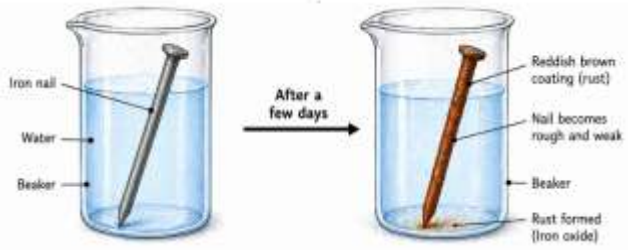
Title: Rusting of Iron - A Chemical Change

Aim: To show that rusting of iron is a chemical change.

Materials Required: Iron nail, Beaker of water, Notebook.

Procedure:

1. Place an iron nail in a beaker containing water.
2. Leave it undisturbed for a few days.
3. Observe the changes on the nail's surface.



Observation:

1. A reddish-brown coating (rust) appears on the nail.
2. The nail becomes rough and weak.

Result: Rusting of iron is a **chemical change**.

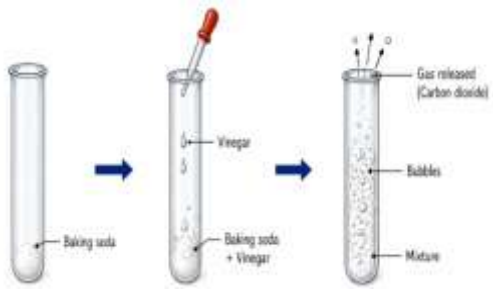
Inference:

1. A new substance (iron oxide) is formed.
2. Rusting is irreversible.

Activity 4: Reaction of Vinegar with Baking Soda

Title: Reaction of Vinegar with Baking Soda - A Chemical Change

Aim: To show that mixing vinegar and baking soda produces a chemical change.
Materials Required: Vinegar, Baking soda, Test tube, Dropper.
Procedure:
1. Take a small amount of baking soda in a test tube.
2. Add a few drops of vinegar using a dropper.
3. Observe the reaction.

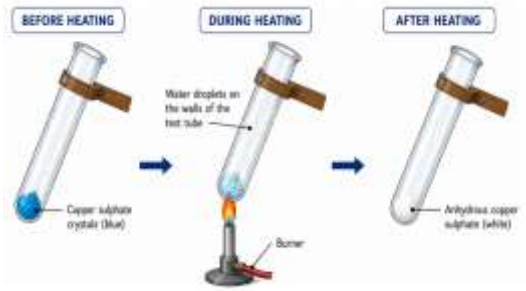


Observation:
1. Bubbles are formed.
2. A gas (carbon dioxide) is released.

Result: The reaction between vinegar and baking soda is a **chemical change**.
Inference:
1. A new substance (carbon dioxide gas) is formed.
2. The change is irreversible.

Activity 5: Heating Copper Sulphate Crystals

Title: Heating Copper Sulphate Crystals - A Chemical Change
Aim: To show that heating copper sulphate crystals causes a chemical change.
Materials Required: Copper sulphate crystals (blue), Test tube, Burner.
Procedure:
1. Take a few copper sulphate crystals in a test tube.
2. Heat the test tube gently over a burner.
3. Observe the change in color.

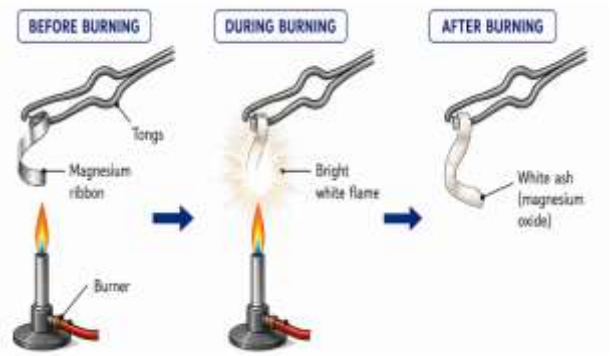


Observation:
1. Blue crystals turn white on heating.
2. Water droplets appear on the walls of the test tube.

Result: Heating copper sulphate crystals is a **chemical change**.
Inference:
1. Water of crystallization is lost.
2. A new substance (anhydrous copper sulphate) is formed.

Activity 6: Burning Magnesium Ribbon

Title: Burning Magnesium Ribbon - A Chemical Change
Aim: To show that burning magnesium ribbon is a chemical change.
Materials Required: Magnesium ribbon, Burner, Tongs.
Procedure:
1. Clean a small piece of magnesium ribbon with sandpaper.
2. Hold it with tongs and bring it near the flame.
3. Observe the burning process.



Observation:
1. Magnesium ribbon burns with a bright white flame.
2. White ash (magnesium oxide) is formed.

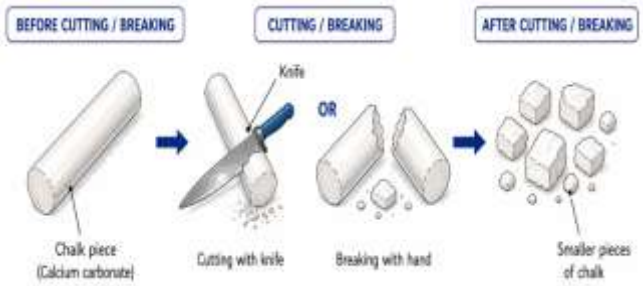
Result: Burning magnesium ribbon is a **chemical change**.
Inference:
1. A new substance (magnesium oxide) is formed.
2. The change is irreversible.

Activity 7: Cutting or Breaking of Chalk

Title: Cutting or Breaking of Chalk - A Physical Change
Aim: To show that cutting or breaking chalk is a physical change.
Materials Required: Chalk piece, Knife or hand pressure.

Procedure:

1. Take a chalk piece.
2. Cut it into small pieces with a knife or break it by hand.
3. Observe the pieces.



Observation:

1. Chalk breaks into smaller pieces.
2. No new substance is formed.

Result: Cutting or breaking chalk is a **physical change**.

Inference:

1. The substance remains the same (chalk/calcium carbonate).
2. Physical changes are reversible and do not produce new substances.

CHAPTER 6. ADOLESCENCE: A STAGE OF GROWTH AND CHANGE

Activity 6.1: Changes During Growing Up

Aim: To identify common changes observed in students during adolescence.

Materials Required: Jar, Paper slips, Pen/Pencil.

Procedure:

1. Take a jar and some paper slips.
2. Write different changes observed from Grades 5 to 8 (without names).
3. Fold the slips and put them in the jar.
4. Mix and pick slips one by one.
5. Discuss the changes in class and list them.

Observation:

S. No	Changes	Your Observation
1	Height	Increase in height.
2	Weight & strength	Body becomes stronger.
3	Appearance	Change in looks (hair, skin, etc.).
4	Voice	Voice changes (especially in boys).
5	Behaviour	More maturity and emotions.

1. Students show **increase in height and weight**.
2. There are **changes in voice and appearance**.
3. Boys and girls develop **different physical features**.
4.Behaviour shows **more maturity and emotions**.

Result:

1. Different physical and behavioural changes occur during adolescence.
2. These changes prepare the body for adulthood.

Inference: Adolescence is a stage of growth where the body and behaviour change gradually.

Activity 6.2: Emotional Changes

Aim: To study emotional and behavioural changes in adolescents.

Materials Required: Notebook, Pen.

Procedure:

1. Think about emotional changes in yourself or classmates.
2. List these changes.
3. Write their effects on behaviour.
4. Suggest ways for positive development.

Observation:

Key Emotional Changes	Probable Effects on Behaviour	Ways for Positive Growth
Mood swings	Sudden change in feelings.	Do music, sports, hobbies.
Strong emotions	Anger, excitement, sadness.	Share feelings, stay calm.
Increased sensitivity	Easily hurt or emotional.	Practice self-control.
Curiosity	Interest in new things.	Learn creative activities.
Peer influence	Copying friends' behaviour.	Choose good friends, think wisely.

1. Adolescents show mood swings and strong emotions.
2. They may feel happy, sad, or angry quickly.
3. Behaviour changes due to increased sensitivity.
4. Positive activities help in better emotional control.

Result:

1. Adolescents experience strong emotional changes.
2. Positive habits help in controlling emotions.

Inference: Understanding emotions helps in better behaviour and personal growth.

Activity 6.3: Nutritional Needs

Aim: To identify healthy foods, nutrients, and their functions.

Materials Required: Notebook/Chart paper, Pen/Pencil, Pictures, Samples of food items (milk, fruits, vegetables, grains, etc.), Glue (optional for chart work).

Procedure:

1. List locally available foods.
2. Identify nutrients present in them.
3. Write their functions for body growth.

Observation:

Food Sources	Nutrients	Functions
Milk, curd, cheese, paneer	Calcium, proteins, fats	Strong bones and teeth.
\ Rice, wheat, millets	Carbohydrates	Provide energy.
Pulses, eggs, nuts	Proteins	Growth and body repair.
Spinach, beans, raisins, figs	Iron	Formation of blood.
Fruits and vegetables	Vitamins, minerals	Protect from diseases.
Butter, oil, ghee	Fats	Give energy and keep body warm.
Fish, meat	Proteins, vitamins	Body growth and strength.
Banana, potato	Carbohydrates, minerals	Quick energy.

1. Different foods provide different nutrients.
2. Nutrients help in growth and energy.
3. Iron helps in blood formation.
4. Vitamins help to protect from diseases.

Result:

1. Different foods provide nutrients that help in **growth, energy, and proper development**.
2. A balanced diet keeps the body **healthy, strong, and protects from diseases**.

Inference: A balanced diet is essential for proper growth during adolescence.

Activity 6.4: Social Media Awareness

Aim: To understand responsible use of social media.

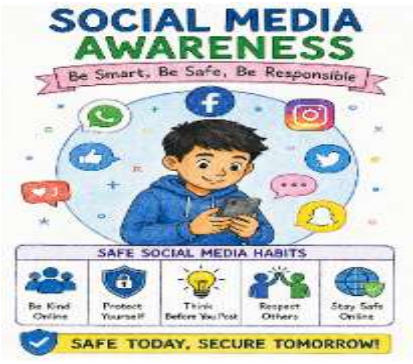
Materials Required: Chart paper, Markers, Internet (for collecting information), Mobile/Computer (optional), Posters/ Printouts, Glue and scissors.

Procedure:

1. Work in groups.
2. Create posters about safe social media use.
3. Discuss and list dos and don'ts.
4. Fill the table based on observations.

Observation:

Do's	Dont's
Be respectful and kind	Do not share personal photos with strangers
Think before posting	Do not spread rumours
Protect privacy	Do not share passwords
Use social media wisely	Do not misuse others' information
Use strong passwords	Do not accept unknown friend requests
Report harmful content	Do not bully or hurt others online
Take permission before posting others' photos	Do not post fake information
Limit screen time	Do not spend too much time online



1. Students follow good habits on social media.
2. They learn to be respectful and careful online.
3. Personal information should not be shared.

4. Wrong use of social media should be avoided.

Result:

1. Students understand safe and responsible behaviour online.
2. They learn how to use social media carefully.
3. They become aware of online risks and safety rules.

Inference:

1. Responsible use of social media ensures safety and healthy relationships.
2. Following good habits helps avoid cyber problems.
3. Awareness helps students become responsible digital users.

CHAPTER 7. HEAT TRANSFER IN NATURE

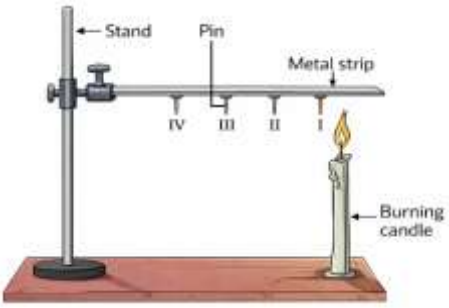
Lab Activities (Hands-on): All 5 are hands-on lab activities

Activity 7.1: Heat Transfer in a Metal Strip (Conduction)

Aim: To observe how heat travels through a metal strip by conduction.

Materials Required: Iron or copper strip, Candle or spirit lamp, Wax pieces, Stand or clamp.

Procedure:



1. Fix the metal strip horizontally on a stand.
2. Attach small wax pieces along the strip at equal distances.
3. Heat one end of the strip using a candle flame.
4. Observe the wax pieces as the strip heats up.

Observation:

1. Wax near the heated end melts first.
2. Gradually, wax pieces farther away also melt.

Result: Heat travels from the hot end to the cold end through the metal strip — this process is **conduction**.

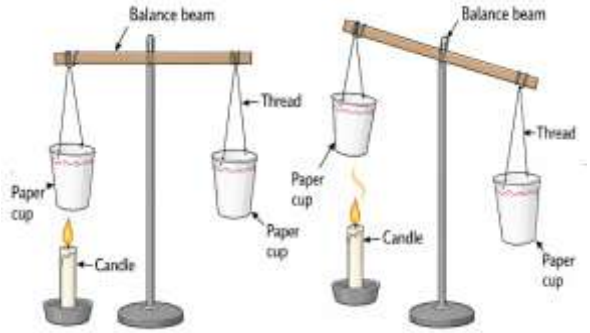
Inference: Metals are good conductors of heat.

Activity 7.2 — Hot Air Rising (Convection in Air)

Aim: To show that hot air rises and cold air sinks.

Materials Required: Two paper cups, Candle, Thread.

Procedure:



1. Hang two paper cups on either side of a balance beam.
2. Place a burning candle below one cup.
3. Observe the movement of the cups.

Observation:

The cup above the candle rises, and the other moves down.

Result: Hot air becomes lighter and rises, while cold air sinks - this is **convection in air**.

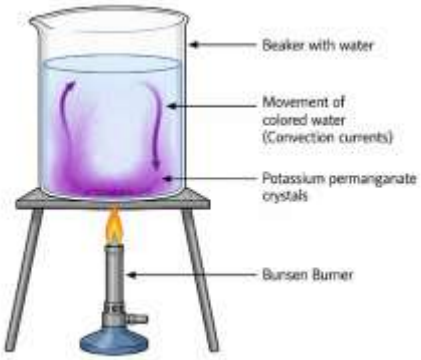
Inference: Air circulates due to convection currents caused by heating.

Activity 7.3: Convection in Water Using Potassium Permanganate

Aim: To observe convection currents in water.

Materials Required: Beaker with water, Potassium permanganate crystals, Bunsen Burner.

Procedure:



1. Fill a beaker with water.
2. Drop a few crystals of potassium permanganate at the bottom.
3. Heat the water gently from one side.
4. Observe the movement of colored water.

Observation:

Colored water moves upward near the heated side and downward on the cooler side.

Result: Convection currents are formed in water - hot water rises and cool water sinks.

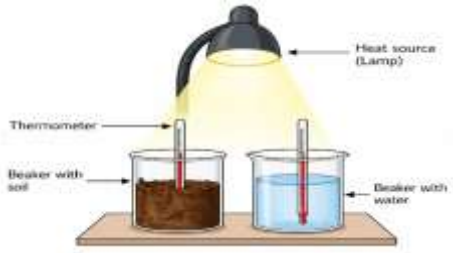
Inference: Heat transfer in liquids occurs by **convection**.

Activity 7.4: Heating of Soil vs Water (Land and Sea Breeze)

Aim: To compare the heating and cooling of soil and water.

Materials Required: Two beakers (one with soil, one with water), Thermometers, Heat source (lamp or sunlight).

Procedure:



1. Place both beakers under a lamp or in sunlight.
2. Record temperatures at intervals.
3. After heating, allow them to cool and record again.

Observation:

Soil heats up and cools down faster than water.

Result: This difference causes **land and sea breezes** - land heats and cools quickly, while water does so slowly.

Inference: Heat absorption and release differ between land and water, leading to air movement near coast.

Activity 7.5: Water Seepage Through Clay, Sand, and Gravel

Aim: To compare water seepage through different types of soil.

Materials Required: Funnels, Filter paper, Clay, sand, and gravel samples, Measuring cylinder, Water.

Procedure:

1. Place filter paper in each funnel.
2. Fill funnels with equal amounts of clay, sand, and gravel.
3. Pour equal amounts of water into each funnel.
4. Collect water that seeps through in measuring cylinders.

Observation:

Material	Amount of Water Collected	Permeability
Clay	Very little	Poor
Sand	Moderate	Medium
Gravel	Most	High

Result: Water passes fastest through gravel and slowest through clay.

Inference: Different soils have different **permeability**, affecting water movement and groundwater storage.

CHAPTER 8. MEASUREMENT OF TIME AND MOTION

Activity 8.1: Making a Simple Water Clock (Construction)

Aim: To construct a simple water clock for measuring time.

Materials Required: Two plastic bottles or cans, Water, Nail (to make a hole), Stopwatch (for calibration).

Procedure:

1. Make a small hole at the bottom of one bottle.
2. Fill the bottle with water.
3. Place it above another empty bottle to collect water.
4. Mark time intervals by measuring the water collected with a stopwatch.

Observation:

1. Water drips at a steady rate.
2. The amount collected corresponds to equal time intervals.

Result: A water clock can measure time based on the flow of water.

Inference: Ancient devices like water clocks were used to measure time before modern clocks.

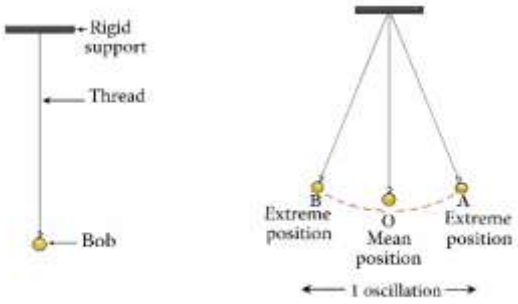
Activity 8.2: Simple Pendulum (Measuring Time Period)

Aim: To measure the time period of a simple pendulum.

Materials Required: Thread (about 1 meter), Small metal ball or stone, Stopwatch.

Procedure:

1. Suspend the ball with thread to form a pendulum.
2. Displace it slightly and release.
3. Measure the time taken for 10 oscillations using a stopwatch.
4. Divide total time by 10 to get the time period.



A Simple Pendulum

Observation:

Time period remains nearly constant for small oscillations.

Result: The time period of a pendulum depends on its length, not on mass or amplitude.

Inference: Pendulums are useful for measuring time intervals accurately.

Activity 8.3: Identifying Smallest Interval on a Wall Clock (Identification)

Aim: To identify the smallest time interval measurable on a wall clock.

Materials Required: Wall clock.

Procedure:

1. Observe the divisions on the clock face.
2. Note the smallest division between two marks.

A Wall Clock

Observation: The smallest division corresponds to **1 minute**.

Result: A wall clock can measure time intervals of one minute or more.

Inference: For smaller intervals, devices like stopwatches are required.

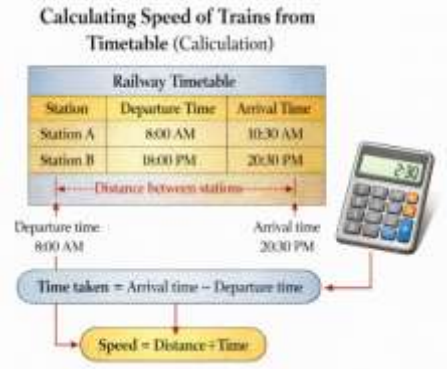
Activity 8.4: Calculating Speed of Trains from Timetable (Calculation)

Aim: To calculate the speed of trains using data from a timetable.

Materials Required: Railway timetable, Calculator.

Procedure:

1. Note the distance between two stations.
2. Record departure and arrival times of a train.
3. Calculate time taken = Arrival time – Departure time.
4. **Speed = Distance ÷ Time.**



Observation:

Different trains have different speeds depending on stoppages and routes.

Result: Speed of a train can be calculated using timetable data.

Inference: Speed is the ratio of distance traveled to time taken.

CHAPTER 9. LIFE PROCESSES IN ANIMALS

Activity 9.1: Action of Saliva on Starch

Aim: To show that saliva breaks down starch into sugar.

Materials Required: Two test tubes (A and B), Boiled rice, Water, Iodine solution, Dropper.

Procedure:

1. Take two test tubes and label them A and B.
2. Put boiled rice in A and chewed rice in B.
3. Add some water to both test tubes.
4. Add a few drops of iodine solution to both.
5. Observe the colour change in both test tubes.

Observation:

Test Tube	Initial Colour before adding iodine	Final Colour afte radding iodine	Possible Reason for the change in colour, if any
A (Boiled rice)	White / colourless	Blue-black	Starch is present
B (Chewed rice)	White / colourless	No colour change	Starch is broken into sugar by saliva

1. After adding iodine, test tube A turns blue-black (starch present).
2. Test tube B shows no or very light colour change (starch absent or less).

Result:

1. Iodine turns blue-black when starch is present.
2. No colour change shows starch is absent or less.

Inference: Saliva breaks down starch into sugar, so less or no starch remains in chewed rice.

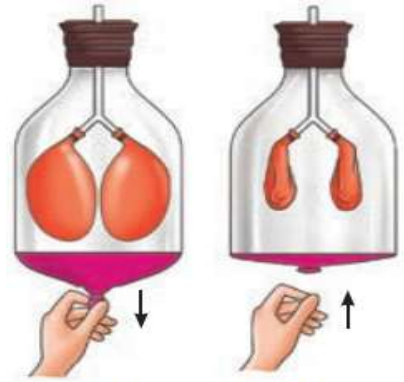
Activity 9.2: Model to Show Breathing

Aim: To understand how breathing happens using a model.

Materials Required: Plastic bottle, Y-shaped tube, Two balloons, Rubber sheet, Rubber bands, clay

Procedure:

1. Take a plastic bottle and remove its bottom.
2. Fix a Y-shaped tube with balloons at its ends inside the bottle.
3. Seal the bottle tightly with clay.
4. Cover the open bottom with a rubber sheet.
5. Pull the rubber sheet down and release it to observe the balloons.



Observation:

1. When the rubber sheet is pulled down, **balloons inflate**.
2. When it is released, **balloons deflate**.

Result:

1. Balloons expand and contract like lungs as air moves in and out.
2. This model demonstrates the process of breathing.

Inference: Balloons represent lungs, the rubber sheet represents the diaphragm, and breathing occurs due to the expansion and contraction of the lungs.

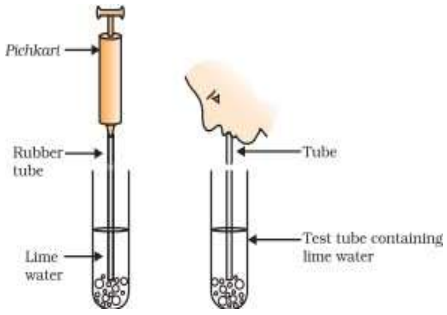
Activity 9.3: Exhaled air contains more Carbon dioxide.

Aim: To show that exhaled air has more carbon dioxide than inhaled air.

Apparatus: Two test tubes, lime water, straw/syringe/pichkari, test tube stand.

Procedure:

1. Take two test tubes and label them **A and B**.
2. Fill both with equal amounts of **fresh lime water**.
3. Blow **normal air** into test tube A using a syringe/pichkari.
4. Blow **exhaled air** into test tube B using a straw.
5. Observe which test tube turns milky faster.



Observation:

1. Lime water in test tube B turns milky/cloudy.
2. Lime water in test tube A shows no change.

Result:

1. Lime water turns milky in the presence of carbon dioxide.
2. Exhaled air contains more carbon dioxide than inhaled air.

Inference: Exhaled air contains more carbon dioxide then here we inhale.

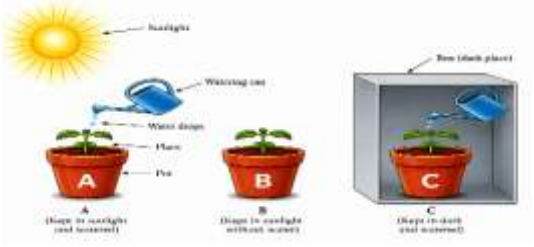
Activity 10.1: Role of Sunlight and Water in Plant Growth

Aim: To show that sunlight and water are necessary for plant growth.

Materials Required: Three potted plants (same size), soil, water, labels (A, B, C).

Procedure:

1. Take three similar potted plants and label them A, B, and C.
2. Keep Plant A in sunlight and water it regularly.
3. Keep Plant B in sunlight but do not water it.
4. Keep Plant C in the dark and water it regularly.
5. Observe the plants for 1–2 weeks.



Observation Table:

Pots kept under different conditions	Availability of Sunlight	Availability of Water	Height of plant (cm) Day 1	Height of plant (cm) After 2 weeks	Number of leaves Day 1	Number of leaves After 2 weeks	Colour of leaves (Green/Yellow)
Pot A: In direct sunlight, with water	Yes	Yes	10 cm	18 cm (good growth)	5	12	Green
Pot B: In direct sunlight, without water	Yes	No	10 cm	6 cm (decreased / dried)	5	2 (dried)	Yellow
Pot C: In the dark, with water	No	Yes	10 cm	12 cm (very little growth)	5	6	Yellow

Observation:

1. Plant A grows well and remains green.
2. Plant B dries or dies due to lack of water.
3. Plant C shows poor growth and yellow leaves.

Result:

1. Plants grow well only when both sunlight and water are available.
2. Lack of either sunlight or water affects plant growth.

Inference: Sunlight and water are essential for plant growth; without either, plants cannot grow properly and may show poor growth or die.

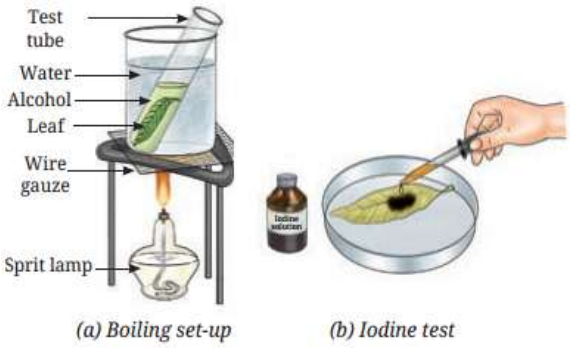
Activity 10.2: Observation of Starch in Leaves (Iodine Test)

Aim: To demonstrate that leaves prepare and store food in the form of starch through photosynthesis.

Materials Required: Healthy green leaf, Beaker with boiling water, Alcohol (in a test tube), Burner, Petri dish, Dropper, Iodine solution.

Procedure:

1. Take a fresh green leaf and boil it in water for a few minutes.
2. Put the leaf in alcohol and heat it to remove the green colour.
3. Wash the leaf in warm water to soften it.
4. Place the leaf on a dish and add iodine solution.
5. Observe the colour change.



(a) Boiling set-up *(b) Iodine test*

Observation:

1. The leaf turns **blue-black** when iodine is added.
2. This indicates the presence of starch.

Result: Leaves store food prepared during photosynthesis in the form of starch.

Inference:

1. Photosynthesis produces carbohydrates, which are stored as starch in leaves.
2. The iodine test is a reliable method to detect starch.

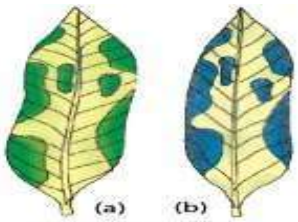
Activity 10.3: Necessity of Chlorophyll for Photosynthesis

Aim: To demonstrate that chlorophyll is essential for photosynthesis in plants.

Materials Required: A variegated leaf (with green and white patches, e.g., Croton or Money plant), Beaker with boiling water, Alcohol (in a test tube), Burner, Petri dish, Iodine solution, Dropper.

Procedure:

1. Take a variegated leaf from a plant kept in sunlight.
2. Boil the leaf in water for a few minutes.
3. Put the leaf in alcohol and heat it to remove the green colour.
4. Wash the leaf in warm water to soften it.
5. Add iodine solution and observe the colour change in green and white parts.



Variegated leaf
(a) before starch test
(b) after starch test

Observation:

1. The **green portions** of the leaf turn **blue-black** with iodine, showing the presence of starch.
2. The **white portions** do **not** turn blue-black, showing no starch formation.

Result: Photosynthesis occurs only in the green (chlorophyll-containing) parts of the leaf.

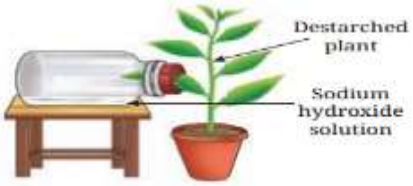
Inference:

1. Chlorophyll is essential for photosynthesis.
2. Only chlorophyll-containing regions can trap sunlight and prepare food.

Activity 10.4: Necessity of Carbon Dioxide for Photosynthesis

Aim: To demonstrate that carbon dioxide (CO_2) is essential for photosynthesis in plants.

Materials Required: Potted green plant, Wide-mouthed bottle, Sodium hydroxide, Split cork, Beaker with water, Alcohol, Test tube, Burner, Petri dish, Iodine solution, Dropper.



(a) The set-up


(b) Iodine test on the leaf

Procedure:

1. Keep the plant in the dark for 2–3 days.
2. Put sodium hydroxide in a bottle and place half of a leaf inside it.
3. Keep the setup in sunlight for some time.
4. Take the leaf, boil it, and remove the green colour using alcohol.
5. Add iodine solution and observe the colour change.

Observation Table:

Part of the leaf	Availability of Water	Availability of Sunlight	Availability of Chlorophyll	Availability of Carbon dioxide	Starch present (Yes/No)
Part of the leaf inside the bottle	Yes	Yes	Yes	No	No
Part of the leaf outside the bottle	Yes	Yes	Yes	Yes	Yes

Observation:

1. The leaf does **not** turn blue-black with iodine.
2. This shows that starch has not been formed.

Result:

1. The part of the leaf outside the bottle turns blue-black (starch present).
2. The part inside the bottle does not turn blue-black (no starch).

Inference: Carbon dioxide is an essential raw material for photosynthesis, and in its absence, plants are unable to prepare food (starch), so no starch is formed in the leaf.

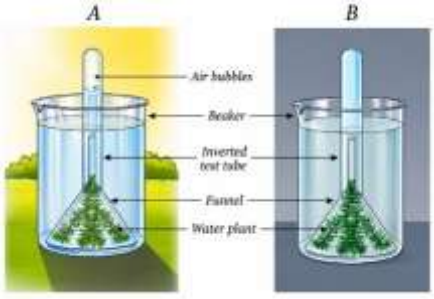
Activity 10.5: Release of Oxygen during Photosynthesis

Aim: To show that oxygen is released during photosynthesis.

Materials Required: Beaker, Water Plant (Hydrilla), Funnel, Test Tube, Water, Sunlight.

Procedure:

1. Take a beaker and fill it with water.
2. Place a water plant inside the beaker.
3. Cover the plant with a funnel.
4. Invert a water-filled test tube over the funnel.
5. Keep the setup in sunlight and observe.



Observation:

1. Gas bubbles are formed and collected in the test tube.
2. The collected gas supports burning (a glowing splinter burns brightly).

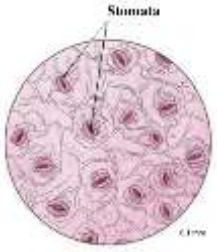
Result:
1. Oxygen gas is released during photosynthesis.
2. Gas bubbles are formed and collected in the test tube.
3. More bubbles are seen in sunlight than in dark.

Inference: Photosynthesis occurs in the presence of sunlight, releases oxygen gas, and without sunlight the process does not take place properly.

Activity 10.6: Observation of Stomata in Leaves (Microscope Slide)

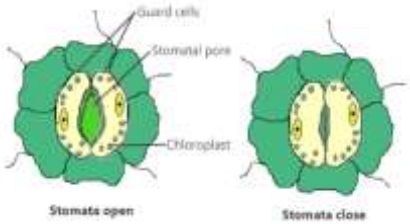
Aim: To observe stomata (tiny pores) present on the surface of leaves.

Materials Required: Fresh leaf (e.g., from a money plant or balsam plant), Forceps, Needle or blade, Microscope slide and cover slip, Compound microscope, Safranin stain (optional).



Procedure:
1. Take a fresh leaf and carefully peel off a thin layer of its lower epidermis using forceps.
2. Place the peel on a clean microscope slide.
3. Add a drop of water or safranin stain to make the structures more visible.
4. Gently place a cover slip over the peel to avoid air bubbles.
5. Observe the slide under a compound microscope (first under low power, then high power).

Observation:
1. Small openings (stomata) are visible on the peel.
2. Each stoma is surrounded by two kidney-shaped **guard cells**.
3. The guard cells control the opening and closing of the stomata.



Result: Stomata are present on the leaf surface and are responsible for gaseous exchange and transpiration.

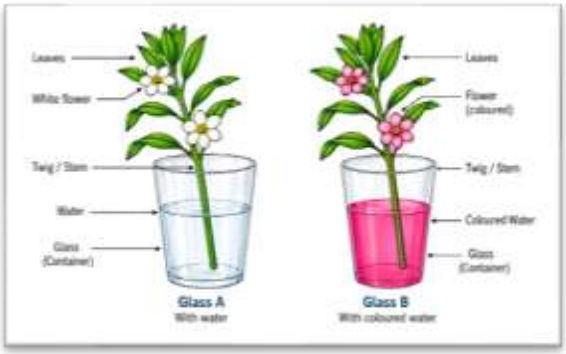
Inference:
1. Stomata allow entry of carbon dioxide needed for photosynthesis.
2. They also regulate water loss through transpiration.
3. Their presence confirms the leaf's role in respiration and photosynthesis.

Activity10. 7: Demonstration of Sap Movement in Plants (Using Balsam Plant or Colored Water)

Aim: To demonstrate the upward movement of water and minerals (sap) through the stem in plants.

Materials Required: A balsam plant (or any small transparent-stemmed plant), Beaker or glass jar, Water, Red/blue ink or food coloring, Knife or blade.

Procedure:
1. Take a healthy balsam plant and wash its roots gently to remove soil.
2. Place the plant in a beaker containing water mixed with red/blue ink or food coloring.
3. Leave the setup undisturbed for a few hours.
4. Observe the stem and leaves of the plant.
5. Cut a thin section of the stem and examine it.



Observation:
1. Colored streaks appear in the stem and veins of the leaves.
2. The colored water rises upward through the stem.

Result: Water (along with dissolved minerals) moves upward through the stem via **Xylem vessels**.

Inference:
1. This experiment proves the presence of conducting tissues in plants.
2. Xylem transports water and minerals from roots to leaves, enabling photosynthesis and growth.

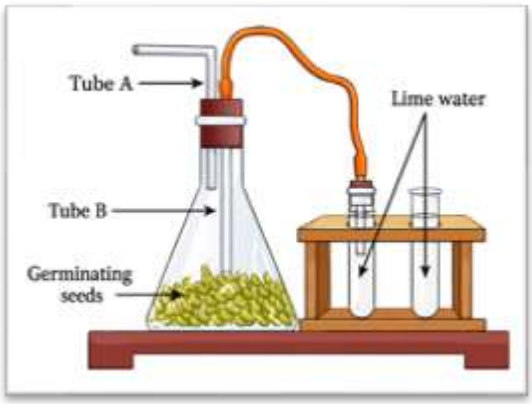
Activity 10.8: Do Plants Respire?

Aim: To show that plants respire and release carbon dioxide.

Materials Required: Soaked Germinating Seeds (Moong), Conical Flask, Wet Cotton, Cork with two holes, Two Glass Tubes, Rubber Tube, Two Test Tubes, Lime Water.

Procedure:

1. Soak seeds overnight and place them on wet cotton in a conical flask.
2. Close the flask with a cork having two tubes.
3. Connect one tube to a test tube containing lime water.
4. Keep the setup undisturbed for 24 hours.
5. Observe the change in lime water.



Observation:

1. Lime water turns milky in the connected test tube.
2. No change is seen in the other test tube.
3. Germinating seeds remain active after 24 hours.

Result:

1. Carbon dioxide is released during respiration in plants.
2. Germinating seeds show respiration activity.
3. Respiration occurs even in the absence of light.

Inference: Plants respire and release carbon dioxide, and all living parts carry out respiration which is essential for releasing energy.

Activity10. 9: Demonstration of Symbiotic Nutrition (Lichen)

Aim: To study symbiotic nutrition in organisms like lichens.

Materials Required: Picture/chart of lichens (or actual sample if available), Magnifying lens (optional), Notebook and pencil.

Procedure:

1. Observe the lichen sample or picture carefully.
2. Identify the two components: **algae** and **fungus**.
3. Note how they live together in close association.
4. Record observations in the notebook.

Observation:

1. Lichen appears as a patchy growth on rocks, walls, or tree bark.
2. It consists of green algae and thread-like fungus intertwined.

Result: Lichens show **symbiotic nutrition** - algae prepare food by photosynthesis, while fungi provide water and shelter.

Inference:

1. Symbiosis is a relationship where two organisms live together and benefit each other.
2. Lichens are a classic example of symbiotic nutrition.

Activity10. 10: Observation of Parasitic Nutrition (Cuscuta/Amarbel)

Aim: To study parasitic nutrition in plants like Cuscuta (Amarbel).

Materials Required: Host plant with Cuscuta growing on it, Notebook and pencil.

Procedure:

1. Observe the host plant and the Cuscuta twining around it.
2. Note the absence of green leaves in Cuscuta.
3. Record how Cuscuta attaches itself to the host stem.
4. Write down observations in the notebook.

Observation:

1. Cuscuta is a yellow, thread-like plant without green leaves.
2. It attaches to the host plant and absorbs nutrients directly.

Result: Cuscuta shows **Parasitic nutrition** - it depends entirely on the host plant for food.

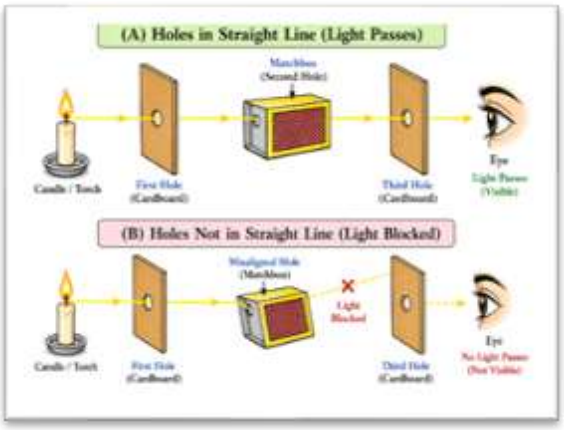
Inference: Parasitic plants lack chlorophyll and cannot prepare their own food. They survive by absorbing nutrients from host plants.

CHAPTER 11. LIGHT: SHADOWS AND REFLECTIONS

Activity 11.1: Light Through Matchbox Holes (Straight Line Propagation)

Aim: To show that light travels in a straight line.

Materials Required: Empty matchbox, Cardboard pieces, Candle or torch.



Procedure:

1. Make three holes in a straight line through the matchbox and cardboard pieces.
2. Place the candle or torch behind the holes.
3. Observe the light passing through all holes.
4. Now misalign one hole and observe again.

Observation:

1. Light passes only when holes are in a straight line.
2. When one hole is shifted, light is blocked.

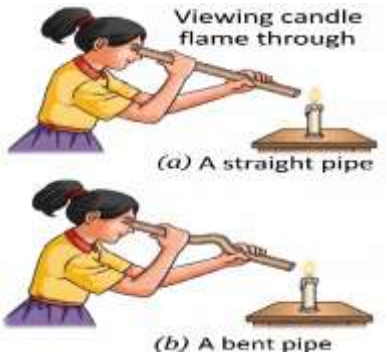
Result: Light travels in a straight line.

Inference: This property explains shadow formation and the direction of light beams.

Activity 11.2: Candle Flame Through Bent/Straight Pipe (Exploration)

Aim: To compare light travel through straight and bent pipes.

Materials Required: Two pipes (one straight, one bent), Candle.



Procedure:

1. Look through the straight pipe toward the candle flame.
2. Then look through the bent pipe.

Observation:

1. Flame is visible through the straight pipe.
2. Flame is not visible through the bent pipe.

Result: Light cannot bend around corners; it travels in a straight line.

Activity 11.3: Light Through Transparent, Translucent, and Opaque Materials

Aim: To study how light passes through different materials.

Materials Required: Glass sheet (transparent), Butter paper (translucent), Cardboard (opaque), Torch.

Procedure:

1. Shine the torch on each material.
2. Observe how much light passes through.

Observation:

Material	Light Passage	Type
Glass	Full	Transparent
Butter Paper	Partial	Translucent
Cardboard	None	Opaque

Result: Different materials allow light to pass through in varying amounts.

Activity 11.4: Shadow Formation with Opaque Objects

Aim: To observe how shadows form.

Materials Required: Torch or candle, Opaque object (book, ball), Screen or wall.

Procedure:

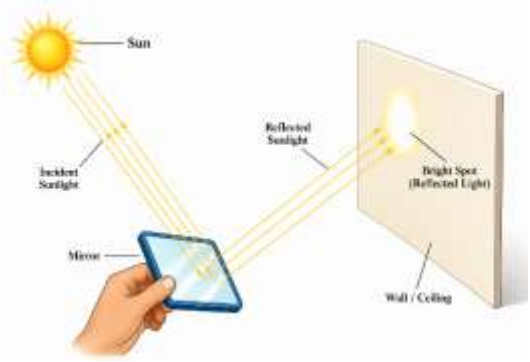
1. Place the object between the light source and screen.
2. Observe the shadow formed.

Observation:

1. A dark shadow appears on the screen.
2. Shadow changes size with distance.

Result: Shadows form when light is blocked by opaque objects.

Activity 11.5: Reflection Using Mirror and Sunlight



Aim: To observe reflection of sunlight using a mirror.

Materials Required: Small mirror, Sunlight.

Procedure:

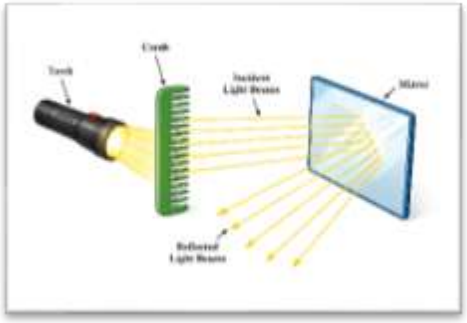
1. Hold the mirror in sunlight.
2. Direct the reflected light onto a wall or ceiling.

Observation:

A bright spot appears where light is reflected.

Result: Light reflects from smooth surfaces like mirrors.

Activity 11.6: Reflection of Light Beam Using Comb and Mirror



Aim: To observe reflection of multiple light beams.

Materials Required: Torch, Comb, Mirror.

Procedure:

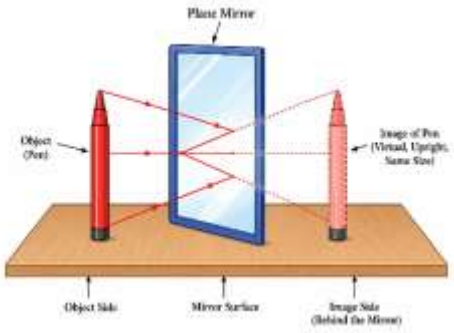
1. Shine torch light through the comb onto the mirror.
2. Observe the reflected beams.

Observation:

Several light beams reflect from the mirror.

Result: Each beam follows the law of reflection-angle of incidence equals angle of reflection.

Activity 11.7: Image in a Plane Mirror (Pen)



Aim: To observe image formation in a plane mirror.

Materials Required: Plane mirror, Pen or object.

Procedure:

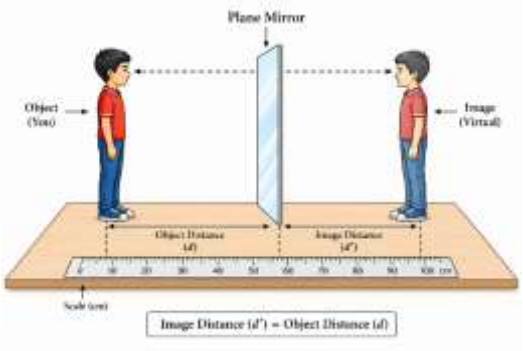
1. Place the pen in front of the mirror.
2. Observe its image.

Observation:

1. Image appears behind the mirror.
2. Image is upright and of same size.

Result: Plane mirrors form virtual, erect, same-size images.

Activity 11.8: Image Distance in Plane Mirror (Self-Observation)



Aim: To verify that image distance equals object distance.

Materials Required: Plane mirror, Scale.

Procedure:

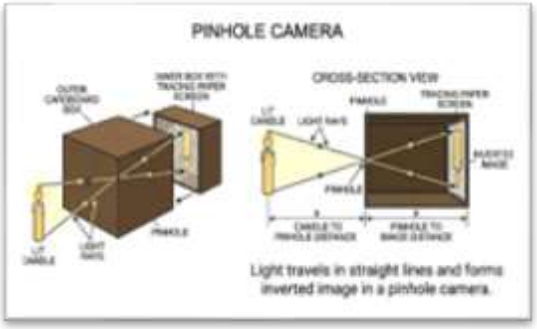
1. Stand at a known distance from the mirror.
2. Measure the distance between you and the mirror.
3. Observe your image.

Observation:

Image appears at the same distance behind the mirror as you stand in front.

Result: Image distance = Object distance in a plane mirror.

Activity 11.9: Pinhole Camera (Simple Version with Candle)



Aim: To observe image formation using a pinhole camera.

Materials Required: Two cardboard boxes (one smaller), Candle, Tracing paper.

Procedure:

1. Make a small hole in one box and fix tracing paper on the other end.
2. Place the candle in front of the hole.

3. Observe the image on tracing paper.

Observation:

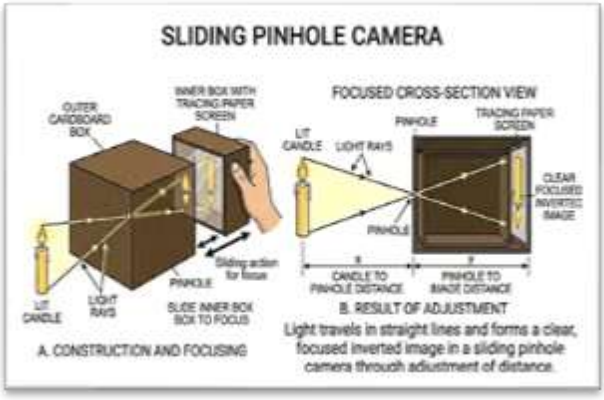
An inverted image of the candle appears.

Result: Light travels in straight lines and forms inverted images in a pinhole camera.

Activity 11.10: Making a Sliding Pinhole Camera (Construction)

Aim: To construct a working sliding pinhole camera.

Materials Required: Two cardboard boxes (one fits into the other), Tracing paper, Pin or needle.



Procedure:

1. Make a small hole in the outer box.
2. Fix tracing paper on one side of the inner box.
3. Slide the inner box to focus the image.

Observation:

A clear inverted image appears when adjusted properly.

Result: A sliding pinhole camera helps focus images by changing the distance between the hole and screen.

CHAPTER 12. EARTH, MOON, AND THE SUN

Activity 12.1: Rotation and Revolution (Globe + Lamp)

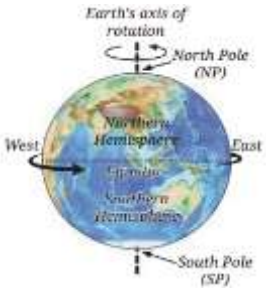
Demonstrating Rotation and Revolution Using Globe and Lamp

Aim: To demonstrate how Earth's rotation causes day and night, and how its revolution around the Sun causes seasons.

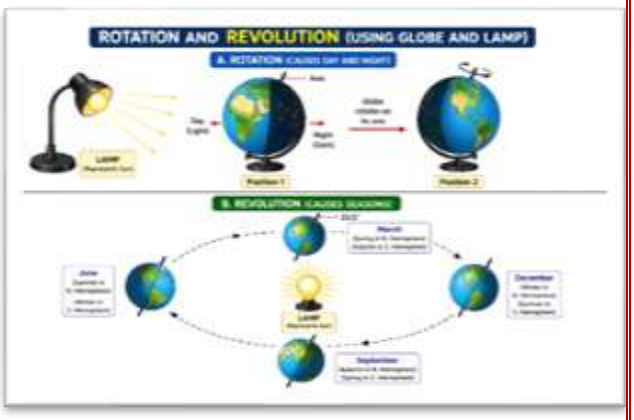
Materials Required: Globe (to represent Earth), Table lamp or torch (to represent the Sun), Dark room for clear observation.

Procedure:

1. Place the lamp at the center of a table — this represents the Sun.
2. Position the globe at some distance from the lamp.
3. Rotation demonstration:
   - Slowly rotate the globe on its axis.
   - Observe how one half of the globe faces the lamp (day) while the other half is dark (night).



4. Revolution demonstration:
   - Tilt the globe slightly (23.5°) to represent Earth's axis.
   - Move the globe around the lamp in a circular path.
   - Observe how different hemispheres receive varying amounts of light during the revolution.



Observation:

1. Rotation of the globe shows day and night.
2. Revolution of the tilted globe shows seasonal changes (summer, winter, spring, autumn).

Result:

1. Rotation of Earth on its axis causes day and night.
2. Revolution of Earth around the Sun, combined with the tilt of its axis, causes seasons.

Inference: Earth's two motions-rotation and revolution-explain the cycle of time (day/night and year) and seasonal variations.

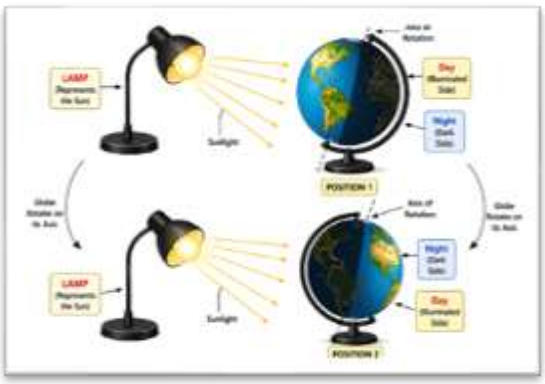
Activity12. 2: A) Day and Night Demonstration

Aim: To demonstrate how day and night occur due to Earth's rotation.

Materials Required: Globe (to represent Earth), Table lamp or torch (to represent the Sun), Dark room for clear observation.

Procedure:

1. Place the lamp at the center of a table - this represents the Sun.
2. Position the globe at some distance from the lamp.
3. Switch on the lamp in a dark room.
4. Rotate the globe slowly on its axis.
5. Observe how one half of the globe is illuminated while the other half remains dark.



Observation:

1. The illuminated half of the globe represents daytime.
2. The dark half represents nighttime.
3. As the globe rotates, different regions move into light or darkness.

Result: Day and night are caused by the rotation of Earth on its axis.

Inference:

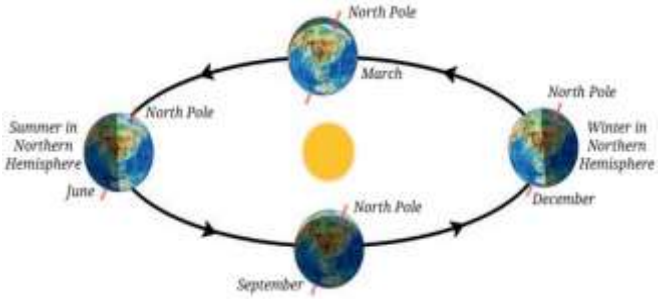
1. Earth rotates once every 24 hours.
2. This rotation causes the cycle of day and night.
3. Only half of Earth faces the Sun at a time, while the other half remains dark.

Activity12.2: B) Seasons Demonstration (Tilt of Axis)

Aim: To demonstrate how the tilt of Earth's axis and its revolution around the Sun cause seasons.

Materials Required: Globe (to represent Earth), Table lamp or torch (to represent the Sun), Dark room for clear observation.

Procedure:



1. Place the lamp at the center of a table-this represents the Sun.
2. Tilt the globe at about 23.5° to represent Earth's axis.
3. Move the globe around the lamp in a circular path to represent Earth's revolution.
4. Observe how different hemispheres receive varying amounts of light during the revolution.
5. Note which hemisphere is tilted toward the lamp and which is tilted away.

Observation:

1. When the Northern Hemisphere is tilted toward the Sun, it receives more light → Summer in North, Winter in South.
2. When the Southern Hemisphere is tilted toward the Sun, it receives more light → Summer in South, Winter in North.
3. Intermediate positions show Spring and Autumn.

Result: Seasons occur due to the tilt of Earth's axis combined with its revolution around the Sun.

Inference:

1. Earth's axis is tilted at 23.5°.
2. This tilt causes unequal heating of hemispheres during revolution.
3. Thus, the cycle of summer, winter, spring, and autumn repeats every year.

Activity 12.3: Observing Constellations

Aim: To identify and study patterns of stars (constellations) in the night sky.

Materials Required: Notebook and pencil, Clear night sky view, Star chart (optional).

Procedure:

1. Go outdoors at night and observe the sky.
2. Identify bright star patterns such as Orion (Hunter), Ursa Major (Great Bear), or Cassiopeia.
3. Sketch the patterns in your notebook.
4. Compare with a star chart for confirmation.

Observation:

1. Stars appear fixed in patterns.
2. Constellations are visible only during certain seasons.

Result: Constellations are groups of stars forming recognizable patterns in the sky.

Inference:

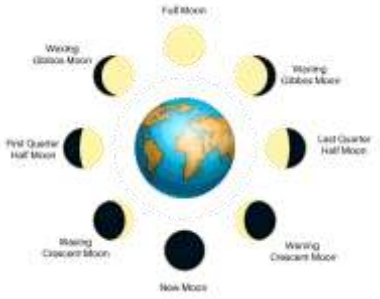
1. Constellations help in navigation and calendar marking.
2. They are not real groups of stars but appear as patterns from Earth's perspective.

ADDITIONAL ACTIVITIES

Activity 1: Observing the Moon's Phases

Aim: To observe and record the different phases of the Moon over a month.

Materials Required: Notebook and pencil, Calendar (to mark dates), Clear view of the night sky.



Procedure:

1. Go outdoors each night and observe the Moon.
2. Sketch its shape (crescent, half, gibbous, full) in your notebook.
3. Record the date and time of observation.
4. Continue for at least 28–30 days to cover a full lunar cycle.

Observation:

1. The Moon appears to change shape daily.
2. Sequence observed: **New Moon → Crescent → First Quarter → Gibbous → Full Moon → Gibbous → Last Quarter → Crescent → New Moon**.
3. The cycle repeats approximately every 29.5 days.

Result: The Moon's phases are caused by its revolution around Earth and the changing positions of the Sun, Earth, and Moon.

Inference:

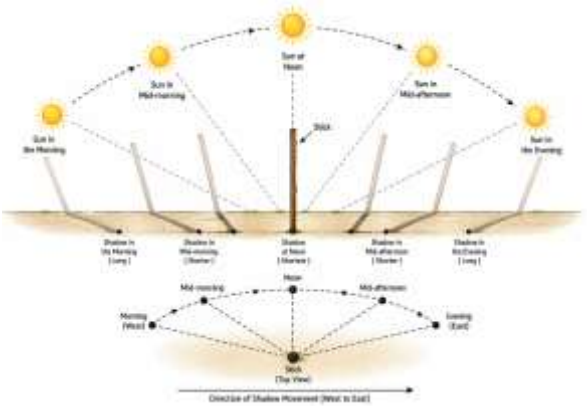
1. The Moon does not produce its own light; it reflects sunlight.
2. The visible portion changes due to the relative positions of Earth, Moon, and Sun.
3. This explains the repeating lunar phases.

Activity 2: Shadow Stick Experiment

Aim: To study the apparent motion of the Sun by observing the movement of shadows during the day.

Materials Required: A straight stick (about 30–40 cm long), Open ground with sunlight, Notebook and pencil, Compass (optional, for direction).

Procedure:



1. Fix the stick vertically in the ground in an open area.
2. In the morning, mark the tip of the shadow on the ground.
3. Continue marking the shadow tip at regular intervals (every hour).
4. Record the direction and length of the shadow.
5. Compare the shadow positions throughout the day.

Observation:

1. Shadow is long in the morning, short at noon, and long again in the evening.
2. Shadow moves from west to east direction during the day.

Result: The apparent movement of the Sun across the sky (east to west) is shown by the changing position of the shadow.

Inference:

1. Shadows change due to Earth's rotation on its axis.
2. This experiment demonstrates the apparent daily motion of the Sun.

Activity 6: Solar Eclipse Model

Aim: To demonstrate how a solar eclipse occurs when the Moon comes between the Earth and the Sun.

Materials Required: Table lamp or torch (to represent the Sun), Globe (to represent the Earth), Small ball (to represent the Moon), Dark room for clear observation.

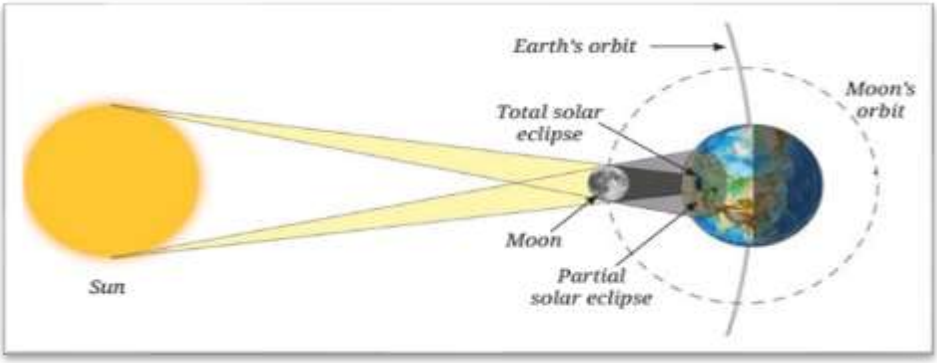
Procedure:

1. Place the lamp at the center of a table-this represents the Sun.
2. Position the globe at some distance from the lamp-this represents the Earth.

3. Hold the small ball (Moon) between the lamp and the globe.
4. Align the ball so that it blocks the light from the lamp falling on part of the globe.
5. Observe the shadow cast by the ball on the globe.

Observation:

1. The ball blocks sunlight and casts a shadow on the globe.
2. The shadowed region represents the part of Earth experiencing a solar eclipse.



Result: A solar eclipse occurs when the Moon passes between the Earth and the Sun, blocking sunlight from reaching certain regions of Earth.

Inference:

1. Solar eclipses are possible only on a new moon day.
2. They can be partial, total, or annular depending on alignment.
3. This model helps visualize how celestial bodies align during an eclipse.

Activity 7: Lunar Eclipse Model

Aim: To demonstrate how a lunar eclipse occurs when the Earth comes between the Sun and the Moon.

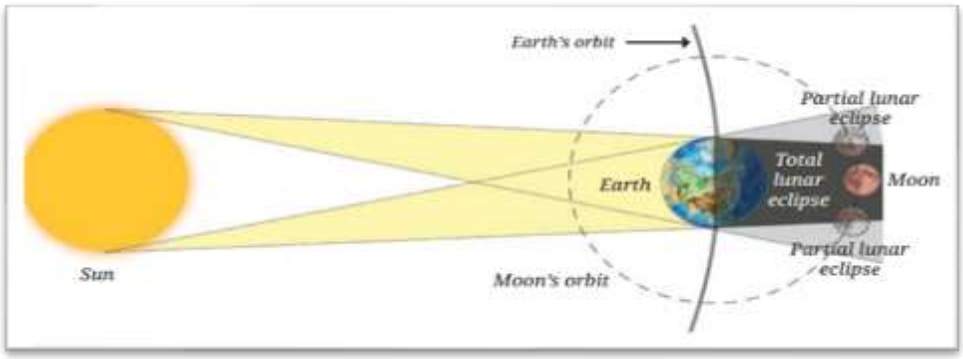
Materials Required: Table lamp or torch (to represent the Sun), Globe (to represent the Earth), Small ball (to represent the Moon), Dark room for clear observation.

Procedure:

1. Place the lamp at the center of a table - his represents the Sun.
2. Position the globe at some distance from the lamp - this represents the Earth.
3. Place the small ball (Moon) behind the globe in line with the lamp.
4. Observe the shadow of the globe falling on the ball.

Observation:

1. The globe blocks the lamp's light, casting a shadow on the ball.
2. The ball appears dark when in the shadow.



Result: A lunar eclipse occurs when the Earth comes between the Sun and the Moon, and Earth's shadow falls on the Moon.

Inference:

1. Lunar eclipses occur only on a full moon night.
2. They demonstrate the straight-line travel of light and alignment of celestial bodies.

Activity 9: Making a Sundial

Aim: To construct a simple sundial and use it to measure time based on the Sun's shadow.

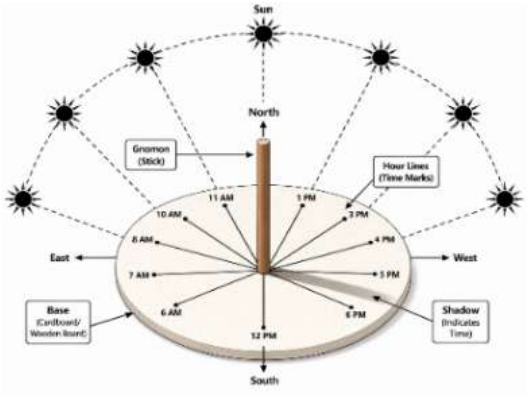
Materials Required: A cardboard or wooden base, A stiff stick (about 15–20 cm long, Compass (to find North direction), Scale and pencil, Watch (for calibration).

Procedure

1. Fix the stick vertically at the center of the cardboard base.
2. Place the sundial outdoors in sunlight.
3. Use a compass to align the stick so that shadows fall correctly (pointing North–South).
4. At regular intervals (e.g., every hour), mark the position of the shadow on the base.
5. Label the marks with the corresponding time using a watch for reference.
6. Continue marking throughout the day to complete the sundial scale.

Observation:

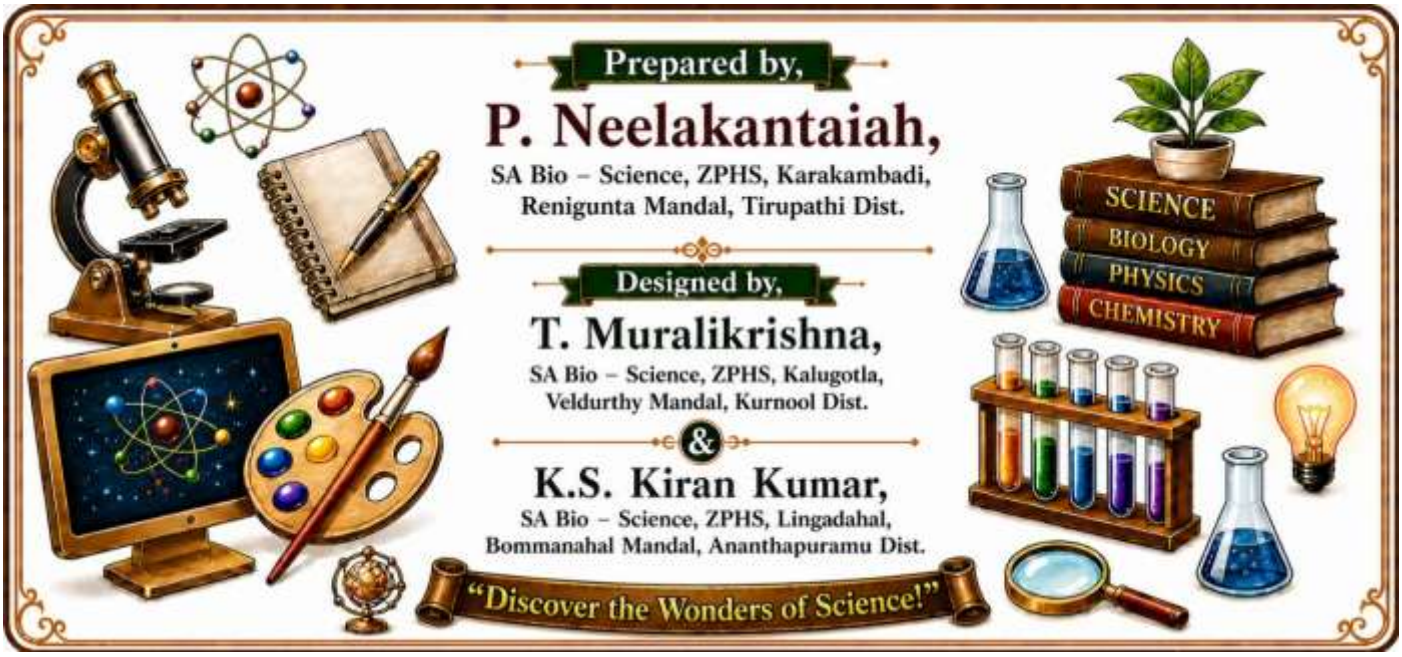
1. The shadow moves in a circular path around the stick.
2. Shadow length changes - shorter at noon, longer in morning and evening.
3. Marked positions correspond to specific times of day.



Result: The sundial shows time based on the position of the Sun. It works accurately during clear daylight.

Inference:

1. Sundials were one of the earliest time-keeping devices.
2. They rely on the apparent motion of the Sun caused by Earth's rotation.
3. **Limitations:** They cannot be used at night or on cloudy days.



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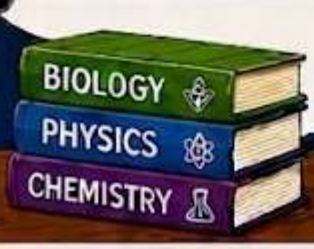

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