Vande Mataram

Vande Mataram!

Sujalam, suphalam, malayaja shitalam,

Shasyashyamalam, Mataram!

Vande Mataram!

Shubhrajyotsna pulakitayaminim,

Phullakusumita drumadala shobhinim,

Suhasinim sumadhura bhashinim,

Sukhadam varadam, Mataram!

Vande Mataram, Vande Mataram!

- Bankimchandra Chatterji

వందేమాతరం

వందేమాతరం!
సుజలాం సుఫలాం మలయజ శీతలాం,
సస్యశ్యామలాం మాతరం!
వందేమాతరం!

శుభ్రజ్యోత్స్న పులకితయామినీం,
ఫుల్లకుసుమిత ద్రుమదళ శోభినీం
సుహాసినీం సుమధుర భాషిణీం,
సుఖదాం వరదాం మాతరం!
వందేమాతరం!

- బంకించంద్ర ఛటర్జీ

AP SCERT

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Pledge | ప్రతిజ్ఞ

"India is my country. All Indians are my brothers and sisters.
I love my country and I am proud of its rich and varied heritage.

I shall always strive to be worthy of it.

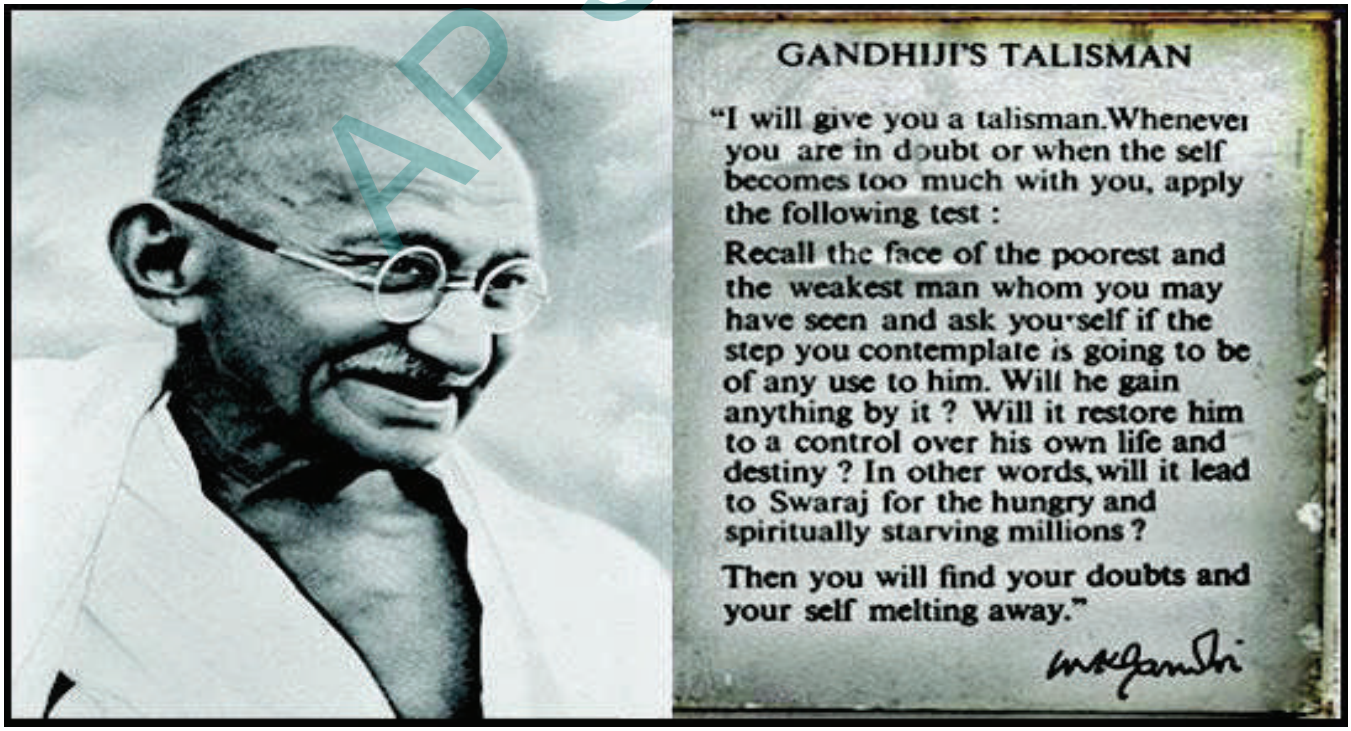
I shall give my parents, teachers and all elders respect,
and treat everyone with courtesy. I shall be kind to animals.

To my country and my people, I pledge my devotion.
In their well-being and prosperity alone lies my happiness."

- Pydimarri Venkata Subba Rao

"భారతదేశం నా మాతృభూమి. భారతీయులందరూ నా సహోదరులు.
నేను నా దేశాన్ని ప్రేమిస్తున్నాను. సుసంపన్నమైన, బహువిధమైన నా దేశ వారసత్వ సంపద నాకు గర్వకారణం.
దీనికి అర్హత పొందడానికై సర్వదా నేను కృషి చేస్తాను.
నా తల్లిదండ్రుల్ని, ఉపాధ్యాయుల్ని, పెద్దలందర్ని గౌరవిస్తాను. ప్రతివారితోను మర్యాదగా నడుచుకొంటాను.
జంతువులపట్ల దయతో ఉంటాను.
నా దేశంపట్ల, నా ప్రజలపట్ల సేవానిరతితో ఉంటానని ప్రతిజ్ఞ చేస్తున్నాను.
వారి శ్రేయోభివృద్ధులే నా ఆనందానికి మూలం."

– పైడిమర్రి వెంకట సుబ్బారావు



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Curricular Goal	Description	Competencies
CG - 2	Explores the physical world around them in scientific and mathematical terms	C-2.1 Describes one-dimensional motion (uniform, non-uniform, horizontal, vertical) using physical quantities (position, distance, time - speed, and changes in speed) through mathematical and diagrammatic representations C-2.2 Describes how electricity works through manipulating different elements in simple circuits, and demonstrate the heating and magnetic effects of electricity C-2.3 Describes the properties of a magnet (natural and artificial, earth as a magnet) C-2.4 Demonstrates rectilinear propagation of light from different sources of light (natural, artificial, reflecting surfaces), and verify the laws of reflection through manipulation of light source and objects, and use of apparatus and artefact (plane and curved mirrors, pinhole camera, kaleidoscope, periscope) C-2.5 Observes and identifies celestial objects in the night sky using simple telescope and images (planets, stars, natural and artificial satellites, constellation, comets), and explains their role in navigation, calendars, and phenomena (phases of the moon, eclipse, life on earth)
CG - 4	Understands the components of health, hygiene and well-being	C-4.1 Undertakes a nutrition-based analysis of food components with reference to Indian and modern dietary and culinary practices, and explain the effect of nutrition on health C-4.2 Examines different dimensions of diversity of food - sources, nutrients, geographical, social, time-period based, diets C-4.3 Describes biological changes (growth, hormonal, reproductive) during adolescence, and measures to ensure overall well-being C-4.4 Recognizes and discuss substance abuse, viewing school as a safe space to raise these concerns
CG - 5	Understands the interface of science, technology and society.	C-5.1 Illustrates how science and technology help improve the quality of lives in every walk of human life (health care, communication, transportation, food security, mitigation of climate change, judicious consumption of resources, applications of artificial satellites, etc.) C-5.2 Shares views on news and articles related to the impact science and technology, and society have on each other.
CG - 7	Communicates own questions, observations and conclusions related to science.	C-7.1 Uses scientific vocabulary to communicate inferences and ideas about science accurately in oral and written form, and through visual representation C-7.2 Designs and build simple models to demonstrate scientific concepts C-7.3 Represents real world events and relationships through diagrams and simple mathematical representations

APSCERT

DAY 1 Acids, Bases and Salts

N4YZI9

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Acid	Base	Salt	Sour	Bitter	Slippery
Soap	Lemon	Curd	Vinegar	Baking soda	Neutralise
Indicator	litmus paper	Turmeric			

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situations (experience).

- Acids are sour to taste.
- Bases are Bitter/slippery substances.
- Tasting chemicals can be dangerous and harmful to health.
- Some acids and bases may be corrosive or poisonous. A safer method to test is to use indicators like litmus paper or turmeric.
- When soil becomes too acidic, it can harm plant growth. Farmers add bases such as lime to neutralise the acid in the soil. The acid-base reaction forms salt and water, making the soil more suitable for crops.
- Salt is not only table salt - many salts exist.
- Every sour substance is an acid. Do you agree?

Apply:

Fill in the blanks:

1) Baking soda is bitter. So it is _____
2) Curd is sour. So it is _____
3) Litmus paper and turmeric are examples of _____
4) Acid reacts with base to form _____ and _____

AP SCERT

DAY 2 Electric Circuits and their Components

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Electric cell Battery Electric circuit Switch Conductors Insulators

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situations (experience).

- Electric cell is a source of electricity.
- An electric cell has two terminals; one is positive (+ ve) terminal and the other is negative (- ve) terminal.
- An electric bulb has a filament that is connected to its terminals.
- An electric bulb glows when electric current passes through filament.
- In a closed electric circuit, the electric current passes from one terminal of the electric cell to the other terminal.
- Switch is a simple device that is used to either break the electric circuit or to complete it.
- Materials that allow electric current to pass through them are called conductors.
- Materials that do not allow electric current to pass through them are called insulators.

Apply:

Answer the following questions by using the words given below.

(switch, filament, electric bulb, electric cell, jute string)

(a) I am a thin wire inside a bulb. Who am I?

(b) I produce electricity from the chemicals stored inside me. Who am I?

(c) I glow when electric current passes through me. Who am I?

(d) I can either break or complete an electric circuit. Who am I?

(e) I do not allow electric current to pass through me. Who am I?

AP SCERT

DAY 3 Metals and Nonmetals

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Malleability Ductility Lustrous Sonority Copper Gold

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situations (experience).

1. **Malleability :** The property of a metal that allows it to be hammered into thin sheets is called malleability.
2. **Ductility**: The property of a metal that allows it to be drawn into thin wires is called ductility.
3. **Lustrous**: Lustrous means shiny. Gold and silver look shiny.
4. **Sonority:** Sonority means making a ringing sound when hit.
5. **Gold:** Precious metal which is not corroded, so commonly used in making ornaments.

Apply:

Match the Following:

Column A		Column B
A) Malleability	( )	1) Ability to be drawn into thin wires.
B) Ductility	( )	2) Property of producing a ringing sound when struck.
C) Lustrous	( )	3) Ability to be hammered into thin sheets.
D) Sonority	( )	4) Metal widely used in electrical wiring due to high conductivity.
E) Copper	( )	5) Shiny surface that reflects light.
F) Gold	( )	6) Precious metal commonly used in ornaments because it does not corrode easily.

AP SCERT

DAY 4 Metals and Nonmetals

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Conduction Rusting Aluminium Silver Oxygen Sulphur

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situations (experience).

1. **Conduction:** Ability of a material to allow heat and electricity to pass through them.
2. **Rusting:** Rusting is a chemical process in which iron reacts with air and water and forms a reddish-brown layer. This layer is called rust.
3. **Oxygen:** Oxygen is a gas in the air that helps us breathe and stay alive. It also helps things burn.
4. **Sulphur:** Sulphur is a yellow solid substance found in nature. It is used in making medicines, fertilizers, and matchsticks.
5. **Aluminium:** Cheap and light weight metal often used in making cooking vessels and thin sheets.

Apply:

Match the Following:

Column A		Column B
A) Conduction	( )	1) Formatin of iron oxide in the presence of air and moisture.
B) Rusting	( )	2) Gas essential for respiration and burning.
C) Aluminium	( )	3) Yellow non-metal used in fertilizers and matchsticks.
D) Silver	( )	4) Good conductor of heat and used in making cooking vessels and foil.
E) Oxygen	( )	5) Metal used in making mirrors and decorative items.
F) Sulphur	( )	6) Ability of a meterial to allow heat or electricity to pass through it.

AP SCERT

DAY 5 Changes around us

Teacher Activity

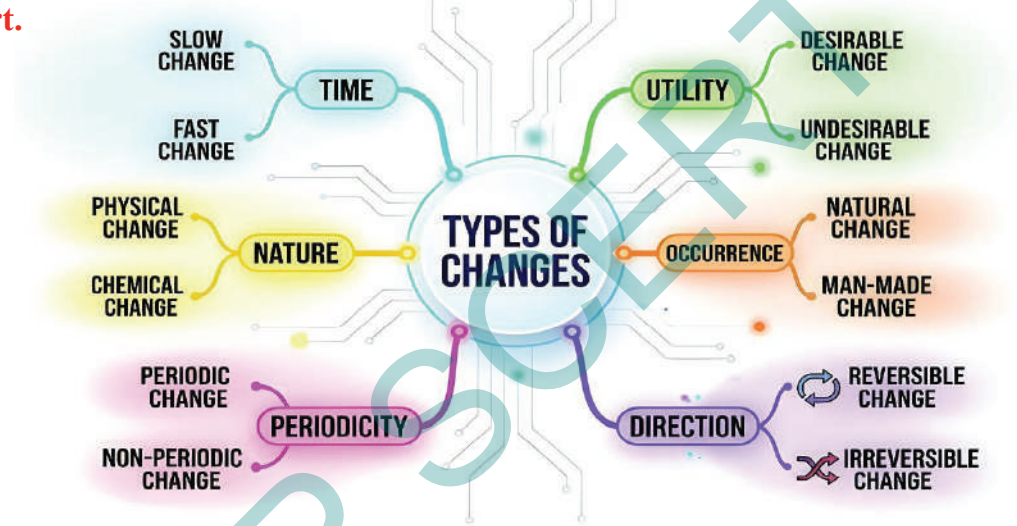
Learn :

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Physical change	Chemical change	Natural change	Man-made change
Reversible change	Irriversible change	periodic change	Non-periodic change

Understand:

Read and Explain: The teacher reads the sentences and explain the keywords from the flow chart.



Apply:

In nature, many changes occur in pairs of opposites. Based on what you have learned about the types of changes, write the exact opposite for each of the following changes:

1. Slow change - _____
2. Desirable change - _____
3. Natural change - _____
4. Reversible change - _____
5. Periodic change - _____
6. Physical change - _____

Read the following statements and fill in the blanks with the correct opposite type of change:

7. If the melting of ice is a Reversible change, then the burning of wood is an _____.
8. If the changing of seasons is a Periodic change, then an earthquake is a _____.
9. If the ripening of a mango is a Desirable change, then the spoiling of food is an _____.

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DAY 6

Heat

Teacher Activity

Learn:

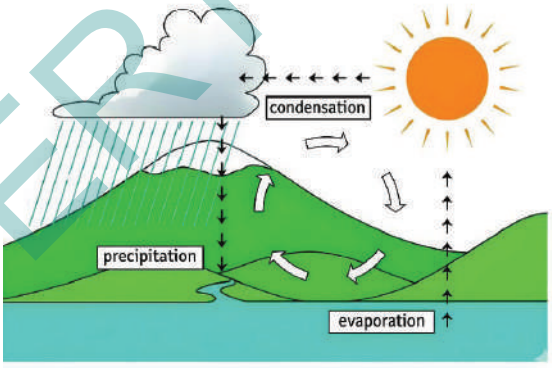
Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Solid liquid gas Conductors Insulators Water cycle Thermometer

Understand:

The teacher reads the sentences in the passage and explains the keywords in it.

Journey of a rain drop



Generally, the water in the ponds, tanks, rivers and seas gets evaporated into the air due to the sun's heat. The process of changing water into water vapour is called evaporation. As water vapour rises up, it encounters cooler temperature in upper atmospher and cools down. Water vapour turns into tiny liquid droplets, this is called condensation. These droplets cluster together to form clouds. Cloud droplets collide and grow larger until they become too heavy for the air to hold them. When water drops fall from clouds, it is called precipitation or rain. Evaporation, condensation and precipitation form a continuous cycle called the water cycle. This constantly circulates water between the earth's surface and the atmosphere.

Apply:

Short Answer Questions.

1. What is the process called when water changes into water vapour?
2. Name any four places where water generally evaporates from.
3. What causes the water vapour in clouds to cool down and turn into little droplets?
4. What are the two names given for water-drops falling from the clouds?
5. How does the passage define the "water cycle"?

Fill in the Blanks

6. Water goes up into the air as water vapour due to the heat of the _____.
7. When evaporated water goes into the air, it _____ and forms clouds.
8. The continuous cycle of water evaporating, forming clouds, and falling back to the surface is called the _____.

Look at the above diagram and answer the questions below.

9. Look at the arrows pointing up from the blue water. What process do these arrows represent?
10. Which provides the energy or heat to start the water cycle in the picture?

AP SCERT

DAY 7

Heat

Teacher Activity

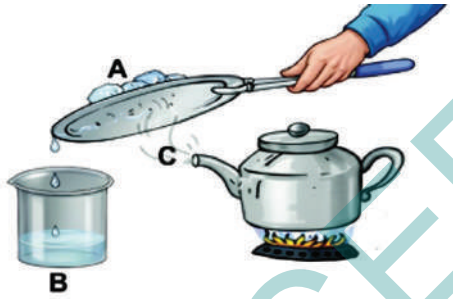
Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Solid liquid gas Conductors Insulators Thermometer

Understand:

Read and explain : The teacher has to read the paragraph given and explain the context.



Observe the above image.

When the steam comes in contact with the metal plate(A) cooled with ice, it condenses and forms water(B). The water drops that you observed falling from the plate, were due to condensation of steam(C).

Now fill in the blanks with the appropriate words.

1) 'A' is _____ (solid / liquid / gas)
2) 'B' is _____ (solid / liquid / gas)
3) 'C' is _____ (solid / liquid / gas)

The metal plate allows heat to spread quickly, while the plastic handle prevents heat from reaching the hand.

4) The metal plate is a/an _____(conductor / insulator)
5) The plastic handle is a/an _____(conductor / insulator)

6) Name the above device.

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DAY 8

Light

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Luminous Non luminous Transparent Translucent Opaque

Shadow Mirror Reflection Image

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

- Objects that emit their own light are called luminous objects.
- Objects that do not emit their own light are called non luminous objects.
- Opaque objects do not allow light to pass through them.
- Transparent objects allow light to pass through them and we can see through these objects clearly.
- Translucent objects allow light to pass through them partially.
- Shadows are formed when an opaque object comes in the path of light.
- Light always travels in straight line.
- Mirror reflection gives us clear images.

Apply:

1) Classify the objects or materials given below as opaque, transparent or translucent and luminous or non-luminous:

Air, water, a piece of rock, a sheet of aluminium, a mirror, a wooden board, asheet of polythene, a CD, smoke, a sheet of plane glass, fog, a piece of red hot iron, an umbrella, a lighted fluorescent tube, a wall, a sheet of carbon paper, the flame of a gas burner, a sheet of cardboard, a lighted torch, a wire mesh, kerosene stove, sun, firefly, moon.

2) Can you think of creating a shape that would give a circular shadow if held in one way and a rectangular shadow if held in another way?

3)In a completely dark room, if you stand in front of a mirror, will you see a reflection of yourself in the mirror?

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DAY 9 Measurement of Time and Motion

Teacher Activity

Learn:

Read and Recite: The teacher read and pronouns the words and make the students to read and recite.

Pendulum Linear motion Periodic motion Hour Minute Second

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

A) Linear Motion B) Periodic Motion

- In figure (A) Kamala is dragging a stone tied to a thread along a straight line. This type of motion in a straight line is called linear motion.
- In figure (B) Kamala is suspending a stone tied to a thread making to and fro motion. This type of motion that repeats itself after some period of time is called Periodic motion.
- 1 hour = 30 minutes 1 minute = 60 seconds

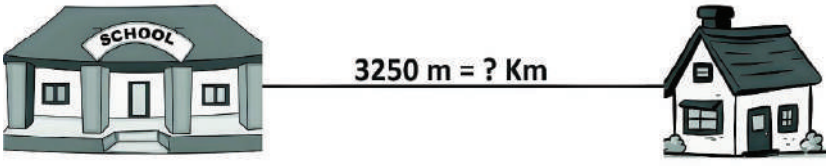
  1 km = 1000 m

Apply: Answer the following.

1. Give two examples of Periodic motion.
2. Give two examples of Linear motion.
3. Motion of a car moving on straight road is _____.
4. Motion of the needle in sewing mechine is _____.
5.

   1. Hour's hand is at_____.
   2. Mintue's hand is at _____.
   3. Second's hand is at _____.

6. What can you write at '?' in the picture below?



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DAY 10 Let's Classify Plants

Teacher Activity

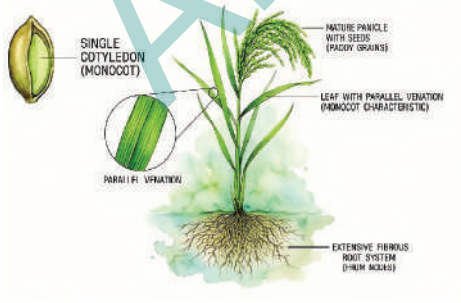
Learn:

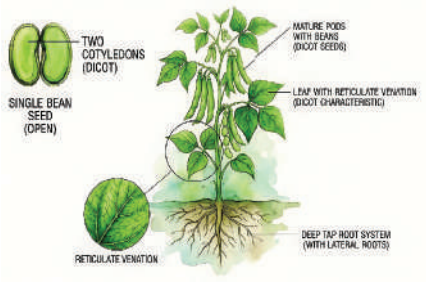
Read and Recite: The teacher read the words and make the students to read and recite

Herbs Shrubs Tree Cotyledon Monocot plants Dicot plants Fibrous root system Taproot system Venation Reticulate venation Parallel venation.

Understand: Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

1. Herbs are small plants with soft, green stems.
2. Shrubs are medium-sized plants with woody stems.
3. A tree is a tall plant with a hard, thick trunk.
4. A cotyledon is the seed leaf that provides food for the baby plant.
5. Monocot plants have seeds with only one cotyledon.
6. Dicot plants have seeds with two cotyledons.
7. Fibrous roots are a bunch of thin roots growing from the base of the stem.
8. A taproot is one main thick root that grows straight down.
9. Venation is the pattern of veins on a leaf.
10. In reticulate venation, veins form a net-like design.
11. In parallel venation, veins run straight next to each other parallelly.





Application:

1. Give three examples for each of the following.
   a) Herbs: _____, _____, _____
   b) Shrubs : _____, _____, _____
   c) Trees : _____, _____, _____
   d) Monocot plants : _____, _____, _____
   e) Dicot plants : _____, _____, _____

AP SCERT

DAY 11 Let's Classify Animals

Teacher Activity

Learn:

Read and Recite: The teacher read the words and make the students to read and recite

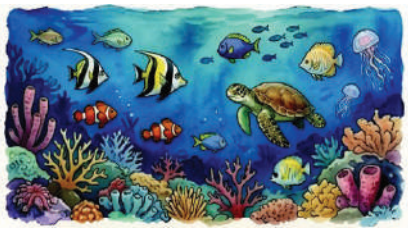
Amphibians Aquatic animals Terrestrial animals Herbivores carnivores omnivores

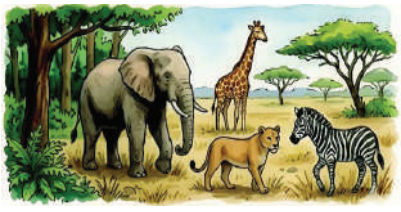
Understand: Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

1. Amphibians are animals that can live both on land and in water.
2. Aquatic animals live only in water.
3. Terrestrial animals live on land.
4. Herbivores are animals that eat only plants.
5. Carnivores are animals that eat only meat.
6. Omnivores are animals that eat both plants and meat.

Apply:

1. Write the relavent word to the picture.





2. Above picture shows all wild animals. Now list out and classify the animals around you as Herbivores, Carnivores and Omnivores.
3. Draw your favourite animals in your drawing book.

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DAY 12

Am I Changing?

Teacher Activity

Learn:

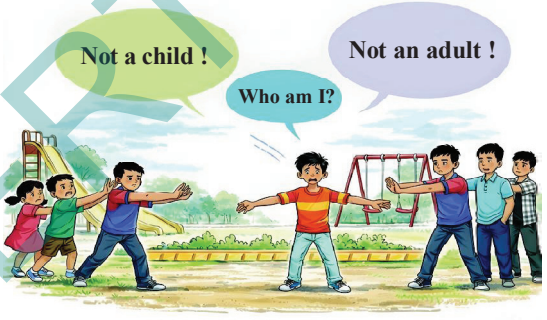
Read and Recite: The teacher read the words and make the students to read and recite

Health Hygiene Growth Deficiency Diseases Healthy Habits Infancy Childhood Adolescence Adulthood Old Age Balanced Diet Anaemia Stages of Life Reproduction

Understand:

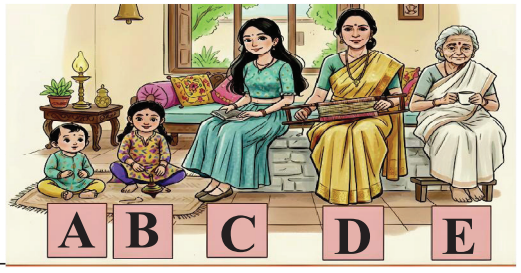
Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

1. Good health means being fit in body and mind.
2. Daily hygiene keeps our bodies clean and germ-free.
3. Playing sports and sleeping early are healthy habits.
4. A balanced diet gives us all the nutrients we need.
5. We need protein for the growth of our muscles.
6. Missing vitamins can cause deficiency diseases.
7. Anaemia happens when our blood lacks enough iron.
8. Reproduction is how living things produce their babies.



Apply: Choose the Correct Keyword:

1. The stage of life where a person is a very small baby and depends entirely on parents for food: _____
2. At what stage do you start going to school_____
3. What do you think about the stage C _____



A. Life Cycle Ordering: Rearrange the stages of human life in the correct order from youngest to oldest: Adulthood, Infancy, Old Age, Childhood, Adolescence.

B. Statement: Your friend prefers to eat only potato chips and soft drinks for lunch every day.

1. Is your friend eating a Balanced Diet? Why or why not?

   _____

2. What Good Habits would you suggest to help them stay healthy as they grow?

   _____

APSCERT

DAY 13 Life processes in Animals

Teacher Activity

Learn:

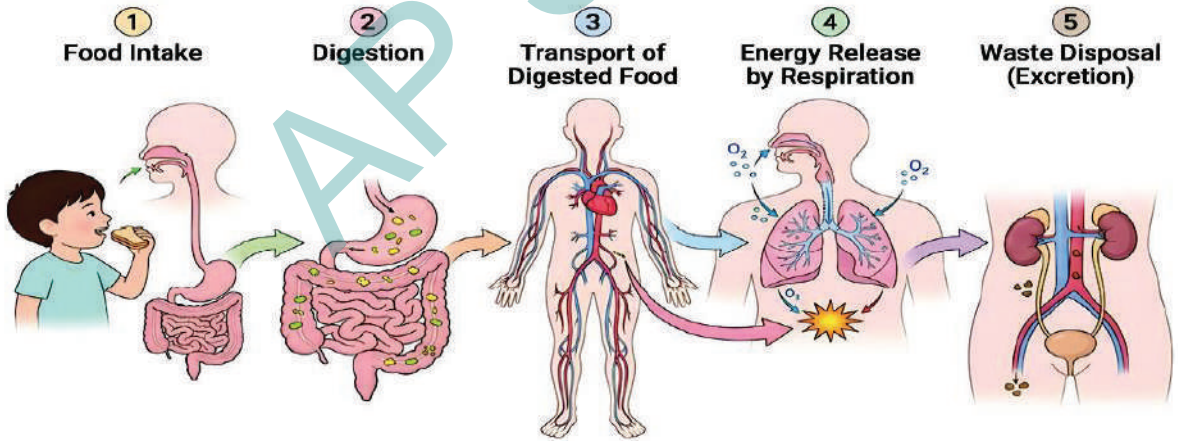
Read and Recite: The teacher read the words and make the students to read and recite.

Life Processes Nutrition breathing lungs Respiration Excretion kidneys
Reproduction Growth Starch Saliva lime water heart Blood vessels

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

1. Nutrition is taking in food for energy.
2. Saliva helps moisten and digest food.
3. Starch is a food component found in rice and potatoes.
4. Breathing is taking in air and letting it out.
5. Lungs are the main organs for breathing.
6. Respiration is making energy from food and oxygen.
7. Lime water turns milky with carbon dioxide.
8. The heart pumps blood to the whole body.
9. Blood vessels are tubes that carry blood.
10. Excretion is removing waste from the body.
11. Kidneys filter waste from our blood.



Apply:

A. Match the following

1. Digestive System	( )	A. The Filter(Cleaning the blood)
2. Circulatory System	( )	B. The Grinder (Breaking down food)
3. Respiratory System	( )	C. The Super-Highway (Moving nutrients)
4. Excretory System	( )	D. The Air Exchange (Trading gases)

B. Draw your favorite food items in your drawing book.

AP SCERT

DAY 14 Life process in Plants

Teacher Activity

Learn:

Read and Recite: The teacher read the words and make the students to read and recite.

Stomata Respiration Water and Minerals Carbon dioxide Oxygen
sunlight energy Nutrition Nutrients Iodine test Starch

Understand:

Read and Explain: The teacher reads the sentences and explains the key words in day to day life situation (experience).

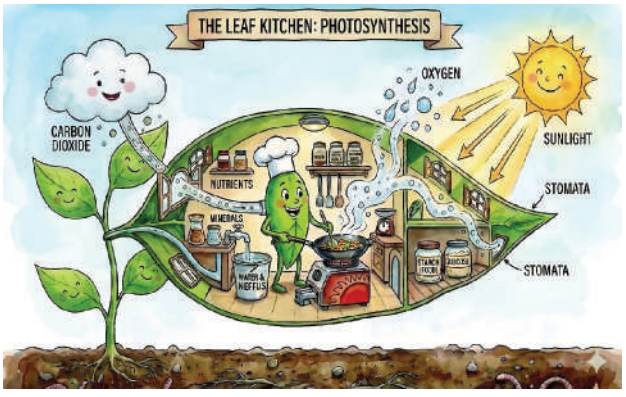
1. Stomata are tiny holes on leaves used for breathing.
2. Roots take water and minerals from the soil.
3. Plants use sunlight to make their own food.
4. Plants take in carbon dioxide from the air.
5. Plants give us oxygen to breath.
6. Plants turn sunlight into energy to grow.
7. Respiration is how plants get energy from their food.
8. Nutrition is the way living things take in and use food.
9. Nutrients are parts of food that help us stay healthy.
10. Starch is the extra food stored inside a plant.
11. We use an iodine test to see if food has starch.

Apply:

Match the Kitchen parts with the below scientific words.

Stomata, Sunlight, Starch, Water and Minerals, Oxygen

Kitchen Part	Scientific Term
The Tiny Windows	
The Stove (Heat)	
The Finished Meal	
The Delivery Straw	
The Fresh Air Released	



Pit tick (✓)mark to the correct answer.

1. Do plants need food to grow? (YES / NO)
2. Can we see Stomata with our naked eyes? (YES / NO)
3. Does the Iodine Test turn a leaf blue-black if starch is present? (YES / NO)
4. Do plants release Carbon Dioxide when they make food? (YES / NO)
5. Is Sunlight used as energy by the plant? (YES) /NO)

AP SCERT

1 The Wonderful World of Science

We hope you enjoyed your adventures with General Science in Class 6, and are now ready to continue our journey into the wonderful world of science. This again, is not just a textbook with facts — it is an invitation to question, to perform experiments, and to explore, as we try to understand the beautiful world we live in. The world of science covers everything — small and large, near and far. We may be looking at tiny cells inside a leaf, or the movement of the sun and the stars. We may be testing out the materials around us at home, or discussing how water flows underground. As you go through the chapters in this book, you will start new adventures that challenge your thinking, expand your knowledge, and help you become an explorer, making small discoveries for yourself.

X1M1W8

Before we dive into our exciting journey, take a moment to observe something special about this book. Look at the page numbers — they follow the playful flight of a butterfly and the soaring of a paper plane! Just as a butterfly flutters freely and a paper plane flies into the sky, learning takes flight when curiosity leads the way. Did you know that something as simple as a paper plane inspired real scientific explorations of flight? From early inventors studying bird wings to modern engineers designing aircraft, the dream of flying started with simple observations and experiments. So, as you turn each page, let your imagination take flight — exploring new ideas, discovering wonders, and reaching for the skies!

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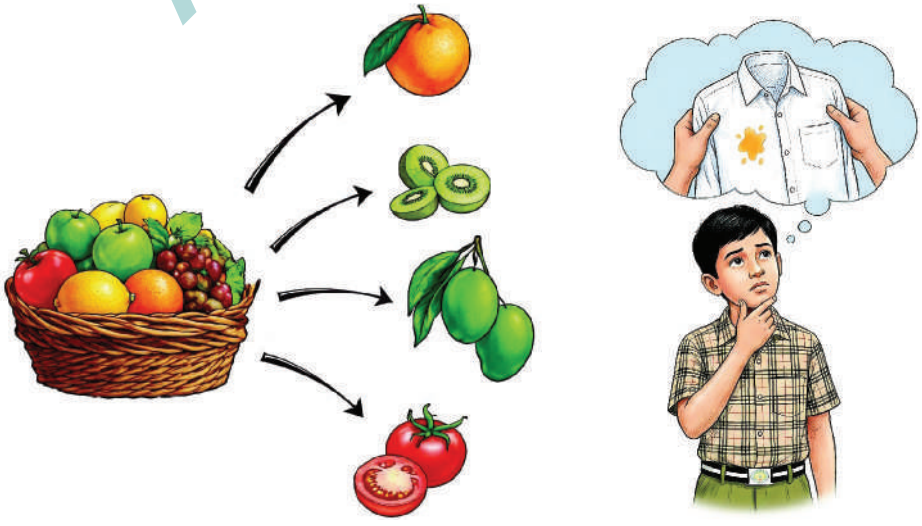
Exploration, of course, isn't just about discovering new facts or learning about different things in nature. Science, as we said in Grade 6, is a process, so it is about a way of thinking that welcomes curiosity, asks questions, and is open to the unknown. In Grade 7, we will try to ask deeper questions: How do things work? Why do events happen the way they do? And what can we learn from the patterns that we see in nature?

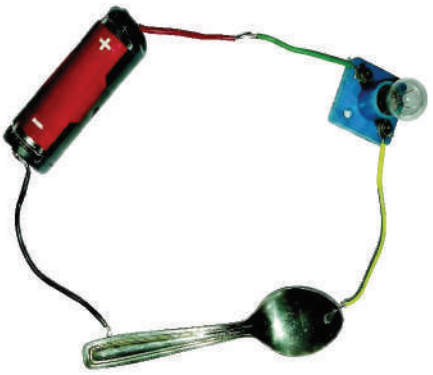
To do this, we have to step out of this book, step out of the classroom perhaps, and experience the world through activities and experiments. These are experiences that we hope will not just be interesting or exciting but also serve as stepping stones to a deeper understanding of the environment we live in and of our place on this planet. We believe that this will also help you to see science as an ongoing process of discovery. And not just about discovery alone, but also about responsibility. As young science explorers, you will soon see how human activities are linked to what happens in the natural world and are connected to the society we live in. You will, we hope, also see the role that science can play in addressing environmental challenges and help in creating a more sustainable world.

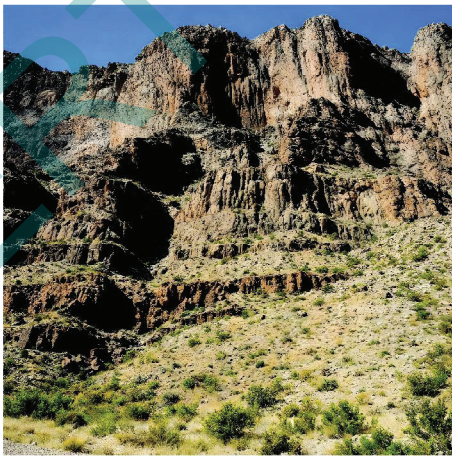
But let's get back into this book for now. You will read about topics in different fields of science, from physics and chemistry to biology and earth sciences. While they might appear as different chapters, just as we had said in Grade 6, they are all interconnected. Scientific ideas in one area often inspire discoveries in another, or at least allow us to ask questions in another area. So, let's take a quick journey through our book for this year. We will start by looking at the properties of materials around us, mostly the things we experience but perhaps never ask questions about — why are some fruits sour? What happens when we wash a haldi stain on our dress with soap?

AP SCERT



We then move on and play with some electric batteries, lamps and wires to try to find other kinds of properties of materials. What kind of materials do we need to make a lamp glow? This will lead us to classifying materials based on their properties — and we will enter the world of metals and non-metals. We know from our experience that a torch battery runs out eventually, and can't be used again. We'll explore what kind of changes happen around us. Some changes can be reversed and others cannot be reversed.





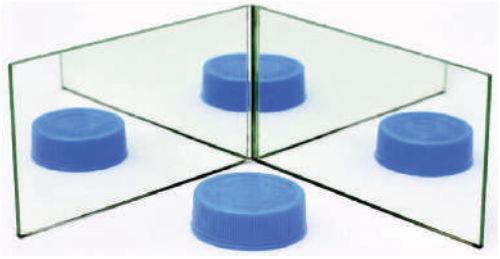
Batteries run out, ice melts into water, fruits ripen, rocks break into pebbles… what kind of changes are these? Some of these happen, or happen faster, when things are heated. We will look at how heat flows — whether it is the melting of an ice cube in a glass, or the melting of a glacier. Water is, of course, everywhere, and with the heat from the Sun, it evaporates from the seas and falls as rain, perhaps trickling down into the ground, somewhere far away.

AP SCERT

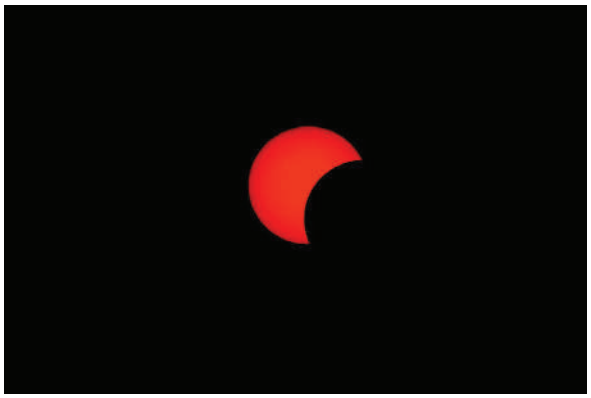
However, it isn't just changes in materials around us that we see, or the hidden changes in water that we do not see. As we are growing, our bodies are changing as well. Especially around the middle-school years, our bodies are changing rapidly! Why? Not just us humans, there are life processes that are essential to all animals for their survival. To grow, we have to eat and breathe, blood has to circulate the nutrients from the food all over the body and so on. But why animals alone? Don't plants also need food to grow? How do they get their food? Do they also breathe?

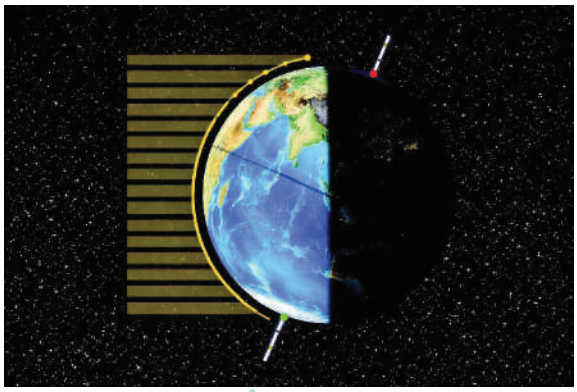
How? Over the time that life has evolved on our planet Earth, it has figured out how to do this in a beautiful and carefully balanced way. Ah, but what is time? The clock on the wall or a wrist watch tells us the time and how it passes. We get prepared to go to school in the morning and are ready to sleep at night but have you thought about how we measure time? And how fast does something happen?

Long before the age of electric clocks and digital watches, early humans observed the shadows of objects in the Sun and used the position of the shadows to tell the time. Light and shadows are not just useful for shadow puppets or to tell the time. Naturally, light helps us see and today, we've developed a lot of ways to generate light (so we can read a book at night, even when the Sun doesn't shine). But, more importantly, asking questions about the nature of light has given us a very deep understanding of the universe we live in. While we'll perhaps learn about it only later, light and shadows are not just limited to things around us at home.

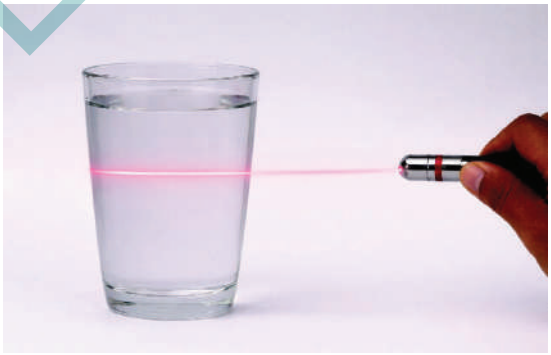


NCERT





Even the Earth and the Moon can cast shadows, leading to the fascinating phenomena of eclipses. And of course, we have day and night that depend on receiving light from the Sun. To understand all of this, we need to know how the Earth rotates around its axis, how the Moon goes around the Earth, and the Earth around the Sun. And the consequences of these movements on life on our beautiful planet. While all this might have your head spinning, think about it. Isn't it amazing that we humans can wonder about the wonderful world we live in?



In the chapters that follow, you'll also make simple observations and do fun experiments, and dive into topics that need careful thinking. Each chapter builds on what you already know and encourages you to ask questions, explore, do hands on experiments, and think like a scientist! As you will find out, even those experiments that seem to confirm what we think will happen, might lead to some additional questions that might need more experiments and more questions.

1.1 Happy Exploring

Activity 1. 1: Question the Answer

In school or during tests, you're usually given questions and expected to find the answers. But let's turn that around! To think like a scientist, it is equally important to ask interesting questions!

AP SCERT

Great scientists don't just answer questions — they ask amazing ones! (Remember last year we had said, "To be a wise person, you must be a whys person".)

Look at the answers below. Your task is to come up with a curious, creative, and fun question or situations that could lead to these answers. There are never any wrong questions, so let your imagination run wild! Since such exercises might not be very familiar, here is an example to help you! Suppose the answer was 'just make it half!' — what all could this be a response to? Well, it could range from "How do we ensure getting equal shares of cake?" to "My essay is too long", or "I can't fi t this in the envelope" or even "I cannot dance to such a long song"... all very different! So, let's see what kind of creative questions you can ask!

Question: _____?

Answer: Just add some milk.

Question: _____?

Answer: Because the cat's teeth were crooked.

Question: _____?

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

Question: _____?

Answer: 42.

(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?")

AP SCERT

2 Acids, Bases and Salts

Learners will be able to...

- Identify the substances as acidic, basic and neutral using litmus (CG-1)
- Prepare and use a rose flower indicator to test the acidic or basic nature of substances (CG-1).
- Explain how colour changes help us to find out nature of substances. (CG-1).
- Conclude neutralisation as a reaction in which acids and bases cancle each other's effects. (CG-1)
- Apply neutralisation to every day situations such as ant sting and acidic or basic nature of soil. (CG-5)

On 28 February, the school hosted a science fair to celebrate National Science Day. At the entry gate, siblings Krishna and Keerthi were greeted with a white sheet of paper. They were curious to know why a white sheet of paper was given to them!

A few steps ahead, there was a volunteer spraying a liquid on these sheets of paper. The siblings also got their white sheets sprayed. To their surprise, the words 'Welcome to the Wonderful World of Science' appeared on the papers the moment the liquid was sprayed (Fig. 2.1). They were excited and eager to know how this happened and the **reason** behind it.

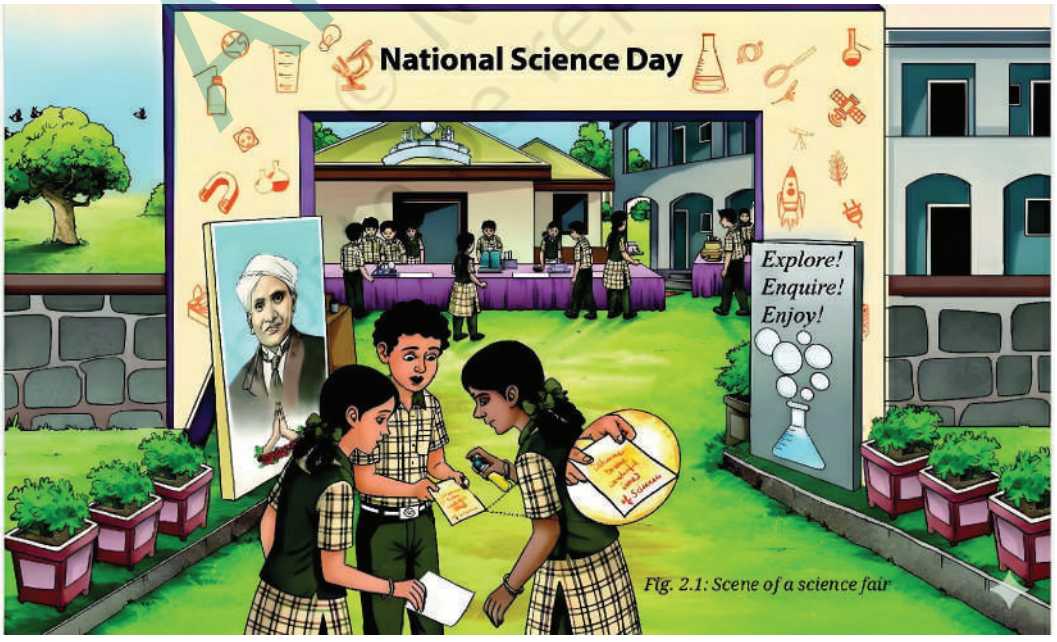


Fig. 2.1: Scene of a science fair

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Their curiosity was partly satisfied at the 'Colourful World of Substances' stall. They saw many activities showing colour changes on mixing different substances. They decided to **explore** these changes further. Let us join them on this learning adventure.

2.1 Nature – Our Science Laboratory

2.1.1 Litmus as an indicator

Activity 2. 1: Let us explore

- Collect samples of lemon juice, soap solution, amla juice, tamarind water, vinegar, baking soda solution, lime water, tap water, washing powder solution, sugar solution, and salt solution.

Fig. 2.2(a): Colour change in blue litmus paper

- Take a strip of blue litmus paper and cut it into small pieces.
- Spread these pieces on a clean and dry white tile.
- Using a dropper, put one drop of each of the samples, one-by-one, on these litmus paper pieces, as shown in Fig. 2.2a.

- Do you **observe** any change in the colour of the blue litmus pieces?
- **Record** your observations in Table 2.1.
- Repeat the same activity with pieces of red litmus paper as shown in Fig. 2.2b and record your observations in Table 2.1.

Fig. 2.2(b): Colour change in red litmus paper

How to prepare lime water?

Do not confuse lime water with the word lime, which is a fruit similar to lemon. Lime water (solution of calcium hydroxide in water) can be easily prepared by mixing lime (Sunnam, i.e. calcium oxide) in water and leaving it undisturbed for some time, say an hour. Filter the liquid into another container and use it as lime water.

AP SCERT

Table 2.1: Testing the nature of samples with blue and red litmus papers

S.No.	Name of the sample	Colour of blue litmus paper after putting a drop of sample	Colour of red litmus paper after putting a drop of sample
1.	Lemon juice		
2.	Soap solution		
3.	Usiri juice		
4.	Tamarind water		
5.	Vinegar		
6.	Baking soda solution		
7.	Lime water		
8.	Tap water		
9.	Washing powder solution		
10.	Sugar solution		
11.	Salt solution		
12.	Any other		

Now, let us **analyse** Table 2.1 and sort the samples into three groups as follows —

- Group A with samples that turn the blue litmus paper to red.
- Group B with samples that turn the red litmus paper to blue.
- Group C with samples that do not affect either of the two litmus papers.

Record the data in Table 2.2.

Table 2.2: Grouping Samples tested in Table 2.1

Group A	Group B	Group C

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I am curious to know — what are these red and blue litmus paper strips made of ? Why do they change colour when drops of some samples are put on them?

Fig. 2.3: Blue and red litmus paper strips

Let us find out!

Litmus is a natural substance obtained from lichens. It is available both as a solution and in the form of paper strips, known as litmus paper. The litmus paper is available in two colours—blue and red, as shown in Fig. 2.3.

Substances that turn blue litmus paper to red are **acidic** in nature, while those that turn red litmus paper to blue are **basic** in nature. Since litmus shows different colours in acidic and basic solutions, it is called an **acid-base indicator**.

Some other substances, both natural and synthetic, can also be used as indicators. Synthetic indicators are made in laboratories, and you will learn more about them in higher grades.

HOLISTIC LENS

Lichens are formed by the association of two living organisms, a fungus and an alga. They grow on rocks and trees in regions that have abundant rainfall and clean air. Do you find lichens on trees in your neighbourhood?

Now, let us **classify** the substances sorted in Group A, Group B, and Group C in Table 2.2.

- The substances in Group A, such as lemon juice, *Usiri* juice, tamarind water, and vinegar turned the blue litmus paper to red, implying that these substances are acidic in nature.
- The substances in Group B, such as soap solution, baking soda solution, lime water, and washing powder solution turned the red litmus paper to blue. Hence, these substances are basic in nature.
- The substances in Group C, such as tap water, sugar solution, and salt solution, did not change the colour of either litmus paper. Can you **predict** their nature? These substances are said to be **neutral** because they are neither acidic nor basic.

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Activity 2. 2: Let us relate and explore

Are all the substances in Group A of Table 2.2 edible? Have you ever tasted these edible substances? Can you recall their taste? You will find that all these substances taste sour. Thus, we can say that substances that taste sour tend to contain acids and are acidic in nature.

⚠ Caution — Do not taste anything until asked to do so. Do not taste any unknown substance.

Some common edible substances and the names of the most common acids present in them are given in Fig. 2.4.

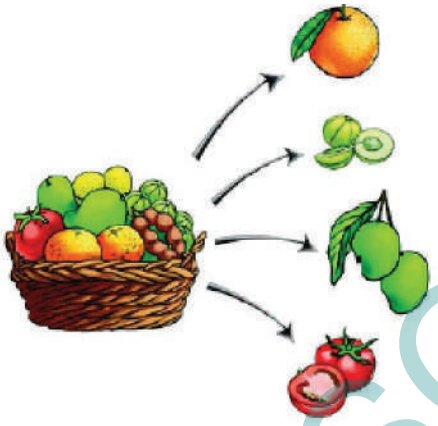


Fig. 2.4: The most common acids present in some edible substances

Find out and write the names of the most common acids present in the following substances —

Lemon_____, Curd_____, Tamarind_____, Vinegar_____.

Now we will see where these acids are useful in our daily life:

- Used in food preservation (like vinegar in pickles).
- Used in cleaning agents (to remove stains/rust)
- Present in batteries (sulphuric acid).
- Used in medicines and cosmetics.
- Helps in digestion (Hydrochloric acid in stomach).

Now, let us take baking soda solution from Group B. Rub the baking soda solution between your fingers. What do you observe?

It feels soapy or slippery. Basic substances are generally slippery to touch.

Also, bases generally taste bitter, but everything that tastes bitter may not contain a base. For example, bitter gourd possesses a bitter taste but is not basic in nature.

AP SCERT

Now we will see where these bases are useful in our daily life:

- **Cleaning:** soaps, detergents contain bases.
- **Health:** Antacids (like milk of magnesia) reduce acidity.
- **Construction:** Lime ($Ca(OH)_2$) used in whitewash and plaster.
- **Cooking:** Baking soda used in cakes and biscuits.
- **Industry:** Used in making paper, textiles and medicines.

Now, I can check the nature of floor cleaning liquid using an indicator!

If litmus is not available, are there some other natural substances that can serve as acid-base indicators?

2.1.2 Red rose as an indicator

You might have observed many coloured flowers in your surroundings. Try making your indicators using these flowers.

Activity 2.3: Let us prepare

Fig. 2.6: Red rose petals immersed in hot water

- Collect some fallen petals of red roses available in your surroundings (Fig. 2.5). It is advised not to pluck flowers. You may pick petals or flowers fallen on the ground.
- Take a fistful of the collected petals of red roses and wash them with water.
- Crush the petals using a mortar and pestle.
- Place them in a glass tumbler.
- Pour some hot water into the glass tumbler to ensure that the crushed flower petals are completely immersed.

Fig. 2.5: Red roses

AP SCERT

⚠ Caution — Perform this step under the supervision of an adult.

- Cover the glass tumbler with a lid. Wait for 5 – 10 minutes till the water becomes coloured (Fig. 2.6), and filter it.
- The filtrate (liquid after filtration) is the required flower extract (Fig. 2.7) to be used as an acid-base indicator.

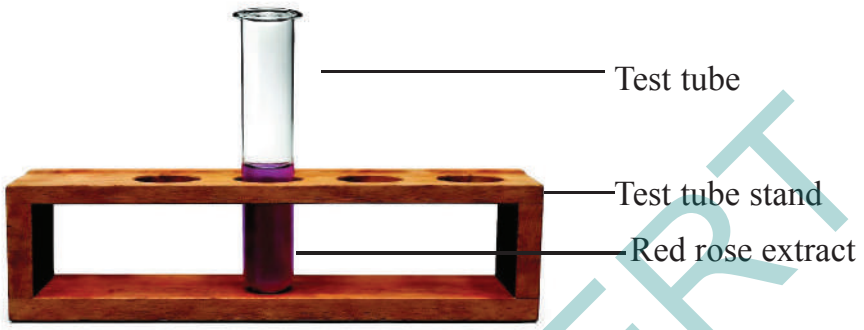


Fig. 2.7: Test tube containing the red rose extract

Activity 2.4: Let us find out

- Place 10 – 20 drops of the prepared red rose extract in each of two small transparent bottles or test tubes. Mark them A and B.
- Add 20 – 30 drops of lemon juice in test tube A and 20 – 30 drops of soap solution in test tube B with the help of droppers.
- Observe and record any colour changes (Fig. 2.8) to the extract in Table 2.3.
- Repeat the same with the other samples used in Activity 2.1 and record your observations in Table 2.3.

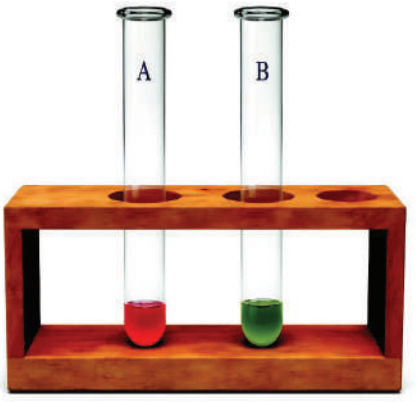


Fig. 2.8: The changes in colour of the red rose extract on adding lemon juice (A) and soap solution (B)

AP SCERT

Table 2.3: Testing the nature of samples with the red rose extract

S.No.	Name of the sample	The colour of the red rose extract after adding the sample	Nature of the substance
1.	Lemon juice		
2.	Soap solution		
3.	Usiri juice		
4.	.....		

Discuss your observations with your classmates.

- Are the samples that change the colour of the flower extract to a shade of red the same as those that changed the colour of blue litmus paper to red? (Group A, Table 2.2)
- Are the samples that change the colour of the flower extract to a shade of green the same as those that changed the colour of red litmus paper to blue? (Group B, Table 2.2)
- Are the samples that do not change the colour of the flower extract the same as those that did not change the colour of red and blue litmus papers? (Group C, Table 2.2)

From the above activity, we can **conclude** that the red rose extract can also be used to test the nature of the substances; hence, it is another example of an acid- base indicator. We can conclude that the red rose extract seems to give red colour in an acidic solution and green colour in a basic solution.

Can you now fill in the nature of the substances in Table 2.3?

We are sure that you will be excited about the above results. You may repeat the process of preparing the extract and testing substances with some vegetables, fruits, or flowers, such as beetroot, purple cabbage, turmeric, Indian blackberry, and red hibiscus flower. They can also act as acid-base indicators.

FASCINATING FACTS

Hydrangea flowers

Hydrangea is a plant that grows in cooler climates in the Himalayan region and the North-eastern states. It gives flowers of diff erent colours, depending on the nature of the soil. Acidic soil produces bluecoloured flowers, whereas in basic soil, the flowers are pink or red. Can gardeners alter the colour of hydrangea flowers by adjusting the acidic or basic nature of the soil ?

AP SCERT

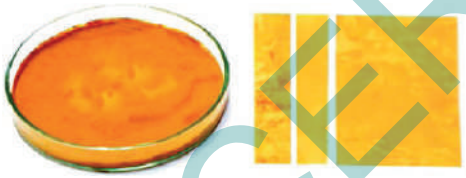
2.1.3 Turmeric as an indicator

We have used blue and red litmus paper strips in Activity 2.1. Can you also make paper strips with some other natural indicators? Find out by performing the following activity.

Activity 2.5: Let us prepare

- Take a spoonful of turmeric in a petri dish or container and add a little water to make a paste (Fig. 2.9a). You may also grind a piece of fresh turmeric.
- Carefully dip a piece of filter paper in the turmeric paste until it gets yellow colour.
- Take it out and allow it to dry.
- Cut this yellow paper into thin strips, which are used as 'turmeric paper' (Fig. 2.9b).

⚠ Caution — Perform this step under the supervision of an adult.



(a) Turmeric paste (b) Turmeric paper strips

Fig. 2.9: Preparing turmeric paper

- Using a dropper, put a drop of each of the samples used in Activity 2.1, one by one, on separate pieces of turmeric paper.
- Record your observations in Table 2.4.

Table 2.4: Testing the nature of samples with turmeric paper

S.No.	Name of the sample	The colour of the turmeric paper after putting a drop of the sample
1.	Lemon juice	
2.	Soap solution	
3.	Amla juice	
4.	.....	

What did you observe?

- Do all samples change the colour of the turmeric paper?
- Group the samples which do not change the colour of the turmeric paper.

AP SCERT

Compare them with the samples in Group A, Group B, and Group C in Table 2.2.

Can turmeric paper be used as an indicator for acidic substances? Discuss your observations with your classmates.

I got a curry stain on my white shirt and on applying soap it changed its colour! Wow! Now I know the reason.

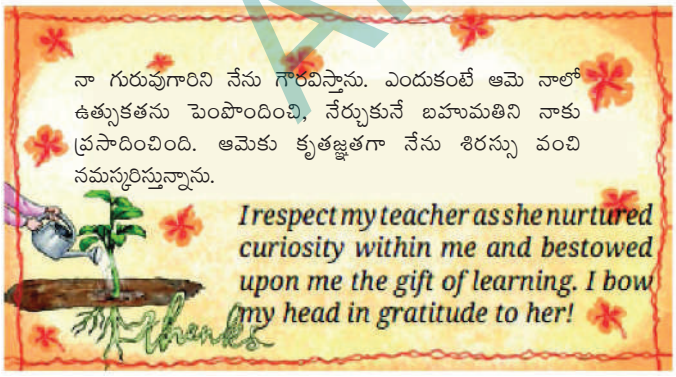
Based on the observations, we can conclude that turmeric paper can be used to test basic substances. However, it cannot differentiate between acidic and neutral substances.

FASCINATING FACTS

Why is turmeric known as a 'Golden' spice? Turmeric is a member of the ginger family, which is grown in India and other countries. A common spice in daily households, it is being researched for benefits beyond the taste and colour it provides to the food! In the Ayurvedic system of medicine, turmeric is considered to have numerous health benefits, and is commonly used in several traditional home remedies.

Turmeric (Pasupu)

Krishna created a greeting card to pay gratitude to his teacher on the day of Guru Purnima. He applied turmeric paste on white paper and dried it. He wrote his wishes in the teacher's mother tongue (Telugu language) on the dried paper using one of the solutions tested in Table 2.4. Which solution can be used to write the message? His teacher applauded his creative use of this concept.



Are there any substances whose odours change on adding acidic or basic substances?

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There are some substances whose odours change in an acidic or basic medium. These are called **olfactory indicators**. Let us explore more!

Activity 2.6: Let us investigate

- Take some finely chopped onions in a container, along with some strips of clean cotton cloth or filter paper.
- Tightly close the container and leave it overnight.
- Take two of the cotton cloth or filter paper strips from the container and check their odour.
- Keep them on a clean surface and put a few drops of tamarind water on one strip and a few drops of baking soda solution on the other. Allow the drops to spread on the strips.
- Check the odour again.
- Do you notice any change in the odour of the onion strips before and after putting tamarind water and baking soda solution on them?
- Note your observations.
- Similarly, test the change in the odour with other acidic and basic substances and record your observations.

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KNOW A SCIENTIST

Acharya Prafulla Chandra Ray (P.C. Ray) is known as the 'Father of Modern Indian Chemistry'. He earned a doctorate in chemistry from the United Kingdom and returned to India. He contributed towards advancing scientific research in India. He also established India's first pharmaceutical company in 1901. He was a person rooted in Indian culture and knowledge traditions. Through his writings on the history of chemistry in India, he highlighted the achievements and expertise of ancient Indian scientists to the achievements and expert is of ancient Indian scientists to the modern world. Ray, a social reformer, also advocated the use of the mother tongue as a medium of instruction in educational institutions.

2.2 What Happens When Acidic Substances Mix with Basic Substances ?

Let us investigate by performing the following **experiment**.

Activity 2.7: Let us experiment

- Take one drop of lemon juice in a test tube and add around twenty drops of water to it. Observe the colour.
- Add a drop of blue litmus solution to it.
- Do you observe any colour change (Fig. 2.10a)?
- Slowly add drops of lime water to this test tube with the help of a dropper and swirl it well.
- What do you observe? Is there any change in the colour of the solution?
- A stage comes when the colour of the solution changes from red to blue (Fig. 2.10b).
- Again, add one drop of lemon juice to the above solution. Can you predict why there is a change in colour?

Fig. 2.10(a): The colour of the solution on adding blue litmus solution

Fig. 2.10(b): The colour of the solution on adding lime water

Initially, when a drop of blue litmus solution is added to the lemon juice solution, the colour of the solution turns red. When lime water is added to this test tube, the colour of the solution eventually changes from red to blue. This shows that the solution in the test tube is no longer acidic. Lime water has neutralised the effect of the acid.

When the solution of an acid is mixed with the solution of a base in sufficient quantity, we find that the resulting solution is neither acidic nor basic. Such reactions are called **neutralisation** reactions. In a neutralisation reaction, **salt** and water are formed with the evolution (i.e., release) of heat.

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water} + \text{Heat}$$

There are many examples in everyday life where you can observe the use of neutralisation processes.

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Let us find out!

Fig. 2.11: Stinging eff ect of an ant bite

2.3 Neutralisation in Daily Life

Situation 1: Keerthi was observing a butterfly in the garden with her hand resting on a tree trunk. Suddenly, a red ant bit her, leaving her skin red with stinging pain (Fig. 2.11). Her brother helped her by applying moist baking soda to the affected area, which relieved the pain. What do you think might be the reason for this? When an ant bites, it injects an acidic liquid (formic acid) into the skin. The effect of the acid can be neutralised by rubbing moist baking soda, which is a base.

What remedies do people use to treat ant bites in your region?

Situation 2: On the Farmer's Portal (an online platform from the Department of Agriculture, Cooperation and Farmers Welfare), a query from a farmer states, "My plants are not growing well lately". After a detailed discussion, it was found that the excessive use of chemical fertilisers (substances added to soil to help plants grow better) made the soil acidic. What remedy might be provided to him?

When the soil is too acidic, the plants do not grow well. It can be treated with lime, which is a base. (Fig. 2.12).

Fig. 2.12: Neutralising the acidic nature of soil

If the soil is basic, organic matter like manure and composted leaves are added to it. Organic matter releases acids that neutralise the basic nature of the soil.

Sometimes, the soil may be neutral, but the plants growing in it may still show poor health, which can be due to the deficiency of nutrients in the soil.

Situation 3: Krishna's friend Khasim stays near an industrial area. He shared with him that the fish population in his neighbourhood lake was declining day by day! What do you think might be the causes for this? It may be due to factory waste being released into the lake. If the factory waste is acidic in nature, what could be done to save the fish in the lake? The factory waste can be neutralised by adding basic substances before releasing into the lake.

Let us wrap up!

Now, can you explain why the words 'Welcome to the Wonderful World of Science' appeared on Krishna and Keerthi's paper sheets when the liquid was sprayed on them? Do you think that one possibility could be using a turmeric solution for the spraying liquid and a soap solution for writing on the paper?

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Key words

Acid | Base | Neutral | Litmus

Indicator | Acidic | Basic | Salt

Neutralisation | Natural Indicator

In a Nutshell

- Substances around us may be classified as acidic, basic, and neutral in nature.
- Extracts of lichen, red rose, red hibiscus, purple cabbage, turmeric, etc., can be used to indicate the nature of substances.
- Substances that show different colours in acidic and basic solutions are called acid-base indicators.
- Acids turn the colour of blue litmus to red. Bases turn the colour of red litmus to blue.
- Extract of red rose gives red colour in acidic solutions and green colour in basic solutions.
- The yellow colour of turmeric turns red in basic solutions but remains unchanged in cidic and neutral solutions.
- An acid and a base neutralise each other, forming salt and water, along with the evolution of heat.
- Many day-to-day problems like a red ant bite, acidic or basic nature of soil, and industrial waste can be attempted to be managed by the process of neutralisation.

Let us Enhance our Learning

1. Match the fruits with the acids naturally present in them.

Column I (Fruit)	Column II (Acid present)
P. Orange	1. Tartaric acid
Q. Amla	2. Citric acid
R. Tamarind	3. Ascorbic acid and citric acid
S. Tomato	4. Citric acid and oxalic acid

Choose the correct matching:

A. P–2, Q–3, R–1, S–4 B. P–3, Q–2, R–1, S–4

C. P–2, Q–1, R–3, S–4 D. P–4, Q–3, R–2, S–1

2. Define the following. a) acid-base indicators b) neutralisation c) olfactory indicators

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3. Write any two characteristics each of Acid and Base.
4. One of your friends has been suffering from indigestion and heartburn after eating a spicy meal. To relieve the problem, he has taken a tablet. Which of the following is the most likely active ingredient in the tablet?

   A : Hydrochloric acid B : Magnesium hydroxide

   C : Common salt D : Soda Water
5. How can natural indicators be prepared? Explain by giving an example.
6. Ravi was playing near a field when a red ant bit his ankle. He felt a sharp stinging pain, and the skin around the bite turned red. His grandmother immediately applied a paste made from a household substance, and Ravi felt relief after some time.

   Which of the following best explains why the paste helped reduce the pain?

   A. The paste absorbed moisture from the skin

   B. The paste cooled the skin and reduced swelling

   C. The paste killed the ant venom by chemical reaction

   D. The paste neutralised the acidic substance injected by the ant
7. A solution turns the red litmus paper to blue. Excess addition of which of the following solution would reverse the change?

   (i) Lime water (ii) Baking soda

   (iii) Vinegar (iv) Common salt solution
8. You are provided with three unknown solutions labelled A, B, and C, but you do not know which of these are acidic, basic,or neutral. Upon adding a few drops of red litmus solution to solution A, it turns blue. When a few drops of turmeric solution are added to solution B, it turns red. Finally, after adding a few drops of red rose extract to solution C, it turns green. Based on the observations, which of the following is the correct sequence for the nature of solutions A, B, and C ?

   (i) Acidic, acidic, and acidic (ii) Neutral, basic, and basic

   (iii) Basic, basic, and acidic (iv) Basic, basic, and basic
9. Mani is blindfolded. She is given two unknown solutions to test and determine whether they are acidic or basic. Which indicator should Mani use to test the solutions and why?
10. Could you suggest various materials which can be used for writing the message on the white sheet of paper (given at the beginning of the chapter) and what could be in the spray bottle? Make a table of various possible combinations and the colour of the writing obtained.

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11. Keerthi wrote a secret message to her grandmother on her birthday using orange juice. Can you assist her grandmother in revealing the message? Which indicator would you use to make it visible?
12. The extract of red rose turns the liquid X to green. What will the nature of liquid X be? What will happen when excess of amla juice is added to liquid X?
13. Observe and analyse Figs. 2.13, 2.14, and 2.15, in which red rose extract paper strips are used. Label the nature of solutions present in each of the containers.

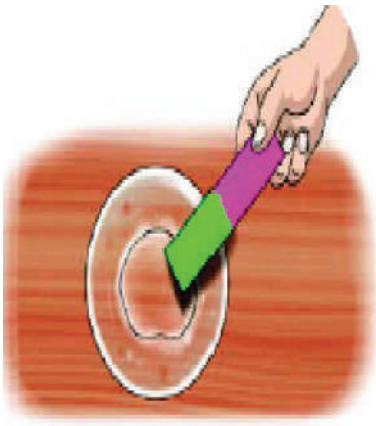

Fig. 2.13

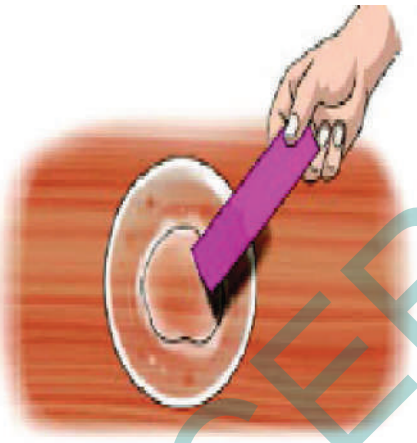

Fig. 2.14

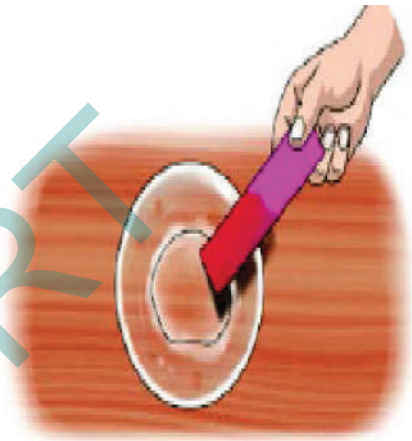

Fig. 2.15

14. Three liquids are given to you. One is vinegar, another is a baking soda solution, and the third is a sugar solution. Can you identify them only using turmeric paper? Explain.
15. Observe and analyse the information given in the following flowchart. Complete the missing information.

Imagine a garden with plants showing signs of poor health.

The soil can be _____ in nature.

The soil can be _____ in nature.

Which indicator can be used to test the nature of the soil?
_____

The acidic soil can be treated with _____.

The basic soil can be treated with _____.

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17. A liquid sample from the laboratory was tested using various indicators:

Indicator	Red litmus	Blue litmus	Turmeric
Change	No change	Turned red	No change in colour

Based on the tests, identify the acidic or basic nature of the liquid and justify your answer.

18. Grape juice was mixed with red rose extract; the mixture got a tint of red colour. What will happen if baking soda is added to this mixture? Justify your answer.

Dive Deeper

Anand accidentally spilt vinegar on some pieces of an eggshell or marble and noticed bubbling. He then poured a soap solution on another piece of eggshell or marble, but no bubbles appeared. Why did bubbles occur with vinegar but not with soap solution?

Exploratory Projects

- Create rangoli using acidic or basic substances and natural indicators.
- You may discuss in your class the acidic, basic, or neutral nature of water obtained from various sources. You may like to test the water samples available from sources such as rain, taps, rivers, etc.
- Collect a soil sample of your area and fi nd out whether it is acidic, basic, or neutral in nature.

AP SCERT

3 Electric circuits and their components

Learners will be able to...

- Understand a simple electrical circuit and types of circuits (CG-2)
- Represent electrical circuits using standard symbols . (CG-2)
- Identify materials that are electrical conductors and insulators. (CG-2)
- Explain the importance of insulators in preventing electric shocks. (CG-2)
- Apply safe practices while handling electrical devices. (CG-2)

Varun and his classmates were excited for their school trip to the Srisailam Dam. There, they would visit the hydroelectric power house built on the Krishna River, where the force of falling water was used to generate electricity.

Prior to the trip, Varun and his classmates were given a group assignment to prepare a presentation on the uses of electricity. They began by looking around their houses, then their school, followed by their neighbourhood, their city, and finally they searched the internet. To their astonishment, their list kept growing. They decided to organise the uses under different headings.

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Cooking	Lighting	Transportation	Heating and Cooling
Electric kettle, mixer grinder, toaster, micro-wave oven _____	Homes, offices, streets, markets, factories, _____	Train, bus, car, scooter, lift, escalator, _____	Fan, room heater, immersion rod, geyser, refrigerator, air conditioner, _____

Entertainment	Communication	Others
Television, radio, _____	Mobile phone, Internet, _____	Water pump, crane, computer, _____

Can you help Varun by adding some more uses to his lists? Also, suggest some other ways of grouping the uses of electricity. We use electricity all the time, so let us learn something more about electricity. You have learnt earlier that electricity is generated in multiple ways — by windmills, by using wind energy, by solar panels capturing the Sun's energy, by falling water and by using natural gas or coal. The electric supply from these sources reaches our homes and factories via wires. We use it for a number of applications. For example, at home we plug in various devices to the electrical sockets in the wall. However, to learn about electricity, we will focus on a portable source of electricity that most of us may have used. Let us start with its use in a common device like a torchlight.

⚠ Caution — The danger signs on electric poles and other appliances warn people that electricity can be dangerous if not carefully handled. Never ever perform experiments with power supply at your home or school. Even electricity from portable generators can be dangerous. Use only batteries or cells, like those in torchlights, wall clocks, radios, or remotes, for experiments with electricity.

3.1 A Torchlight

You might have used a torchlight, also called a torch or a flashlight.

Activity 3.1: Let us explore

Fig. 3.1: A torch light

- Take a torchlight similar to the one shown in Fig. 3.1.
- Observe it carefully. Do you notice a lamp? And a switch?
- Slide its switch and observe. Does the torch lamp glow?
- Now slide the switch back to its original position and observe the torch lamp.
- You might have noticed that in the first position of the switch, the torch lamp glows and in the other position the lamp does not glow.
- Now, open the torchlight. What do you find inside?
  Inside the torchlight, you may find two or more electric cells.

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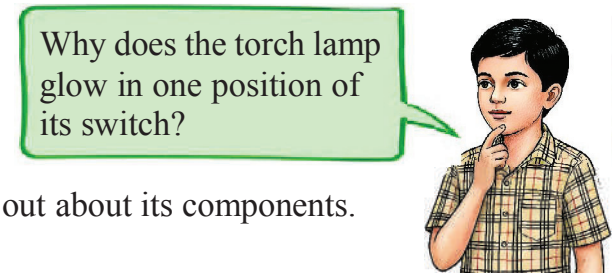
3.2 A Simple Electrical Circuit



To understand how a torch works, let us first find out about its components.

3.2.1 Electric cell

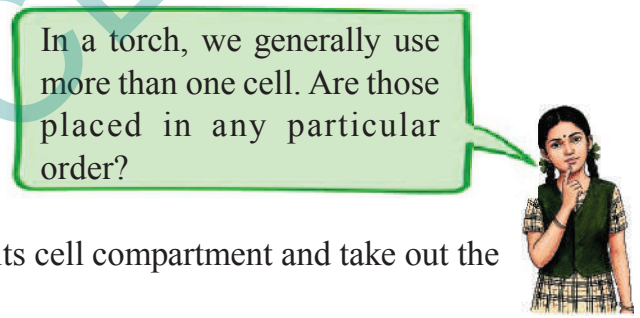
Activity 3.2: Let us observe

- Take an electric cell, turn it around and look at it carefully (Fig. 3.2). Do you notice a positive (+) sign and a negative (–) sign marked on the electric cell? Do you also notice that it has a small protruding metal cap on one side and a flat metal disc on the other side?

Fig. 3.2 : An electric cell

All electric cells have two terminals; one is called positive (+ ve) while the other is negative (– ve). The metal cap is the **positive terminal** of the electric cell and the metal disc is the **negative terminal**. The electric cell is a portable source of electrical energy.

3.2.2 Battery



Activity 3.3: Let us experiment

- Take a torch which uses two cells. Open its cell compartment and take out the cells.
- Put the cells back in a different order. Also, try reversing the direction of one cell. Then, slide the switch and check whether the lamp glows in each case.
- Check the order in which the cells were placed in the torch when the lamp glows.

The lamp glows when the cells are placed in the order as shown in Fig. 3.3. Notice how the terminals of the two cells are connected. The positive terminal of one cell is connected to the negative terminal of the next cell. Such a combination of two or more cells is called a **battery**.

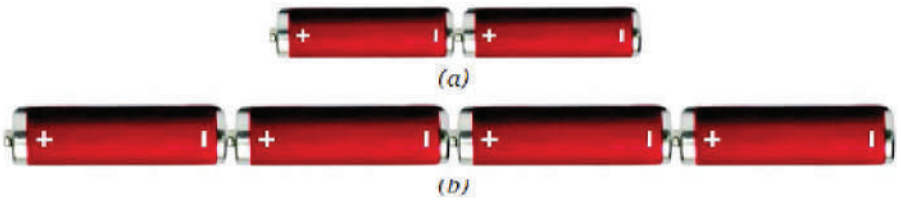


Fig. 3.3: A battery made up of (a) two cells (b) four cells

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For many devices, we may need more than one cell. So, we connect two or more cells together as shown in Fig. 3.3. Connecting more than one cell provides energy to the circuit for a longer time and/or more energy.

FASCINATING FACTS

The term battery is also used for a single cell. We use the term battery even for the single cell that powers our mobile phones.

3.2.3 Electric Lamp

Incandescent Lamp

Activity 3.4: Let us observe

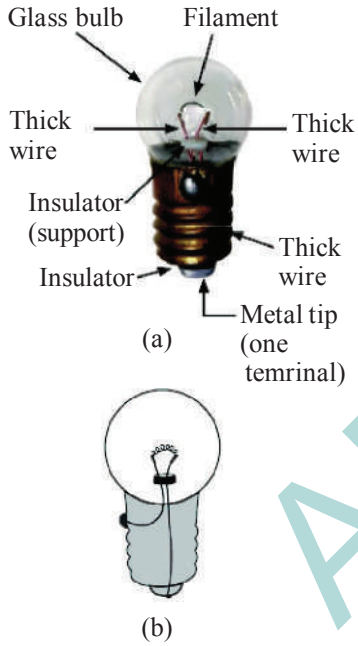

Fig. 3.4: (a) A small incandescent lamp used in a torch (b) its simplified drawing showing the connection of wires to the terminals

For this activity, you will require a torchlight with an incandescent lamp (or light bulb). Many old torchlights still use such lamps. With your teacher's help, confirm that your torchlight uses an incandescent lamp.

- ❖ Take the torch and examine its lamp. What do you see? Do you notice a thin wire fixed in the middle of the glass bulb?
- ❖ Now, switch on the torch. Which part of the lamp glows? The thin wire inside the glass bulb of the lamp glows.

The glowing thin wire is called the **filament** of the lamp.

- ❖ Take out the lamp with the help of your teacher and inspect it from all sides. How is the filament fixed?

The filament is attached to two thicker wires that support it, as shown in Fig. 3.4a. One thick wire connects to the metal case at the lamp's base, while the other connects to the metal tip at the centre of the base (Fig. 3.4b). These form the two terminals of the lamp, and are fixed in a way that they do not touch each other. In such **incandescent** lamps, the filament gets hot and glows to produce light.

However, my torch has a different kind of lamp. In fact, it cannot be taken out of the torch as it is fixed in it.

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LED Lamp

Many torches in use today have a Light Emitting Diode (LED) lamp, instead of an incandescent lamp, as shown in Fig. 3.5.

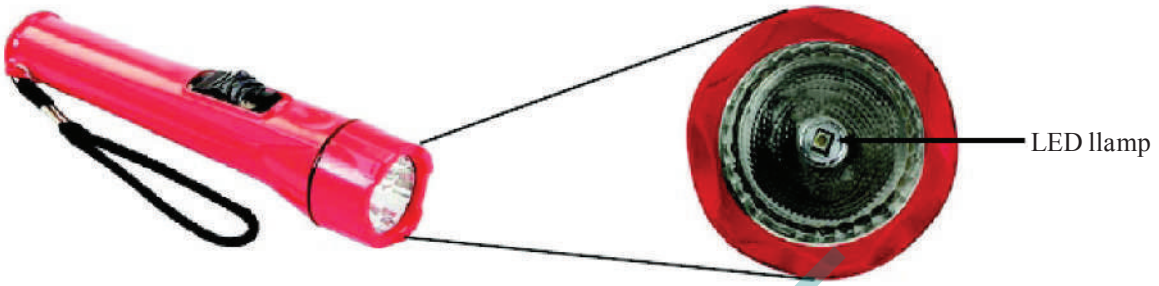

Fig. 3.5: An LED lamp for torch

Activity 3.5: Let us observe

- Take an LED of any colour (Fig. 3.6) and observe. Do you see any filament inside it?
- **Notice** the length of two wires attached to the LED. Do you find one of those longer than the other?

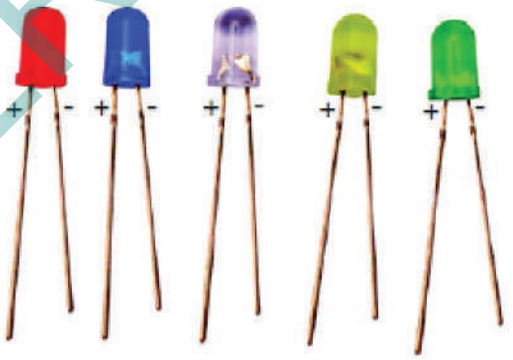

Fig. 3.6: LED of different colours

Unlike incandescent lamps, LEDs do not have filaments (Fig. 3.6). They also have two terminals, but one is positive (attached to a longer wire) and the other is negative (the shorter wire). A torch may use one or more LEDs, sometimes of different shapes, in its lamp.

After having learnt about the electric cell, battery, and electric lamps, we are now ready to make the torch lamp glow using an electric cell or battery.

3.2.4 Making an electric lamp glow using an electric cell or battery

Activity 3.6: Let us construct

- Take an electric cell, an incandescent lamp used in a torch, a cell holder, a lamp holder, and four lengths of electric wire.
- Remove about 1 cm of the plastic covering from both ends of each wire to expose the metal.
  - Attach two wires to the two ends of the cell holder as shown in Fig. 3.7a.

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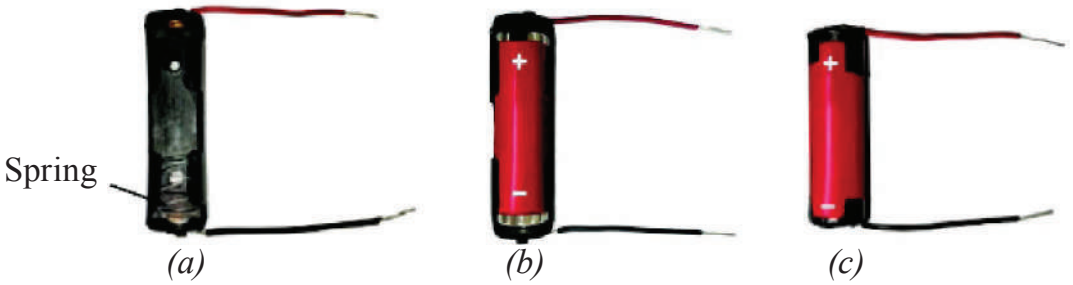

Fig. 3.7: (a) An electric cell holder with two wires attached (b) An electric cell inside the cell holder (c) Wires connected to an electric cell using electrical tape

- Insert the cell in the holder such that its negative terminal is towards the spring side of the holder (Fig. 3.7b). In case a cell holder is not available, fix the two wires to the cell using electrical tape (Fig. 3.7c).
- Attach two wires to the screws of the lamp holder as shown in Fig. 3.8a. Fix the lamp in the holder by turning it around in the holder (Fig. 3.8b). In case a lamp holder is not available, use electrical tape to attach two wires to the two ends of the lamp (Fig. 3.8c).

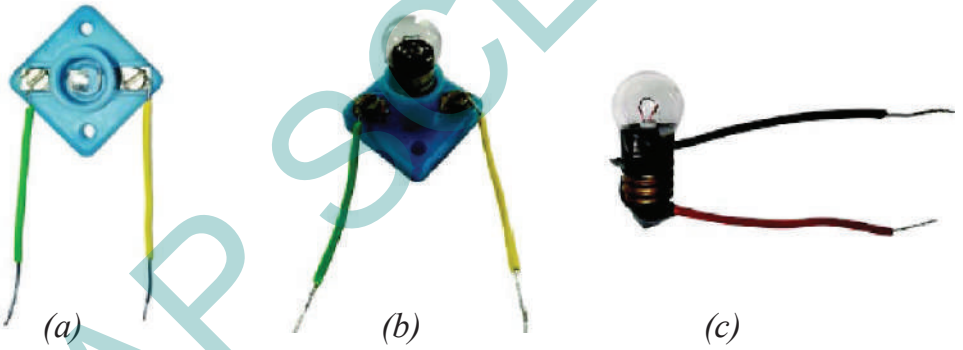

Fig. 3.8: (a) An electric lamp holder with wires attached (b) An incandescent lamp inside the lamp holder (c) Wires connected to incandescent torch lamp with electrical tape

Now, we are ready to connect the cell to the lamp to make it glow.

- We will conduct this activity in two parts — prediction and observation. Some of the ways in which the lamp and the cell can be connected are shown in Table 3.1.
  - Predict, for each arrangement, if the lamp will glow or not and write your prediction in Table 3.1.
  - Now, connect the lamp and the cell, and observe if the lamp glows or not. Note down your observation in Table 3.1. Also, for the lamps which glow, colour their lass bulbs yellow.

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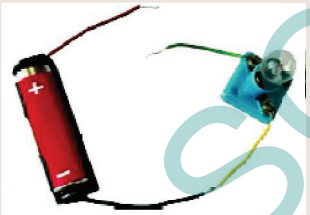
Table 3.1: Trying to make the lamp glow

Note: The lamps are not shown glowing in any circuit.

S.No.	Arrangement of cell and Lamp	Prediction	Observation
1.			
2.			
3.			
4.			
5.			
6.			

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The lamp glows in the arrangements at S.No. 1 and 6 and does not glow in the remaining arrangements. Now, carefully look at the arrangements in which the lamp glows. **Compare** these with those in which the lamp does not glow. Can you find the reason for the difference?

3.2.5 An electrical circuit

The lamp glows when one terminal of the lamp is connected to one terminal of the electric cell and the other terminal of the lamp to the other terminal of the cell as shown in Fig. 3.9. This setup forms an **electrical circuit,** which provides a complete path for electric current to flow through the lamp. The lamp glows only when current passes through the circuit.

Fig. 3.9: An electrical circuit

The direction of electric current in an electrical circuit is taken to be from the positive to the negative terminal of the electric cell. When the terminals of the lamp are connected with those of the electric cell by wires, the current passes through the filament of the incandescent lamp and makes it glow. With an incandescent lamp, it does not matter which of its terminals connects to the positive or negative terminal of the cell. The lamp will glow as long as the circuit is complete and current flows through the filament.

FASCINATING FACTS

Sometimes, an incandescent lamp does not glow even when connected to a cell. We say the lamp has 'fused' usually due to a broken filament. A broken filament stops the flow of current, preventing the lamp from glowing.

Let us now try to make an LED glow.

Activity 3.7: Let us experiment

- Take two electric cells, an LED of any colour, a cell holder that can fit two cells (Fig. 3.8a), and two lengths of electric wire.
- Remove about 1 cm of the plastic covering from both ends of each wire to expose the metal.

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- Connect the two wires to the cell holder as shown in Fig. 3.10a.
- Insert two cells in the holder, taking care that for each cell, its negative terminal is towards the spring side of the holder (Fig. 3.10b) and the battery is ready to use. How will you decide which is the positive terminal of this battery?
  The terminal of the holder which is connected to the positive terminal of one cell is positive and the one connected to the negative terminal of the other cell is the negative terminal.
- Now, connect the free end of the battery positive terminal wire to the longer wire of LED, and the free end of the second wire to the shorter wire of LED (Fig. 3.10c). Does the LED glow?
- Repeat the above step but interchange the wires connected to the LED (Fig. 3.10d). Does the LED glow again?

You would have observed that the LED glows in the first case (Fig. 3.10c) and does not glow in the other (Fig. 3.10d). It is because the current can pass through the LED in one direction only. The current passes through the LED only when the positive terminal (longer wire) of the LED is connected to the positive terminal of the battery, and negative terminal (shorter wire) of the LED is connected to the negative terminal of the battery. When current passes through the LED, it glows. Always take care to connect an LED correctly in a circuit to make it glow.

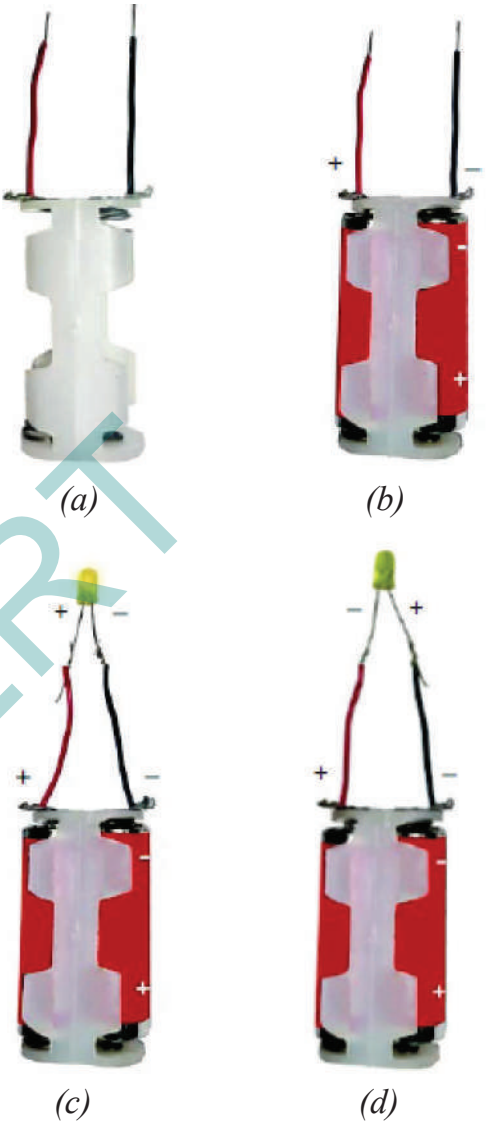

Fig. 3.10: Making an LED glow

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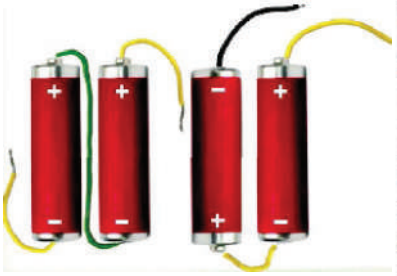
Dive Deeper

Sometimes you may come across a device in which the cells are placed side by side. Then, how are the terminals of the cells connected?

If you carefully look inside the battery compartment, you will usually see a thick wire or metal strip connecting the positive terminal of one cell to the negative terminal of the next. To help with proper placement, '+' and '–' symbols are typically printed inside.



3.2.6 Electric Switch

Let us first make a simple switch on our own.

How does a switch turn on or off the torchlight?

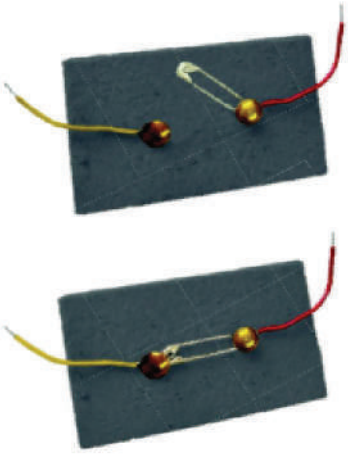
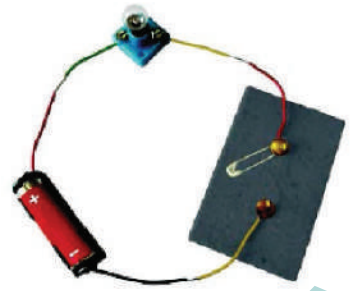


Fig. 3.11: A switch
(a) in 'OFF' position
(b) in 'ON' position

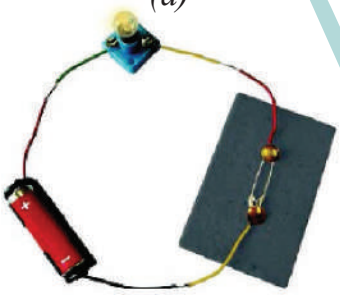
Activity 3.8: Let us construct

- Collect two drawing pins, a safety pin (or a paper clip), two wires, and a small piece of cardboard.
- Insert a drawing pin through the ring of the safety pin and fix it to the cardboard piece, ensuring that the safety pin can rotate freely (Fig. 3.11a).
- Fix the second drawing pin to the cardboard piece so the free end of the safety pin can touch it (Fig. 3.11b).
- Connect a wire to each drawing pin — our switch is ready!

Let us now test our switch.



(a)



(b)

Fig. 3.12: An electrical circuit with a switch in
(a) 'OFF' position
(b) 'ON' position

Activity 3.9: Let us test

- Connect the electric cell, lamp, and switch as shown in Fig.3.8a. Does the lamp glow?
- Rotate the free end of the safety pin till it touches the other drawing pin as shown in Fig. 3.8b. Does the lamp glow now?

When the safety pin touches both drawing pins, it closes the gap and completes the path, and allows the current to flow. We call this the ON position (Fig. 3.8b) where the circuit is closed and current flows from the cell's positive to negative terminal making the lamp glow. When the safety pin does not touch the second drawing pin, the gap in the circuit prevents current flow, and the lamp does not glow. In this OFF position (Fig. 3.8a), we say that the circuit is open.

Note that a switch can be placed anywhere in a circuit. A **switch** is a simple device that either completes or breaks a circuit. The switches used for lights and other devices at home work the same way, though they are designed differently.

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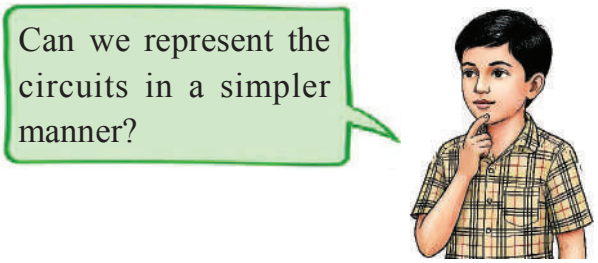
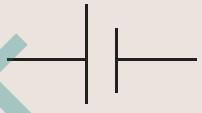
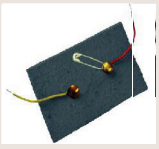
3.3 Circuit Diagrams



The various components of an electrical circuit can be represented by symbols shown in Table 3.2.

Table 3.2: Electrical components and their symbols

S.No.	Electrical component	Symbol
1.	Electrical cell	
2.	Battery	
3.	Electric lamp	
4.	Light Emitting Diode (LED)	
5.	Switch is 'ON' position	
6.	Switch in 'OFF' position 	
7.	Wire	

In the symbol for an electric cell, the long line represents the positive terminal, while the short line represents the negative terminal (Fig. 3.13a).

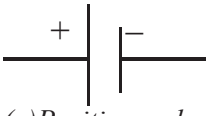


Fig. 3.13 (a)Positive and negative terminals in the symbol of a Cell

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In the symbol for an LED, the triangle points to the direction in which the current can flow. The two arrows indicate that light is emitted by an LED (Fig. 3.13b).

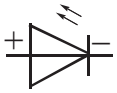


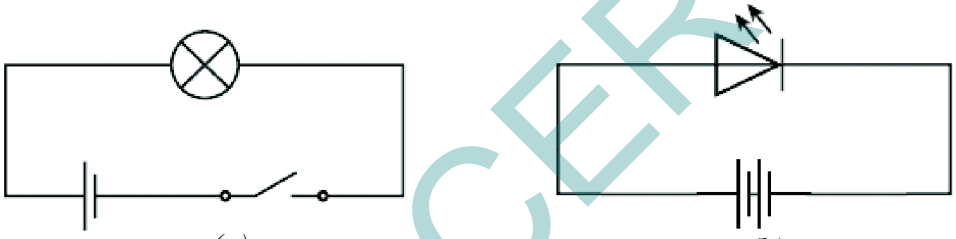
Fig. 3.13(b) : Positive and negative terminals in the symbol of an LED

By using symbols to represent electrical components, it is easier to draw and understand electrical circuits. A representation of an electrical circuit using symbols is called its **circuit diagram**.

Activity 3.10: Let us draw

❖ Using symbols shown in Table 3.2, draw the circuit diagram of an electrical circuit given in Fig. 3.12a and Fig. 3.10c.

Are your circuit diagrams similar to Fig. 3.14a and Fig. 3.14b respectively?



(a) *(b)*

Fig. 3.14: A circuit diagram (a) with an incandescent lamp (b) with an LED lamp

Dive Deeper

International organisations, such as the International Electrotechnical Commission (IEC), American National Standards Institute (ANSI), and the Institute of Electrical and Electronics Engineers (IEEE) create standard symbols for electrical and electronic parts. Using the same symbols across the world helps people from different countries and industries understand each other easily.

3.4 Types of Electrical Circuits

How does one connect multiple lamps in the circuit?

3.4.1 Series Conncection

What happens when bulbs are connected one after another?

Activity 3.11: Let us Observe

❖ Take a 4-cell holder and four cells, three lamp holders and three lamps, a switch with wires.

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- Make a battery with a 4-cell holder attached to wires and insert four cells in it.
- Take three lamps inserted in lamp holders with attached wires.

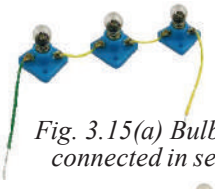

Fig. 3.15(a) Bulbs are connected in series

- Take a switch and connecting wires.
- Connect the three lamps one after another (end-to-end) as shown in Figure 3.15 a.
- Now, connect the three lamps with the battery setup and the switch (key) as shown in Fig. 3.15 b.

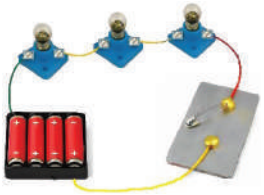

Fig. 3.15(b) A series circuit consisting of bulbs, a battery and a switch

- Close the switch and observe the bulbs Fig.3.15c
- Do the lamps glow when the switch is closed (ON)?
- You would have noticed that the lamps glow. This is because the electric current passes through all the lamps, and the circuit is closed (ON condition).

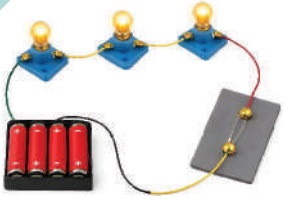

Fig. 3.15(c) A series circuit of bulbs with the closed switch

- Next, remove any one lamp from its holder, then switch on the circuit (Fig. 3.15d)
- What do you observe about the glow of the lamps?
- You would have noticed that the lamps do not glow in this second case. This is because removing one bulb creates a gap in the circuit, which leads to an open circuit condition. electricity does not pass through the circuit.

Fig. 3.15(d) A series circuit with two bulbs

- This type of connection in an electrical circuit is a series connection. In an electric circuit, the components are connected one after another in a single path for the current to flow, which is called a series connection of electric circuits.

3.4.2 Parallel Conncection

Have you ever noticed that some electrical appliances in your home are working while others are turned off?

Activity 3.12: Let us Experiment

- Take two cell holder and two cells insert them into the holder to make battery, three lamps with holders attached wires and a switch with wires.

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- Connect three lamp holders of wires as follows: all first terminal wires to one side and a second terminal to the other side of each lamp holder (Fig. 3.16a).
- Connect the battery, the bulbs, and the switch (Fig.3.16b).
- Now, switch (ON) and observe the lamps (Fig. 3.16c). Do all the bulbs glow?
- Yes, all the bulbs will glow.
- Next, remove any one bulb from the holder and check the bulb's glow (Fig. 3.16d).
- Does any bulb not glow?
- You will notice that the other two lamps are still glowing even when one lamp is removed.
- When the switch is ON, all the lamps are glowing because there are three separate paths for the current to flow. When one lamp is removed, the other two lamps remain working because they are still connected to the battery through their separate paths. This provides current paths through each of the lamps independently.

An electric circuit where first terminal components are connected to the one side second terminals are connected other side is called a parallel connection. In this circuit, multiple paths are created for the current to flow.

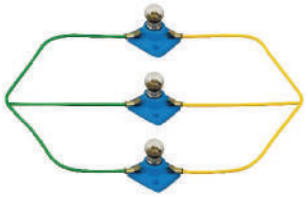

Fig. 3.16(a) Bulbs are connected in parallel

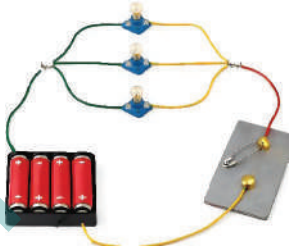

Fig. 3.16(b) A parallel circuit consisting of bulbs, a battery and a switch

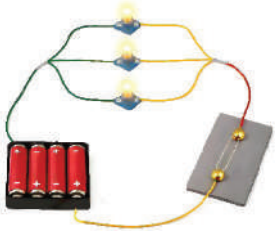

Fig. 3.16(c) A parallel circuit of bulbs with the closed switch

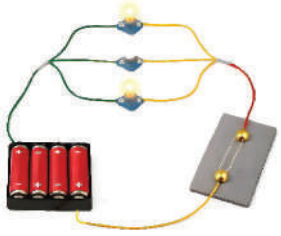

Fig. 3.16(d) A parallel circuit with two bulbs

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Series Connection Applications

- Series connection is often used in lighting systems like those seen during festivals or in shopping malls (like decorative rope lights). These lights are connected in a series with rope, which makes it easy to cover long distances with a single wire. A disadvantage is that if one bulb is damaged, the others do not work.

Fig.3.17:Image of rope serial light

Parallel Connection Applications

- In household and industrial wiring, parallel connections are used. In this connection, each component operates independently due to having multiple paths.

3.5 Electrical Conductors and Insulators

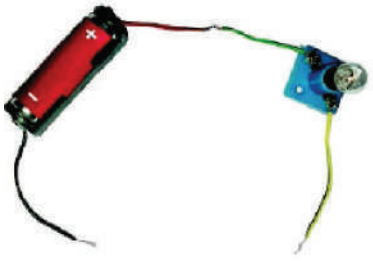
Why did we use metal wires for making electric circuits? Can we not use some other materials for wires?

Also, why are electric wires covered with plastic or rubber?

Suppose, we make wires of materials other than metal and use them for making the electrical circuit. Do you think the electric current will pass through those materials in such a circuit?

Activity 3.13: Let us identity

- Connect an electric cell and a lamp while leaving the two ends of wires free as shown in Fig. 3.18a.
- Touch the two free ends of the wires momentarily. Does the lamp glow? If yes, our tester is ready. We can use this tester to identify the materials through which electric current passes.



(a)

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- Collect objects of different materials, such as metal spoons, coins, cork, rubber, glass, keys, pins, plastic scale, wooden block, aluminium foil, candle, sewing needle, cardboard, paper, and pencil lead.
- One by one, touch the free ends of the tester's wires to both ends of each object you have collected (Fig. 3.18b). Make sure the wires don't touch each other. Does the lamp glow every time?
- Record your observations in Table 3.3.

(b)

Fig. 3.18: (a) Conduction tester (b) Using the conduction tester for testing a material

Table 3.3: Idenrifying conductors and Insulators

S.No.	Object	Material it is made up of	Lamp glows (Yes/No)	Conclusion (Conductor/ Insulator)
1.	Stick	Wood	No	
2.	Scale	Plastic		
3.	Bangle	Glass		
4.	Paper Strip	Paper		
5.	Candle	Wax		
6.	Key	Metal		
7.	Eraser	Rubber		
8.				
9.				

- **Analyse** your observations. Did the lamp glow for all materials?
  The lamp glows for some materials only. This means that electric current can pass easily through some materials but not through others. The materials through which electric current can flow easily are called **good conductors**, or **conductors of electricity**. The materials through which current cannot pass through are called **insulators,** or **poor conductors of electricity.**
- Based on the observations you have recorded in Table 3.3, conclude which materials are conductors of electricity and which are insulators. Note it in Table 3.3. From your conclusions in Table 3.3, you would have realised that metals are conductors of electricity, and thus, are used for making wires.

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Dive Deeper

Silver, copper, and gold are the best electrical conductors. However, for making electrical wires, mainly copper is used due to its comparatively lower cost and abundant supply. Different types of electrical wires are used for different uses.

From Table 3.3, you would have also realised that plastic, rubber, and ceramics are electrical insulators. Have you now understood why wires are covered with those materials?

Conductors and insulators are both important. Electrical wires, switches, connectors of plugs, and sockets are made of conductors. Insulators like rubber, plastics, and ceramics are used to cover wires, plug tops, and switches to protect people from electric shocks.

⚠ **Caution** — Our body is a conductor of electricity. Electric current passing through our body may cause severe injury or even death. Always handle electrical appliances with care. Never touch switches or plugs with wet hands, or use electrical devices in wet areas, or handle equipment with damaged insulation or broken plugs.

Dive Deeper

Have you ever wondered how the electricity from a cell or battery is different from the electricity coming from a wall socket? Electricity from batteries usually powers small devices and is of a type called Direct Current (DC). In contrast, the electricity from power plants that come to the wall socket is known as Alternating Current (AC) and can run larger appliances.

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Key words

Electic cell | Battery | Parallel Circuit | Electric circuit

Electric switch | Circuit diagram | Series Circuit

Conductors | Insulators

Light Emitting Diode

In a Nutshell

- An electric cell is a portable source of electrical energy.
- An electric cell has two terminals; one is called positive (+ve) while the other is negative (–ve).
- In an incandescent electric lamp, there is a thin wire called the filament, which gets hot and glows to produce light when electric current passes through it.
- An LED has two terminals, one is positive (attached to a longer wire) and the other is negative (the shorter wire).
- Electric current can pass through LED in one direction only.
- An LED lights up only when its positive terminal (longer wire) connects to the positive terminal of the battery and its negative terminal (shorter wire) connects to the negative terminal of the battery.
- A switch is a simple device that either completes or breaks a circuit.
- The direction of electric current in a closed electrical circuit is taken to be from the positive to the negative terminal of the electric cell.
- A representation of an electrical circuit using symbols is called its circuit diagram.
- In an electric circuit , the components are connected one after another in a single path is called a series connection.
- In an electric circuit, where first terminal components are connected to the one side and second terminals are connected other side is called a parallel connection.
- Materials through which electric current can flow easily are called good conductors or conductors of electricity.
- Materials through which current cannot pass through are called insulators or poor conductors of electricity.

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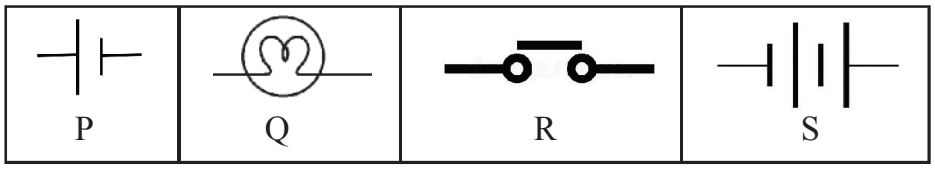
Let us Enhance our Learning

1. Which of these symbols is used for a battery in a circuit?



A: P B: Q C: R D : S

2. Observe the circuit shown in the figure 3.19 The switch is open. What will happen to the bulb?

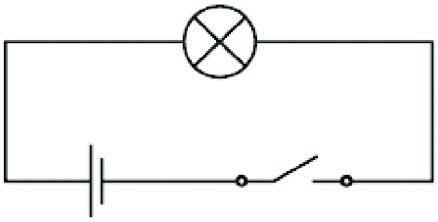


Fig. 3.19

A) The bulb glows due to filament.
B) The bulb glows because the cell is present.
C) The bulb does not glow because the circuit is incomplete.
D) The bulb does not glow because the cell is wrongly connected.

3. Choose the incorrect statement.
(i) A switch is the source of electric current in a circuit.
(ii) A switch helps to complete or break the circuit.
(iii) A switch helps us to use electricity as per our requirement.
(iv) When the switch is in 'OFF' position, there is an air gap between its terminals.

4. Ravi wants to check whether a key made of a new material conducts electricity. He connects the key in the gap of a simple circuit containing a cell and a bulb. The bulb does not glow. He then replaces the key with an iron nail, and the bulb glows. What can Ravi correctly conclude from this observation?
A) Both the key and the iron nail are insulators.
B) The key is an insulator, and the iron nail is a conductor
C) The key is a conductor, but the iron nail is an insulator
D) The bulb glows only because the iron nail is long

5. Define the following.
a) Electric conductors b) Insulators c) electric cell
d) switch e) circuit diagram

6. Observe Fig. 3.20. With which material connected between the ends A and B, the lamp will not glow?

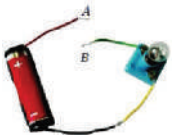


Fig. 3.20

7. Suppose the '+' and '–' symbols cannot be read on a battery. Suggest a method to identify the two terminals of this battery.

8. A student forgot to remove the insulator covering from the connecting wires while making a circuit. If the lamp and the cell are working properly, will the lamp glow?

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9. In Fig. 3.21:

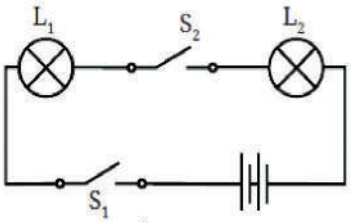

Fig. 3.21

(i) If S_2 is in 'ON' position, S_1 is in 'OFF' position, which lamp(s) will glow?

(ii) If S_2 is in 'OFF' position, S_1 is in 'ON' position, which lamp(s) will glow?

(iii) If S_1 and S_2 both are in 'ON' position, which lamp(s) will glow?

(iv) If both S_1 and S_2 are in 'OFF' position, which lamp(s) will glow?

10. Ramu has made the circuit as shown in Fig. 3.22. Even after closing the circuit, the lamp does not glow. What can be the possible reasons? List as many possible reasons as you can for this faulty operation. What will you do to find out why the lamp did not glow?

Fig. 3.22

11. In Fig. 3.23, in which case(s) the lamp will not glow when the switch is closed?

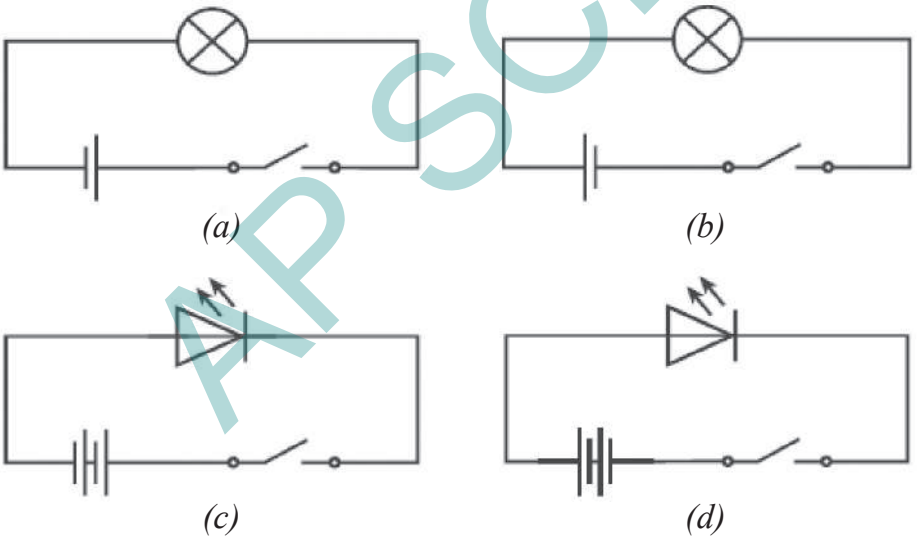

Fig. 3.23

12. An LED requires two cells in series to glow. Ramya made the circuit as shown in Fig. 3.24. Will the lamp glow? If not, draw the wires changed for correct connections.

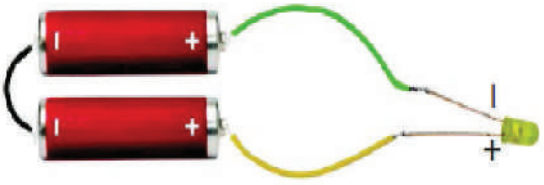

Fig. 3.24

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13. In Fig. 3.25, if the filament of one of the lamps is broken, will the other glow? Justify your answer.

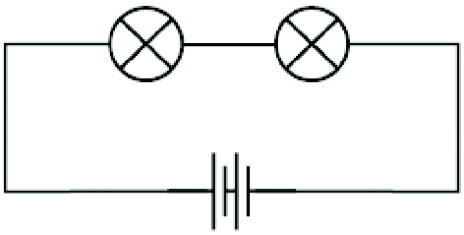

Fig. 3.25

14. Draw a circuit diagram for a simple torch using symbols for electric components.
15. You are given six cells marked A, B, C, D, E, and F. Some of these are working and some are not. Design an activity to identify which of them are working.
    (i) List the items that you require.
    (ii) Write the procedure that you will follow.
    (iii) With the items, carry out the activity to identify the cells that are working.
16. Draw a neat diagram using a battery, lamp, LED, toy motor and switch in series and parallel connections.

Exploratory Projects

- Suppose that due to some problem, the power supply is disrupted in your area for two days. List out which actions from your daily life you would not be able to do.
- Using a solar panel (Fig. 3.26a) as a source of electrical energy, make a circuit to run a toy fan (Fig. 3.26b) as shown in Fig. 3.26c.

(a) *(b)* *(c)*

Fig. 3.26

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- Visit an electrical items shop. With the help of the shopkeeper, identify the various types of cells available. For each cell, also fi nd out which device(s) it is used for. Prepare a report.
- Prepare a list of objects in your home under three categories:
  (i) Objects which are electrical insulators only
  (ii) Objects which are electrical conductors only
  (iii) Objects which are made of both, whose some parts are insulators and some electrical conductors

SCIENCE AND SOCIETY

Electric cells or batteries are compact portable sources of electrical energy that make the use of some electrical devices more convenient. These cells and batteries come in various shapes and sizes for different purposes, such as cylindrical batteries for torchlights, clocks, remotes, toys; button cells for watches, hearing aids; rechargeable batteries for mobile phones, laptops, and electric vehicles.

AP SCERT

Prepare some question based on your learnings so far.....

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4 Metals and Non-metals

Learners will be able to:

- Differentiate metals and non-metals by comparing their physical properties. (CG - 1)
- Explain malleability, ductility and sonority of metals related to their practical uses. (CG - 1)
- Distinguish good conductors from poor conductors of electricity using simple tests. (CG - 2)
- Apply the methods to prevent rusting in daily life. (CG - 1)
- Recognise the importance of non-metals in daily life and natural processes. (CG - 5)

Raju and Kavitha live in a village in Andhra Pradesh. Their school has assigned them a project to learn about crafts persons who work with metals. They decide to visit the local ironsmiths who practise this craft. Raju and Kavitha request their grandfather to accompany them (Fig. 4.1). They are curious to learn how these ironsmiths make different items of daily use. They interact with an elderly craftsperson, Diwakar uncle.

Raju: Which items do you generally make?

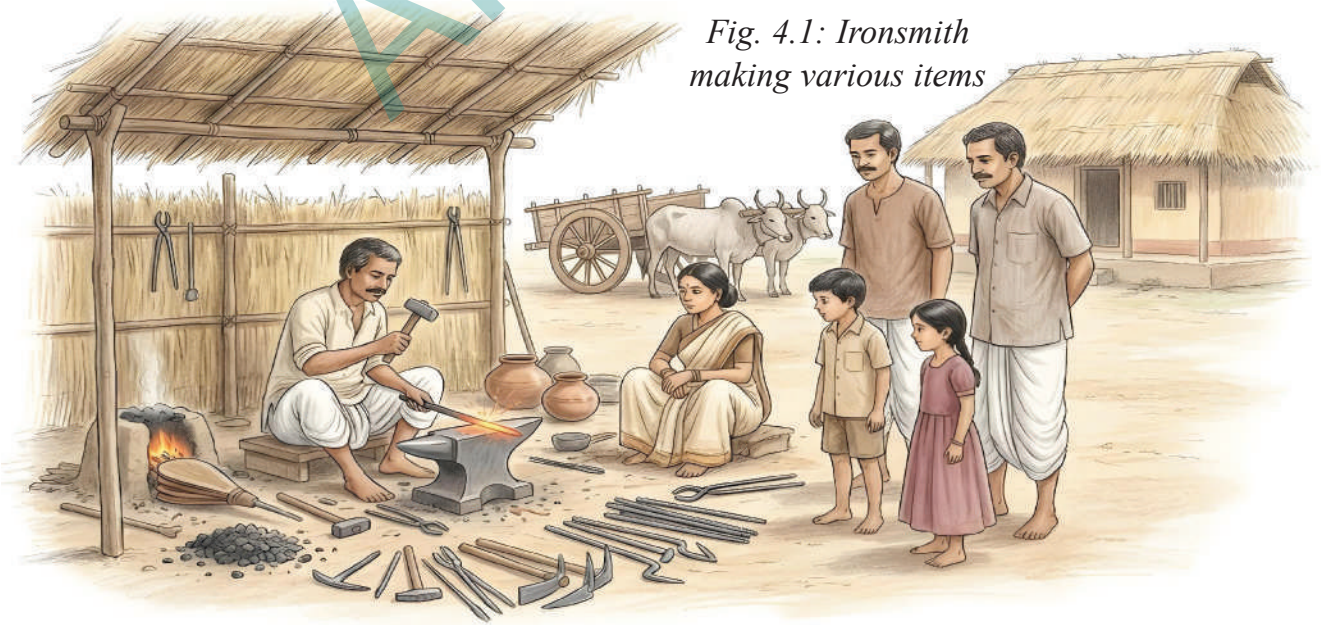

Fig. 4.1: Ironsmith making various items

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Diwakar: Generally, we make items of daily use, such as flat pans, buckets, tongs and farming tools like spades, axes, trowels and rakes.

Kavitha: What materials are they made of ?

Diwakar: We use iron metal to make these items. We also use wood to prepare handles wherever required. Additionally, we use coal in our furnaces to heat the iron. Diwakar is heating an iron block in the furnace. It has become red hot. He starts beating it hard with a hammer. Kavitha is amazed and asks, "Why are you beating it?"

Diwakar: I am beating it to shape it into an axe.

Kavitha: Wow, a piece of iron can be beaten into a flat shape! Can we do this with other metals as well?

You may also have many such questions — let us explore what else we can do with metals.

4.1 Properties of Materials

4.1.1 Malleability

Activity 4.1: Let us explore

⚠ Caution— Conduct this activity under the supervision of your teacher or an adult.

- Collect some waste pieces of copper and aluminium, an iron nail, a piece of coal, a pea-sized lump of sulphur and a block of wood.
- Recall the chapter 'Materials Around Us' in the Class 6 General Science textbook and **observe** the appearances of the above items. Are they lustrous? Also, note whether they are hard or soft and **record** your observations in Table 4.1.

Fig. 4.2

- Now, place each of these items one by one on any hard surface and beat them with a hammer (Fig. 4.2).
- What do you think will happen? Do the objects become slightly flattened or do they break into pieces?
- Record your observations in Table 4.1.

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Table 4.1: Apperance, hardness, and effect of hammering on different objects or materials.

S.No.	Object/Material	Appearance (lustrous/ non-lustrous	Hard/Soft	Effect of hammering (flattens/breaks into pieces)
1.	Piece of copper			
2.	Piece of aluminium			
3.	Iron nail			
4.	Piece of coal			
5.	Lump of sulphur (pea-sized)			
6.	Block of wood			

Analyse Table 4.1. **Identify** the objects that are **lustrous** in appearance and **hard**. You might have observed that objects made from copper, aluminium, and iron are lustrous in appearance and are hard. Lustre shown by metals is known as metallic lustre. Materials like copper, aluminium, and iron are known as **metals**, whereas, coal, sulfur, and wood are **non-lustrous** and not as hard as metals.

Are all metals hard and solid? Not really; some metals like sodium and potassium are so **soft** that they can be cut with a knife. There is one metal, mercury, that is found in a liquid state at room temperature, which you might have seen in thermometers. Recall the chapter 'Temperature and its Measurement' from the Class 6 General Science textbook.

Which objects did you find become flat on beating with a hammer? You must have observed that objects such as a piece of copper, an iron nail, and a piece of aluminium become flat when beaten; whereas other objects or materials behave differently. This property by which materials can be beaten into thin sheets is called **malleability.** Most metals possess this property. Can you give some examples of metal sheets? You might have seen thin silver foil on some sweets and aluminium foil used for wrapping food items. These are formed due to their malleability. Gold and silver are the most malleable metals.

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A piece of coal or a lump of sulphur does not show this behaviour. They break into pieces and are said to be brittle. On the other hand, wood neither gets flattened into a sheet nor breaks into pieces. Therefore, wood is neither malleable nor brittle.

HOLISTIC LENS

The impact of iron on the progress of civilisation of India

In the Class 6 Social textbook Exploring Society India and Beyond, you learnt about the Harappans. They knew how to use metals like copper and gold. They used these metals to make various objects, from utensils to jewellery. However, you would hardly find any evidence of the Harappans using a very prominent metal iron, which you see a lot around you today. This is because it took a long time before iron was used in day-to-day activities.

However, once the use of iron gained prominence in the times that followed, it contributed significantly to the progress of civilisation in India. For instance, due to its strength, agricultural tools like ploughs made from iron were much superior to those used previously. What could be the potential reason that it is generally considered that copper was discovered earlier as compared to iron?

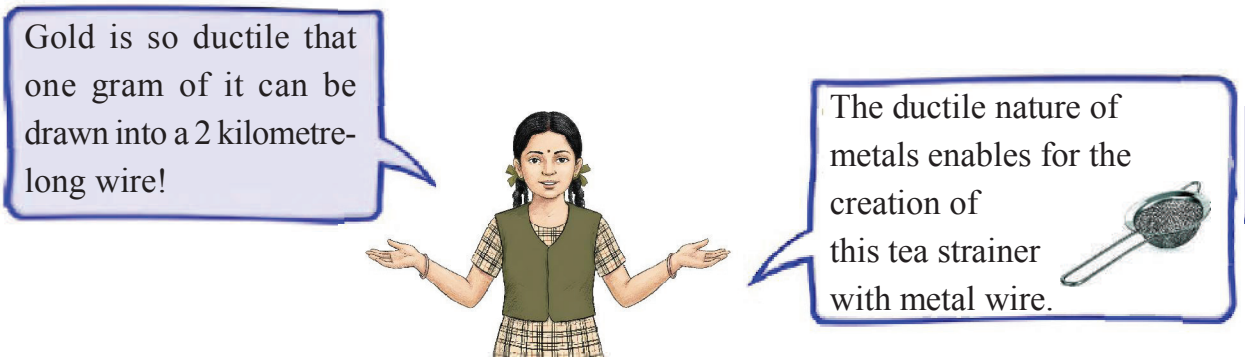
4.1.2 Ductility

Where do you find the use of metal wires?

You might have seen wires of metals like copper or aluminium in electrical fittings. Some ornaments, like bangles, necklaces, ear rings, etc., are also made from metal wires. Metal wires play important functions in a variety of stringed musical instruments, such as veena, sitar, violin, and guitar.

This property of materials by which they can be drawn into wires is called **ductility**.

This property of ductility is mainly possessed by metals.



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Have you ever seen wires made of coal or sulphur? Obviously not! We can say that coal and sulphur are not ductile.

Dive Deeper

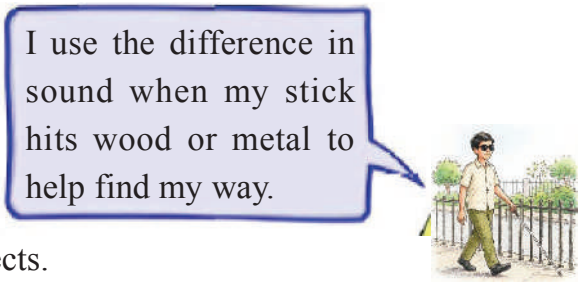
Do you know that ropes made of steel [a mixture of metal (iron) and non-metal (carbon)] wires can support heavy loads? Therefore, they are used in suspension bridges and in cranes to lift heavy objects.

Suspension bridge

4.1.3 Sonority

Have you ever noticed the sound produced when a metal spoon, or a metal plate, or a metal coin is dropped on the floor? How is it different from the sound produced when a piece of coal or wood is dropped on the floor?

Activity 4.2: Let us investigate



Caution— Be careful while dropping the objects.

- Take a few objects, such as a metal spoon, a coin, a piece of coal, and a block of wood.
- Drop them one by one from a certain height.
- Do you notice any difference in the sound produced by these objects?

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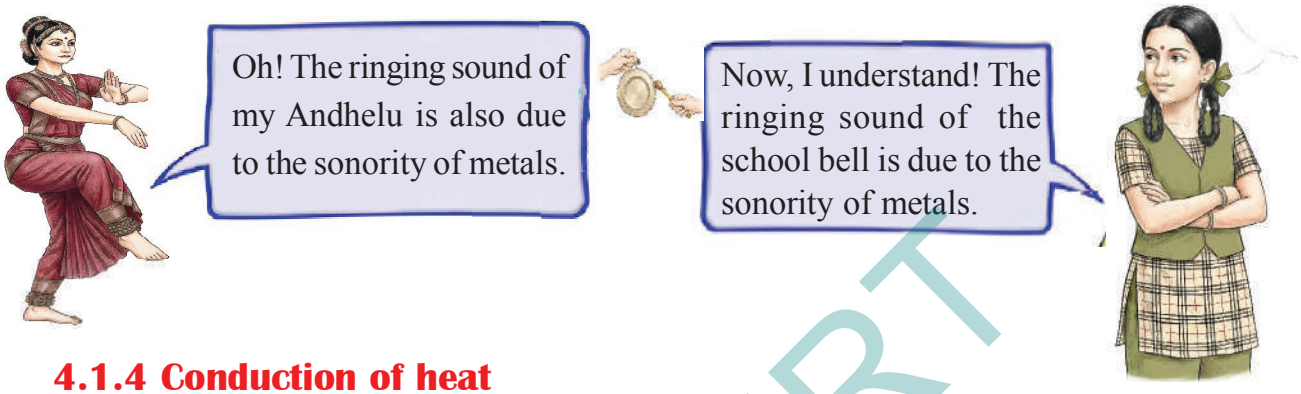
You would observe that the metal spoon and the metal coin produce a ringing sound. Coal and wood, on the other hand, produce dull sounds.

This property of metals that enables them to produce a ringing sound is called sonority, and metals are said to be sonorous in nature.



4.1.4 Conduction of heat

Have you ever observed the vessels used for cooking in the kitchen? You might have noticed that the vessels used for heating are made of metals. Can you name some metals that are used for making cooking vessels? Do you know why these metals are used for this purpose?

Let us find out!

Activity 4.3: Let us investigate

⚠ Caution— This activity must be performed under the supervision of your teacher or an adult. Be careful while handling hot water.

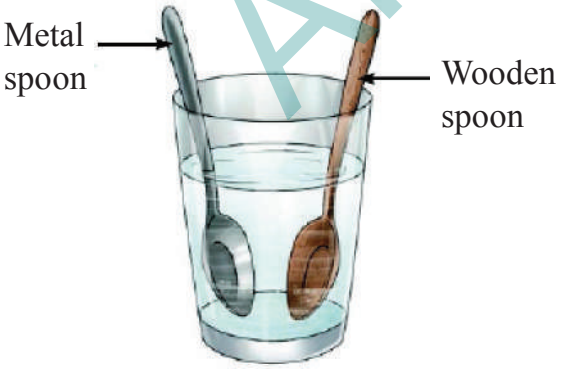


Fig. 4.3: Metal and wooden spoons immersed in hot water

- Place a glass tumbler on a table.
- Fill it with hot water.
- Take a metal spoon and a wooden spoon of almost the same size and thickness.
- Immerse both the spoons simultaneously into the hot water (Fig. 4.3) and leave them undisturbed for a few minutes.
- Now, carefully touch the upper end of each spoon.

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Some discussion points:

- ❖ Which of the spoons get hotter?
- ❖ What does this experiment tell us about heat transfer along the two spoons?

You may have noticed that the metal spoon is hotter to touch than the wooden spoon. Even though both spoons are immersed in the water of the same temperature and for the same time. This shows that the heat transfers through the metal spoon, making it hotter. In contrast, the wooden spoon transfers heat poorly. In such cases, the transfer of heat from one point to another of a material is called conduction, and materials that transfer heat are called **conductors**.

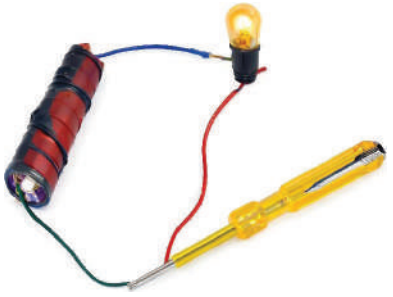
Based on the observations, one can say that metals are **good conductors of heat**, whereas wood is a **poor conductor of heat**. Now, we can understand why mostly metal vessels are used for cooking, and their handles are made with wood or other materials that do not conduct heat.

4.1.5 Conduction of electricity

Have you ever seen an electrician using a screwdriver? What type of material is used for making its handle? You may have also noticed the electrician wearing rubber gloves and shoes while working. What can be the **reason** for this?

Activity 4.4: Let us design and create

Design an electric circuit, like the 'tester' circuit in the chapter 'Electricity: Circuits and their Components'. Repeat the same activity using the materials listed below and record your observations in Table 4.2.



- ❖ You may collect a few objects, such as a piece of aluminium foil, an iron nail, a lump of sulphur (pea-sized), a copper wire, a piece of coal, a piece of dry wood, a stone, an eraser made of rubber and a piece of nylon rope.
- ❖ **Predict** which of these could make the bulb of the tester glow and which could not.

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Table 4.2: Conduction of electricity by different objects or materials

S.No.	Object/Material	Observation (bulb glow/does not glow)	Good conductors of electricity or poor conductor of electricity
1.	Piece of aluminium foil		
2.	Iron nail		
3.	Lump sulfur (pea-sized)		
4.	.....		

You might have observed that objects made of aluminium, iron, and copper make the bulb glow, whereas sulphur, coal, wood, stone, eraser, and nylon rope could not make it glow. Do you see any pattern in the glowing of bulbs when using diff erent materials in Activity 4.4? It is observed that all the materials that make the bulb glow are metals.

Materials that allow electricity to fl ow through them easily are called **good conductors of electricity**. In contrast, materials that prevent the bulb from glowing by not allowing electricity to pass through them are called **poor conductors of electricity**.

So, now we can understand that the plastic covering on screwdrivers and rubber gloves protect the electrician from electric shock because these materials are poor conductors of electricity.

We learnt that metals are generally hard, lustrous, malleable, ductile, and good conductors of heat and electricity. Now, let us learn how metals behave in the presence of air and water.

4.2 Effect of Air and Water on Metals

You would have often noticed that iron objects develop brown deposits when left in the open for a few days. In which conditions would an iron object develop brown deposits?

- When it comes into contact with dry air only.
- When it comes into contact with water only.
- When it comes into contact with both air and water.

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Activity 4.5: Let us experiment

⚠ Caution— Be careful while handling iron nails.

- Take a few shining iron nails. If you are using old iron nails, make sure to remove brown deposits from their surface by scrubbing them with the help of a small piece of sandpaper.
- Take three clean, dry glass bottles or test tubes with tight-fitting caps or stoppers. Label them A, B, and C.
- Take three iron nails and tie each iron nail with a thread.
- Place one iron nail and some silica gel in the glass bottle 'A', and tighten the cap or stopper (Fig. 4.4a). Silica gel makes the air dry. It is the substance that is used in small pouches in some medicine bottles, water bottles, shoe boxes, etc., to keep them dry.
- Place one iron nail in the glass bottle 'B'. Pour freshly boiled and cooled water (to remove dissolved gases) into it until the iron nail is completely dipped in it. Now, pour some oil to form a layer over the surface of the water (Fig. 4.4b). The layer of oil on the surface of the water prevents the air from dissolving in the water. Cap the glass bottle tightly.
- Place one iron nail in the glass bottle 'C', and pour some water so that the iron nail is partially dipped. Keep this glass bottle unstoppered. This allows the iron nail to come into contact with both water and air, as shown in Fig. 4.4c.
- Place all the glass bottles undisturbed at room temperature and observe the changes for 8 – 10 days.
- Record your observations in Table 4.3.

Fig. 4.4(a)

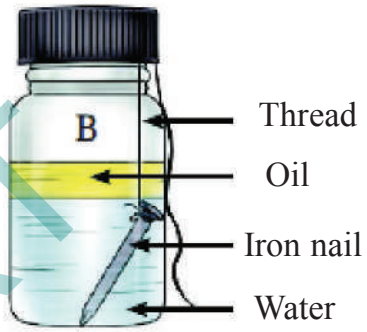

Fig. 4.4(b)

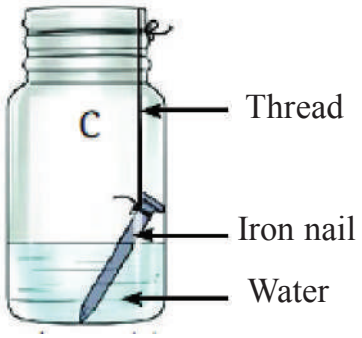

Fig. 4.4(c)

Fig. 4.4: Glass bottles containing iron nails

Table 4.3: Formation of brown deposit on iron nails

Glass Bottle	Conditions		Observations
	Presence of water (Yes/No)	Presence of air (Yes/No)	
A.	No	Yes	
B.			
C.			

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What can you conclude from this experiment?

It is observed in glass bottles A and B that the iron nails do not show any brown deposits. What does this observation indicate? This indicates that brown deposits or discolouration on the iron nails do not develop when the iron nail is kept in dry air alone (bottle A) or water alone (bottle B). However, in glass bottle C, the iron nail shows the presence of brown deposits. This indicates that the presence of both water and air is essential for these deposits to develop. Thus, moist air is responsible for the development of brown deposits on objects made of iron. This brown deposit is called rust. The process of formation of rust on objects made of iron is called **rusting.**

Iron + Oxygen + Water → Hydrated Iron oxide (Rust)

Many other metals also exhibit discolouration when kept open in the atmosphere. Have you noticed the formation of a green coating on the surface of copper objects or a black coating on the surface of silver objects? Gradual deterioration of metal surfaces caused by air, water, or other substances is known as corrosion.

Do you know that rusting of iron is a serious problem in our country? Every year, an enormous amount of money is spent to replace or repair iron structures damaged due to rusting.

The rusting of iron can be prevented by several methods such as painting, oiling, greasing, and applying a protective layer of zinc metal on iron (galvanisation). We will learn about this in higher grades.

AP SCERT

FASCINATING FACTS

The Wonder of ancient Indian metallurgy ?

The Iron Pillar of Delhi was made in the time of Chandragupta II more than 1600 years ago. It is about 8 metres high and weighs more than 6000 kilograms. What is interesting about this iron pillar is that despite all these years of facing winds, rainfall, and intense weather, it has barely any rust. In other words, it has been made in a way that it resists rusting. This tells us about the skills that were developed in metal technology in India.

4.3 Effect of Air and Water on Other Metals

Activity 4.6: Let us investigate (demonstration activity)

The teacher may demonstrate this activity.

⚠ Caution— It is advisable for students to wear protective eyeglasses and keep safe distance.

- Take a magnesium ribbon about 3 – 4 centimetres long. Clean it by rubbing with a piece of sandpaper.
- Hold it with a pair of tongs. Ignite the other end using a spirit lamp or a candle (Fig. 4.5).
- Let the magnesium ribbon burn.
- What do you observe?

Fig. 4.5. Burning of Magnesium ribbon

- You must have observed that magnesium ribbon burns with a dazzling white flame and changes into a white powder. Collect it on a watch glass. This powder is magnesium oxide. It is formed due to the reaction between magnesium and oxygen present in the air.

  Magnesium + oxygen → Magnesium Oxide
- Add a few drops of warm water to this white powder, stir it well, and check its nature.
- Recall the chapter 'Acids, Bases and Salts'. Find out whether the solution of magnesium oxide is acidic or basic or neutral in nature. You can use any acid-base indicator.
- What effect does this solution have on blue and red litmus papers?
- You would observe that it changes the colour of red litmus paper to blue (Fig. 4.6); hence, it is basic in nature. Generally, oxides of metals are basic in nature.

  Magnesium + Water → Magnesium hydroxide

  We will discuss this burning of magnesium ribbon further in the chapter 'Changes Around Us'

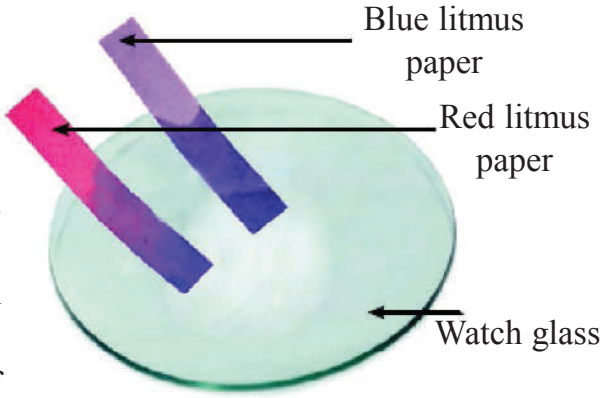

Fig. 4.6: Testing the nature of magnesium oxide

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Do you know that sodium is a metal which is stored in kerosene because it reacts vigorously with oxygen and water. A lot of heat is generated in the reaction. Storing sodium in kerosene prevents its exposure to moisture and air. Can you predict the nature of its oxide?

Let us now discuss some substances that do not behave like metals.

4.4 Substances that Behave Differently from Metals in Air and Water

Activity 4.7: Let us experiment (demonstration activity)

The teacher may demonstrate this activity.

⚠ Caution— This activity must be performed in a fume hood or well-ventilated area. Burning sulphur produces gases, which can be harmful if inhaled.

Fig. 4.7(a): Deflagrating spoon

Fig. 4.7(b): Improvised deflagrating spoon

Fig. 4.7(c): Burning of sulphur

- Take a small amount of powdered sulphur in a deflagrating spoon (it is a long-handled metal spoon used in experiments to safely heat and burn substances Fig. 4.7a). If a deflagrating spoon is not available, you may take a metallic cap of any bottle, wrap a metallic wire around it and give it the shape as shown in Fig. 4.7b.
- Heat it on a flame, and as soon as the sulphur starts burning, introduce the deflagrating spoon into a gas jar or glass tumbler (Fig. 4.7c). Cover the gas jar or glass tumbler with a lid to ensure that the gas produced does not escape.
- Remove the lid after 3 – 4 minutes and take out the deflagrating spoon. Add a small quantity of water into the gas jar, quickly place the lid back and shake it so that the gas dissolves.
- Again, recall the chapter 'Exploring Substances: Acidic, Basic, and Neutral'. Using an acid-base indicator, check whether the solution obtained after the addition of water to the gas jar is acidic or basic or neutral.
- What do you observe?

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You would observe that it is acidic in nature (Fig. 4.7d).

On burning sulphur in air (oxygen), sulphur dioxide gas is formed. On dissolving sulphur dioxide gas in water, sulphurous acid is formed.

Sulphur + oxygen → Sulphur dioxide

Sulphurdioxide + water → Sulphurous acid

Does sulphur behave in water the same way metals do?

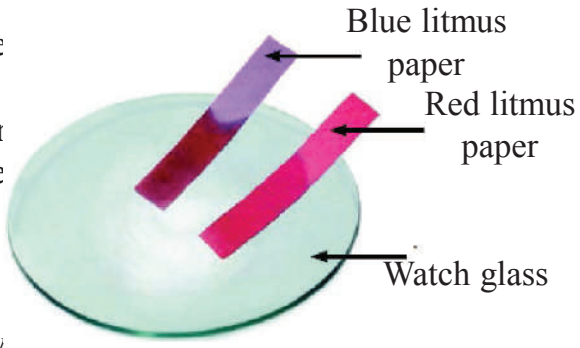

Fig. 4.7(d): Testing of solution with litmus papers

Activity 4.8: Let us explore

- Take some sulphur powder in a glass tumbler.
- Add a small amount of water to it.
- What do you observe?

You may have noticed that there is no reaction when sulphur is placed in water.

Substances like sulphur and phosphorus behave differently with air and water than metals. Phosphorus is stored in water as it catches fire when exposed to atmospheric air. These substances are usually soft and dull in appearance. They are neither malleable nor ductile, and they are not sonorous. They are also poor conductors of heat and electricity. These are called non-metals. Their oxides are acidic in nature. Some other non-metals are oxygen, hydrogen, nitrogen, carbon, etc. These must not be confused with materials such as plastic, glass, wood, rubber, and paper. These materials are not classified as metals or non-metals because they are not elements.

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Dive Deeper

Metals and non-metals are sub-categories of substances called elements. An element is a substance that cannot be broken down into simpler substances. In 1789, Lavoisier published his famous book "Traite Elementaire de Chimie" (Elementary Treatise of Chemistry) – often called the first modern chemistry text book. In it, he listed 33 elements and classified them into groups such as: Metals, Non-metals, Earthy substances, Gases. This was one of the earliest systematic classifications of elements – a major step toward the modern periodic table. Presently 118 elements are known. These elements are the basic building blocks of all matter. Some are naturally occurring, while others are artificially made in the laboratory, and do not exist in nature. The elements included in this lesson are iron (Fe), Copper (Cu), Silver (Ag), Gold (Au), Aluminmum (Al), Sodium (Na), Carbon (C), Sulphur (S), Oxygne (O), Nitrogen (N), Iodine (I), and Phosphorous (P).You will study more about elements in higher grades.

4.5 Are Non-metals Essential in Everyday Life ?

You often observe many metals in your day-to-day lives because of their distinct properties, such as their lustrous nature, heat and electrical conductivity, and high strength. However, this should not give an impression in your mind that non-metals are not important in our lives.

We breathe in oxygen, which is a non-metal, and without it, we would not be able to survive. Can you think of any other uses of oxygen?

Carbon is essential in everyday life because it is the building block of all life forms. It is a key component of proteins, fats, and carbohydrates, which are necessary for growth and energy.

Nitrogen is used in the manufacturing of fertilisers and other chemicals. It is an essential nutrient for the growth of plants. Chlorine is a non-metal commonly used in water purification. A solution of iodine, a non-metal, is applied on wounds as an antiseptic.

SCIENCE AND SOCIETY

Do you know that many metals and their alloys (mixtures of two or more metals or a metal and a non-metal) are important for daily use as utensils and tools. These are also important for modern technologies and essential in almost every industry. Some special metals are also used in atomic energy (such as zirconium), aerospace (titanium), etc. In India, many metals, especially iron and aluminium, are recycled to minimise waste and contribute to sustainability.

Key words

Malleability | Ductility | Lustrous | Sonority | Conduction | Rusting | Corrosion

In a Nutshell

- Metals and non-metals are differentiated based on their properties.
- Generally, metals are lustrous, whereas most non-metals are non-lustrous.
- Metals are generally malleable and ductile, while non-metals do not have these properties.

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- Metals are good conductors of heat and electricity, but non-metals are generally poor conductors.
- Metals react with oxygen to produce metal oxides which are basic in nature.
- Non-metals react with oxygen to produce oxides which are acidic in nature.
- Generally, non-metals do not react with water.
- Metal objects get damaged when exposed to moist air, and the process is known as corrosion.
- Metals and non-metals have wide applications in everyday life.

Let us Enhance our Learning

1. Define the following.
   A) malleability B) ductility
   C) sonority D) corrosion
   E) rusting
2. Write two properties each for metals and non-metals.
3. A substance can be drawn into long wires used for electrical purposes. What property/ properties does that substance show?
   A : only ductility
   B : only conductance of electricity
   C : both ductility and conductance of heat
   D : both ductility and conductance of electricity
4. Which of the following metal catches fire when it comes in contact with water?
   A) Copper B) Aluminium C) Zinc D) Sodium
5. Why are only a few metals suitable for making jewellery?
6. What happens when oxygen reacts with magnesium and sulphur? What are the main differences in the nature of products formed?
7. An ironsmith heats iron before making tools. Why is heating necessary in this process?
8. Students made statements about magnesium oxide solution:
   Amar: It is basic. Turns red litmus blue.
   Nandu: It is acidic. Turns blue litmus red.
   Whose statement/s is/are correct.
   A) Only Amar B) Only Nandu
   C) Both Amar and Nandu D) Neither Amar nor Nandu
9. Which metal is commonly used to make food packaging materials as it is cheaper, and its thin sheets can be folded easily into any shape ?
   A) Aluminium B) Copper C) Iron D) Gold

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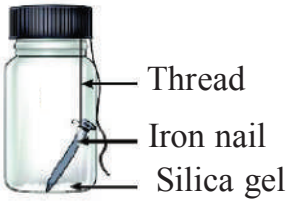
10. Match the uses of metals and non-metals given in Column I with the jumbled names of metals and non-metals given in Column II.

Column I	Column II
(i) Used in electrical wiring	(a) E N X Y G O
(ii) Most malleable and ductile	(b) N E C O H I R L
(iii) Living organisms cannot survive without it.	(c) P E P O R C
(iv) Plants grow healthy when fertilisers containing it are added to the soil.	(d) T E N G O I N R
(v) Used in water purification	(e) O G D L

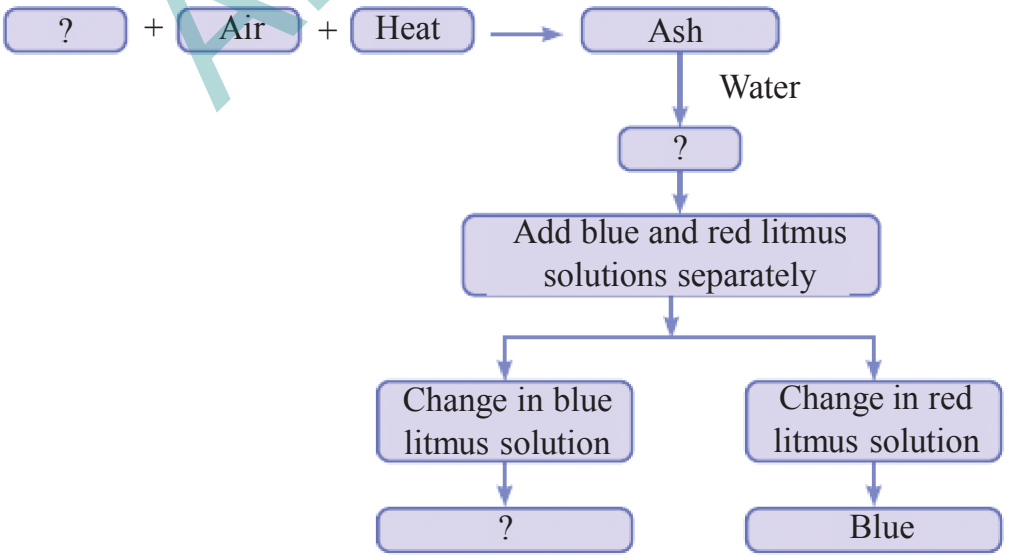
11. The apparatus shown contains an iron nail suspended inside a closed bottle. Silica gel is placed at the bottom of the bottle. The setup is kept undisturbed for 10 days. What will be observed after 10 days?



A) The iron nail rusts because air is present in the bottle
B) The iron nail rusts because silica gel absorbs moisture
C) The iron nail does not rust because moisture is absent
D) The iron nail does not rust because oxygen is absent

12. You are provided with three iron nails, each dipped in oil, water and vinegar. Which iron nail will not rust, and why?

13. Complete the following flow chart:



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14. How do the different properties of metals and non-metals determine their uses in everyday life?

15. State with reason(s) whether the following statements are True [T] or False [F].
    (i) Aluminium and copper are examples of non-metals used for making utensils and statues. [ ]
    (ii) Metals form oxides when combined with oxygen, the solution of which turns blue litmus paper to red. [ ]
    (iii) Oxygen is a non-metal essential for respiration. [ ]
    (iv) Copper vessels are used for boiling water becausethey are good conductors of electricity. [ ]

16. You are provided with the following materials. Discuss which material would be your choice to make a pan that is most suitable for boiling water and why?

Iron	copper	sulphur	coal	plastic	wood	cardboard

17. One of the methods of protecting iron from rust is to put a thin coating of zinc metal over it. Since sulphur does not react with water, can it be used for this purpose? Justify

    Your answer.

Exploratory Projects

- Dhokra, Bidriware, Pembarthi, and Kamrupi are some of India's famous metal art styles. Find out the states where these artworks are made. Also, make a collage of their photographs.
- On a map of India, mark the states where iron, gold, aluminium and other metals are found.
- Explore the metals and non-metals found in smartphones and find out how they help the phone work properly.
- Organise a classroom debate on whether the use of metals for comfort and luxury should be increased or decreased.

AP SCERT

5 Changes Around Us

K7D5M6

Learners will be able to:

- Identify physical changes. (CG-1)
- Distinguish between reversible and irreversible changes. (CG-1)
- Analysis different changes using observations like colour change, gas formations and precipitate formation. (CG-1)
- Apply the knowledge to identify changes in daily life. (CG-5)
- Conclude whether a change is physical, chemical based on observations. (CG-7)

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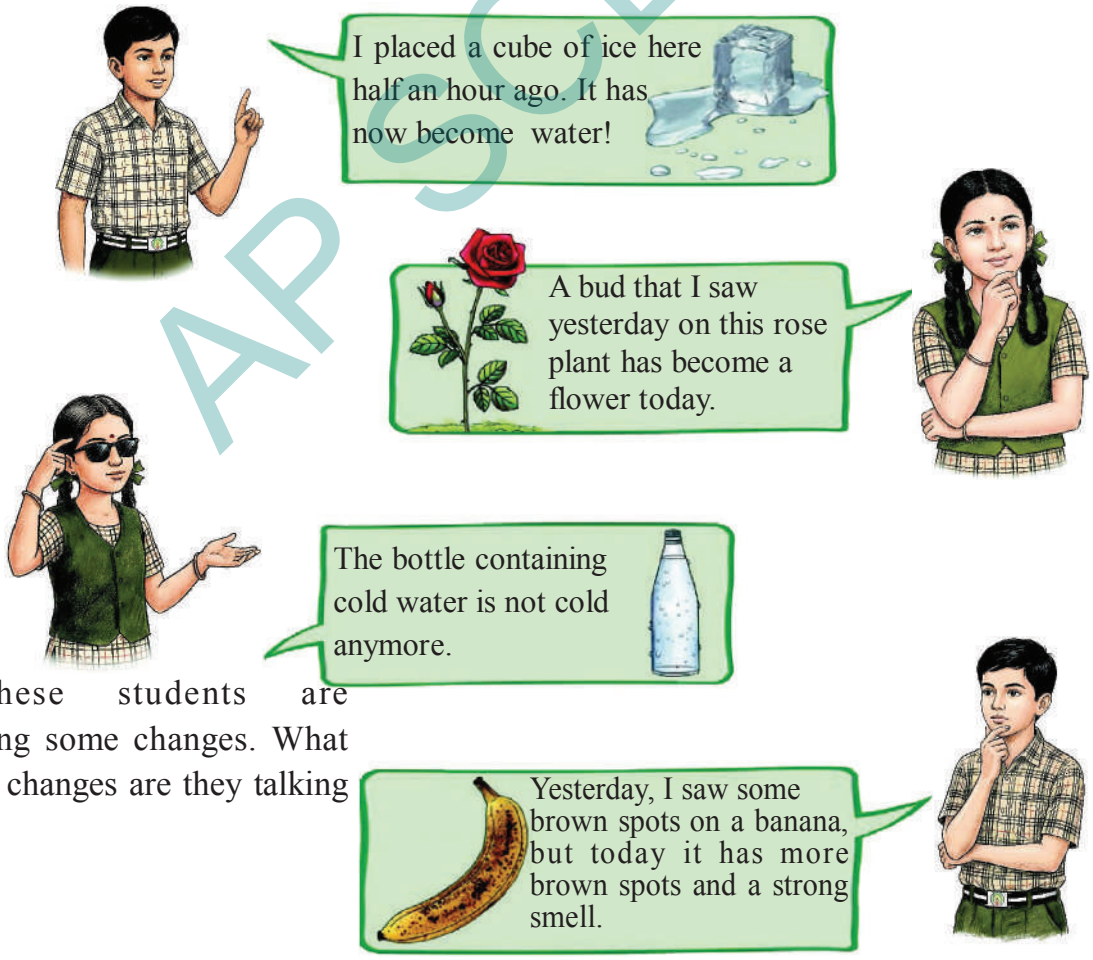

These students are describing some changes. What kinds of changes are they talking about?

Activity 5.1: Let us think and reflect

You might have observed various changes happening around you. Some of them are listed in Table 5.1, you may notice that something is changing in each case. Take a moment to reflect on the changes in each case. Record your observations in Table 5.1.

Table 5.1: Some Changes observed around us

S.No.	Change	Observations
1.	Evaporation of water in lakes	
2.	Burning of paper	
3.	Change of seasons	
4.	Making designs using papers	
5.	Change of day and night	
6.	Earthquakes	
7.	Conversion of milk into curd	
8.	Rottening of fruits	
9.	Water from steam	
10.	Rusting of iron	
11.	Any other	

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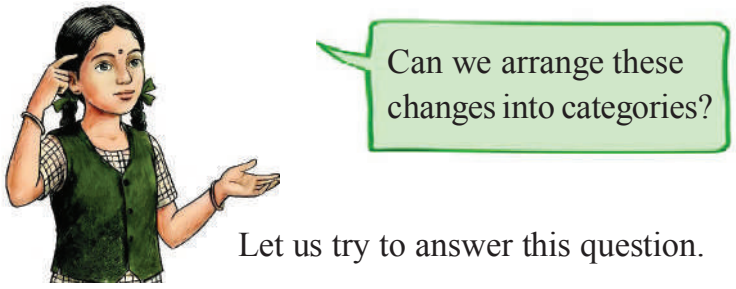
You might have noticed that these changes could be in the size, shape, smell, or other property of the substance or object. Can you think of some other changes that happen in your surroundings? Make a list of those changes too.

We observe the changes occurring around us with the help of our senses of sight, smell, touch, hearing, and taste.



Let us try to answer this question.

5.1 A Substance May Change in Appearance but Remain the Same!

Activity 5.2: Let us create and disucss

A. Creating some objects with paper

- Take a few sheets of paper and fold them to create new objects (Fig. 5.1). ? Do you get the same paper back when you unfold these objects?

Fig. 5.1: Objects made from paper

B. Playing with a balloon

- Take a balloon and inflate it. Now, loosen your grip and let the air escape out.
- Do you get the uninflated balloon back?
- Take another balloon; inflate it and grip the opening tightly. Now, prick it with a pin.

⚠ Caution — Be careful while using a pin.

- What happens? Will you be able to get the uninflated balloon back?

C. Crushing a piece of chalk

- Crush a small piece of chalk into powder.
- Can you get the chalk piece back from the powder?

Is there any similarity in the changes listed in A, B, and C?

During all these changes, materials, such as the paper, the rubber sheet of the balloon, and the chalk, remained the same, though their appearances (shape or size) may have changed. You may also recall from the class 6 General Science textbook that water can exist in different states (solid, liquid, and gas), and can change from one state to another.

In all these cases, although we observe a change in the appearance, no new substance is formed. Such changes in which only physical properties like shape, size, and state of substances change are called **physical changes**.

Let us **explore** a different type of change.

AP SCERT

5.2 A Substance May Change in Appearance and Not Remain the same!

Activity 5.3: Let us explore

- Take two glass tumblers or small transparent bottles. Mark them A and B.
- Fill one-fourth of glass tumbler A with tap water and one-fourth of glass tumbler B with lime water.
- Now, blow air (exhale) into each glass tumbler, one at a time, using separate straws (Fig. 5.2) and observe them.

⚠ Caution — Do not suck the water or lime water while doing this.

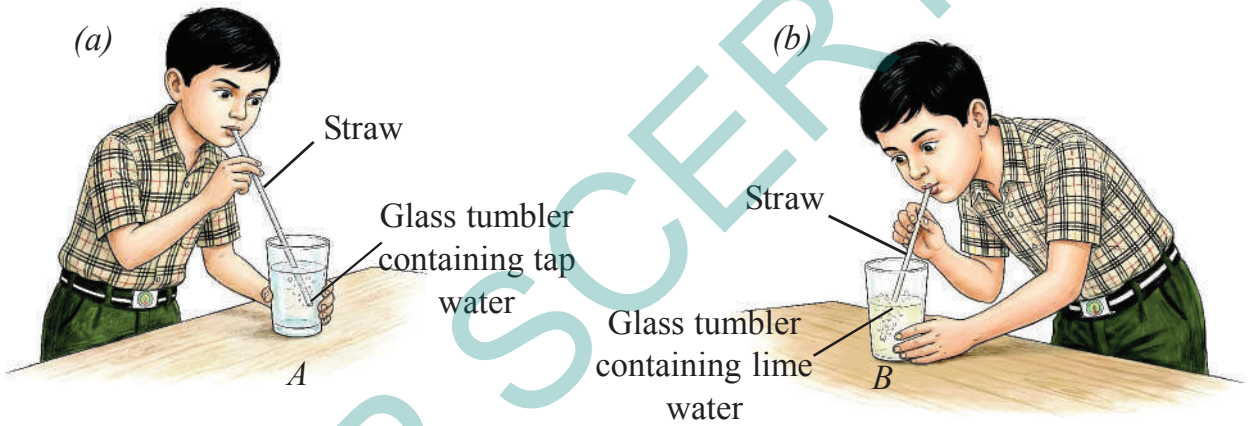


Fig. 5.2: Blowing air in (a) tap water; (b) lime water

Do you notice any changes?

In glass tumbler A, blowing air into water creates bubbles only, and there is no change in the appearance of the water. In glass tumbler B, blowing air into lime water creates bubbles, and turns the lime water milky (or cloudy). If we leave it for some time, a white substance settles at the bottom of the glass tumbler, indicating something new has formed. Such changes, in which one or more new substances are formed, are called **chemical changes.** New substances are formed through a process called **chemical reaction**. In this case, carbon dioxide from the air you breathe out (exhale) reacts with lime water, and forms a new white-coloured substance (calcium carbonate) that is insoluble in water. Therefore, the liquid in the bottle appears milky. Along with this a small amount of water is also formed. This formation of a new substance indicates a chemical change. The chemical reaction involved in this change can be represented in short form as a chemical equation.

AP SCERT

Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water
(Lime water) (Insoluble substance)

The turning of lime water milky is also used as a test for carbon dioxide. Let us explore this with another activity using some substances from our kitchen.

Activity 5.4: Let us experiment

- Take a teaspoonful of vinegar or lemon juice in a test tube.
- Add a pinch of baking soda (sodium hydrogen carbonate) to it.
- What do you observe?
- You would hear a fizzing bubbling sound and see the gas bubbles forming.
- Pass this gas through freshly prepared lime water kept in another test tube, as shown in Fig. 5.3a.
- What do you observe?
- The lime water turns milky. What do you infer about the gas formed by mixing vinegar and baking soda?

This indicates that the gas formed is carbon dioxide.

This activity can also be performed using two small used bottles instead of test tubes and a flexible straw, as shown in Fig. 5.3b.

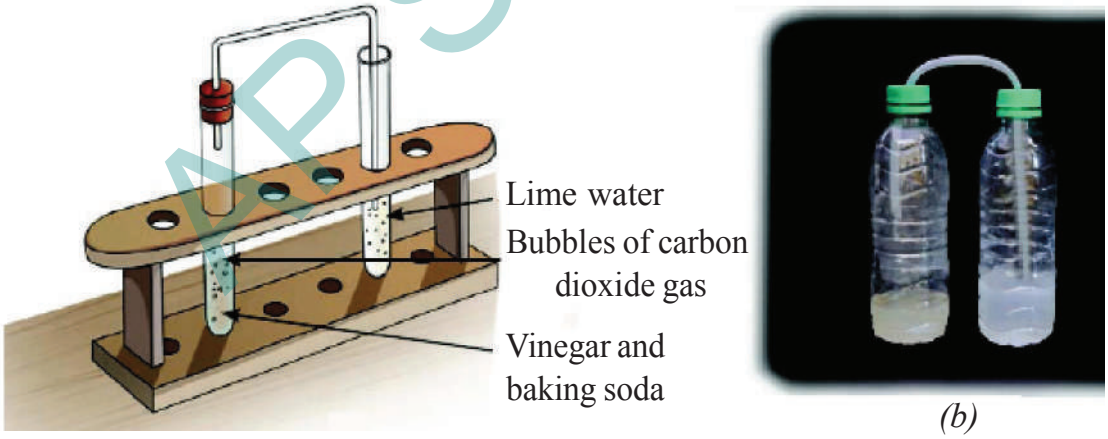


Fig. 5.3: Reaction of vinegar and baking soda

Since a new substance, carbon dioxide, is formed in this reaction, we say that a chemical change has occurred here as well. It can be represented as—

Vinegar + Baking soda → Carbon dioxide + Other substances

Repeat the above activity using baking soda and water. Do you observe any bubble formation? Is this a physical or a chemical change?

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5.3 Some Other Processess Involving Chemical Changes

5.3.1 Rusting

In the rusting of iron, which you studied in the chapter 'The World of Metals and Non-metals', a new brown-coloured substance called rust is formed. Thus, rusting is also a chemical change because it involves the formation of a new substance, iron oxide

Fig. 5.4: Rusted iron nails

5.3.2 Combustion

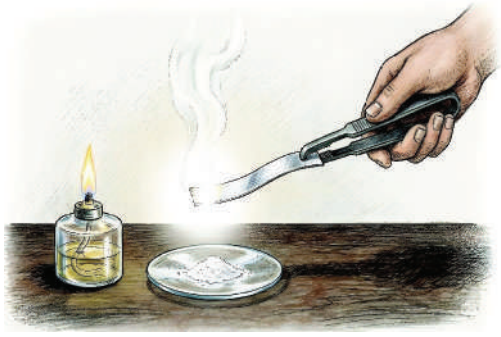

Fig. 5.5: Burning magnesium ribbon

Let us recall the burning of a magnesium ribbon (Fig. 5.5) learnt in the chapter 'The World of Metals and Non-metals'. Can you **predict** if this is a physical or a chemical change?

When the magnesium ribbon is burnt, a new substance, magnesium oxide, is formed. So, the burning of magnesium ribbon also involves a chemical change. We observed that heat and light are also produced along with the formation of a new substance in this reaction.

The burning of magnesium ribbon can be represented as—

Magnesium + Oxygen → Magnesium oxide + Heat + Light

(Ribbon) (Air) (White powder)

A chemical reaction in which a substance reacts with oxygen and produces heat and light is called **combustion**. Substances that undergo combustion reactions are called **combustible substances**. For example, wood, paper, cotton, kerosene, etc., are combustible substances.

Let us find out whether the presence of oxygen is essential for combustion.

Activity 5.5: Let us investigate

- Place two identical candles on two separate petri dishes and light them.
- Cover one of these with a glass tumbler, as shown in Fig. 5.6.
- What happens to the candle flames in the two cases?

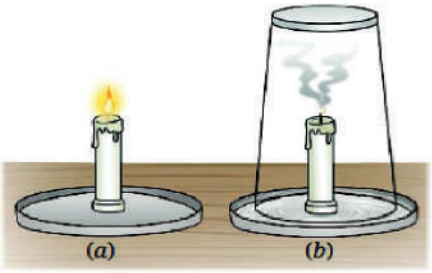

Fig. 5.6: Candle (a) burning (b) covered with a glass tumbler

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We observe that the candle that was not covered (Fig. 5.6a) continues to burn, whereas the candle that was covered with a glass tumbler (Fig. 5.6b) stops burning after some time. Why does this happen?

Since the candle covered by the glass tumbler does not have a continuous supply of air, the flame gets extinguished soon. The component of air that supports combustion is oxygen. This can be confirmed by the presence of carbon dioxide in the glass tumbler inverted on the candle. How can you test the presence of carbon dioxide gas?

You can test the carbon dioxide gas by adding a small amount of lime water in the petri dish. You will notice that it turns milky. This carbon dioxide was formed by the carbon from the wax and the oxygen from the air. In other words, oxygen is required for combustion.

SCIENCE AND SOCIETY

If a person's clothes catch fire, what is the best way to extinguish the fire? Wrap a blanket or cloth around the person. This cuts off the supply of air, and the fire gets extinguished.

Caution — Synthetic blanket or cloth should never be used to put out a fire, as these can melt and stick to the skin.

FASCINATING FACTS

Nature's wonders: You might have seen some insects emitting light in a garden or a fi eld in late evenings. These insects are called fire flies, and their light is produced by a chemical change. This type of light production (without heat) in living organisms is called bioluminescence.

Fire flies

Is the Presence of Air Enough for Combustion?

We learnt above that combustible substances and oxygen are necessary for combustion. We also know that paper is a combustible substance, but we can keep it in the air for any length of time without it catching fi re. What else is needed to start combustion?

Let us learn about this.

AP SCERT

Activity 5.6: Let us investigate

⚠ Caution— Perform this activity under the supervision of your teacher or an adult.

Fig. 5.7(a): Focusing the sunrays using a magnifying glass

- ❖ Hold a piece of paper with a pair of tongs and bring a lighted matchstick to it. It quickly catches fire. Do we say that we need a fire to start the burning process?
- ❖ Take another piece of paper. Using a magnifying glass, focus the sunrays to make the smallest and brightest spot on the paper, as shown in the Fig. 5.7a. Hold it there for some time.

What do you observe?

We observe that the paper starts to emit smoke, and then catches fire (Fig. 5.7b). Thus, we find that a substance can burn even without fire. How do we explain this change?

Fig. 5.7(b): Paper catching fire

Focusing sunrays on the paper heats it. The temperature of the paper increases with time. After some time, the paper becomes so hot that it starts burning. This minimum temperature at which a substance catches fire is called its ignition temperature. Since the temperature of the lighted matchstick was already higher than the ignition temperature of the paper, it caught fire almost immediately.

So, we can conclude that for the combustion process to occur, there are three requirements (Fig. 5.8) —

i) A combustible substance, also called 'fuel'
ii) Oxygen
iii) Heat that allows the fuel to reach its ignition temperature.

Fig. 5.8: Fire triangle

From the above examples we can list the properties of chemical change

I) Chemical changes permanent
II) Change cannot be reversed by simple method
III) Heat or light or both are given out consumed
IV) New substances are formed with entirely different properties
V) The original substance cannot be obtained by simple physical methods

AP SCERT

5.4 Can Physical and Chemical Changes Occur in the same Process ?

What changes take place when a candle is lit? Let us explore!

Activity 5.7: Think, pair and share

Look at the Fig. 5.9. Analyse what students are discussing about the burning candle. What do you think?

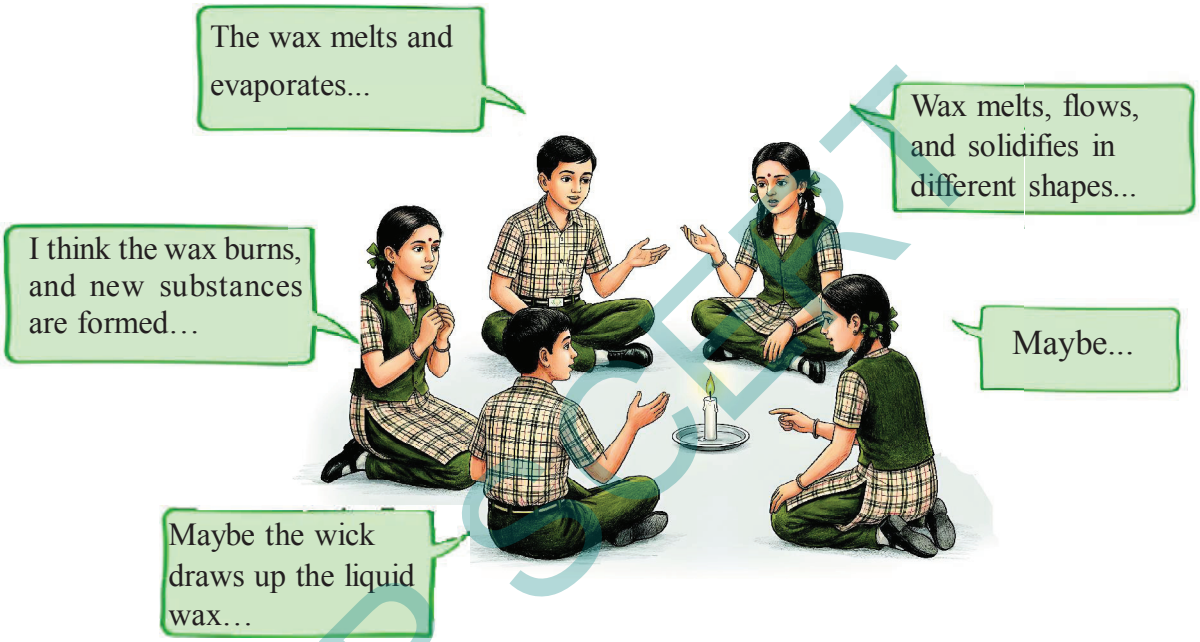
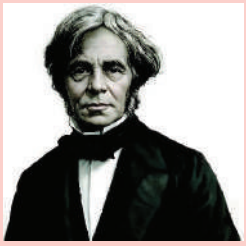


Fig. 5.9: What changes occur when a candle burns?

The wax of the candle melts, is carried up the wick, and evaporates due to the heat of the flame. The vapour of wax burns to produce a flame. The melting of wax, its solidification, and evaporation are physical changes. The burning of vapour on the other hand, is a chemical change. This shows that the burning of a candle involves both physical and chemical changes.

KNOW A SCIENTIST



The candle you just observed has long been an object of curiosity for several scientists including Michael Faraday, who made significant contributions to several areas of science. In the nineteenth century, Faraday delivered a series of lectures called Chemical History of a Candle. Faraday believed that the candle was the perfect object to introduce scientific study. Through it, he discussed differences between various physical and chemical processes like melting, vapourisation, and combustion.

AP SCERT

5.5 Are Changes Permannet ?

Once something has undergone a change, can we get it back in its original form?

Activity 5.8: Let us think

Think again about all the changes that we have discussed or talked about so far. In which of these can we get back the object or substance in the form we started with? Record your observations in Table 5.2.

Table 5.2: Can Changes be reversed ?

S.No.	Change	The Original state can be brought back (Yes/No)
1.	Melting ice cubes	Yes
2.	Chopping vegetables	No
3.	Boiling water	Yes
4.	Making popcorn from corn	No
5.		
.....		
12.		

Returning to the original object or substance with which we started shows that the changes we brought can be reversed. For example, when ice melts, it can be refrozen into ice. Similarly, when water evaporates, it can be condensed back into liquid water. However, some changes cannot be reversed since we cannot get the original object or substance back after the change. For example, chopped vegetables cannot return to their original size and shape, and making popcorn cannot go back to its original form. Thus, changes around us could be grouped into those that can be reversed and those that cannot be reversed.

Thus we can summarize the properties of physical change

I. Physical change is temporary

II. Change can be reversed by simple methods

III. No new substance is formed

IV. There is change only in physical properties

V. Heat or light may or may not be given

VI. The original form of the substance obtained easily by simple physical methods

AP SCERT

5.6 Are All Changes Desirable?

Many useful changes happen in our daily life. For example, the changing of milk into curd, ripening of fruits, cutting of fruits, and cooking of food. All these are **desirable** changes. Can you think of some other desirable changes happening around you? On the other hand, some changes may be undesirable, such as the rusting of iron or the decay of food during its storage. A change that is undesirable in some situations may be desirable in other situations. For example, decomposition of food can be very useful in converting food waste into compost.

Some changes occurring over the years due to human activity can have a long-term environmental impact. For example, the increased consumption of fuels in cars, trains, aeroplanes, etc., is increasing the amount of carbon dioxide in the atmosphere. Drying of paint on walls, doors, furniture, etc., releases many substances through evaporation, causing atmospheric pollution.

Few more examples

1. Cutting of trees 2. Burning of fuels 3. Timely arrival of rains

5.7 Some Slow Natural Changes

5.7.1 Weathering of rocks

Have you seen heaps of sand, soil, and stones lying at the base of mountains as shown in Fig. 5.10a? These are called sediments. How have these formed? These are formed by physical changes that break up large rocks into smaller pieces. Temperature changes due to climatic conditions, growing roots of trees, and even freezing of water within cracks in the rocks can cause them to break.

Water or chemicals present in water, can also react with the rocks and cause chemical changes in their composition. An example of such a chemical change is shown in Fig. 5.10b. Here, an originally black-coloured rock called basalt, which contains iron, has chemically changed to produce a red-coloured layer. The red colour is a result of the iron oxide produced when the rock surface was exposed for a long time to water or air containing water vapour. These physical and chemical changes in rocks are collectively called **weathering**, which eventually leads to the formation of soil.

Fig. 5.10 (a)Sediments at the base of a cliff (b)Red sediment layer

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5.7.2 Erosion

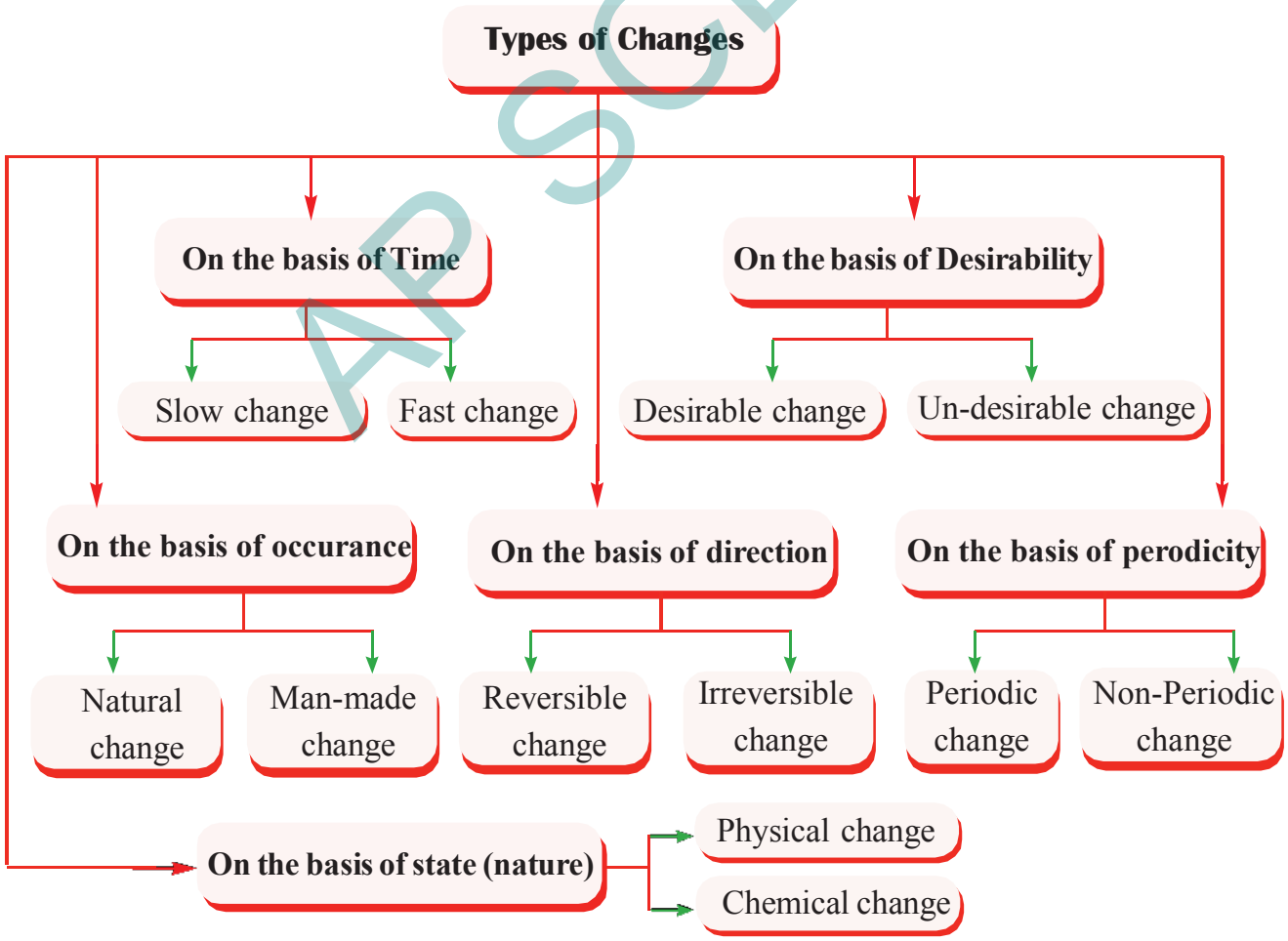
Have you noticed fine sand collecting on riverbeds or in lakes? This sand is formed when rock pebbles, soil, and sediments are broken down and moved from one location to another by natural forces like wind and flowing water. This process is called erosion.

Erosion during a landslide is an example of a physical change. River rocks and pebbles often appear smoother due to the constant erosion caused by the flowing water. When the speed of the water or wind decreases, such as in an ocean or a lake, the material transported during erosion settles down at the bottom. These sediments harden over time and become new rocks. Most of these changes take place over thousands of years and cannot be reversed.

Few more examples

I. Formation of coal
II. Formation of fossils
III. Eruption of volcanos
IV. Change of seasons

From the above activities and discussions we can summarize the changes of different kinds



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Key words

Physical Change	Chemical Change	Reversible Change
Irreversible change	Chemical reaction	Chemical equation
Rusting	Combustion	Ignition
Evaporation	Sublimation	Erosion

In a Nutshell

- A physical change is one in which a substance or object undergoes a change in its physical properties and no new substance is formed.
- A chemical change is one in which one or more new substances are formed. It involves a chemical reaction and can be represented by a chemical equation.
- Combustion, cooking, and rusting are examples of chemical changes.
- Substances that undergo combustion are combustible substances. Heat and light are given out during combustion.
- The lowest temperature at which a substance can catch fire is called its ignition temperature.
- Some changes can be reversed and some cannot.
- Some changes are desirable and some are not.
- Rocks undergo physical and chemical changes due to weathering to form soil.
- Erosion caused by flowing water and wind is a physical change.

AP SCERT

Let us Enhance our Learning

1. Assertion (A): The flame a burning candle covered with a glass tumbler goes out after some time.

   Reason (R): Oxygen inside the glass tumbler gets gradually used up.

   Options:

   A) Both A and R are true, and R is the correct explanation of A.

   B) Both A and R are true, but R is not the correct explanation of A.

   C) A is true, but R is false.

   D) A is false, but R is true.

2. Abdul focuses sunlight on a piece of paper using a magnifying glass, and the paper starts burning. The same paper does not burn when kept in sunlight without the magnifying glass.

   What is the most appropriate explanation?

   A) Paper melts before burning.

   B) The magnifying glass increases oxygen supply.

   C) Paper burns only when sunlight falls on a small area.

   D) Focusing sunlight raises the paper to its ignition temperature.

3. Which of the following correctly represents the sequence of changes involved in the burning of a candle, along with their nature?

   A) Wax melts (chemical change) → wax vapour burns (physical change)

   B) Wax burns directly (physical change) → flame is produced (chemical change)

   C) Wax evaporates (chemical change) → wax melts (physical change) → wax solidifies (physical change)

   D) Wax melts (physical change) → wax evaporates at wick (physical change) → wax vapour burns (chemical change)

4. Which of the following is an example of a physical change?

   A : digestion of food B : respiration in human

   C : combustion of wood D : evaporation of water

5. Which of the following statements are the characteristics of a physical change?

   (i) The state of the substance may or may not change.

   (ii) A substance with different properties is formed.

   (iii) No new substance is formed.

   (iv) The substance undergoes a chemical reaction.

   (a) (i) and (ii) (b) (ii) and (iii)

   (c) (i) and (iii) (d) (iii) and (iv)

6.. Define the following.

   a) Physical change b) Chemical change c) Rusting

   d) Combustion e) weathering, f) erosion

   g) ignition temperature

7. Write any two characteristics each of physical and chemical changes.

8. What are the three essential requirements for a combustion process to occur?

AP SCERT

9. Fill in the blanks in the following statements:

(i) Nalini observed that the handle of her cycle has got brown deposits. The brown deposits are due to _____ and this is a_____ change.

(ii) Folding a handkerchief is a _____ change and can be_____.

(iii) A chemical process in which a substance reacts with oxygen with evolution of heat is called _____, and this is a _____ change.

(iv) Magnesium, when burnt in air, produces a substance called _____. The substance formed is _____ in nature. Burning of magnesium is a _____ change.

10. Predict which of the following changes can be reversed and which cannot be reversed. If you are not sure, you may write that down. Why are you not sure about these?

(i) Stitching cloth to a shirt (ii) Twisting of straight string

(iii) Making idlis from a batter (iv) Dissolving sugar in water

(v) Drawing water from a well (vi) Ripening of fruits

(vii) Boiling water in an open pan (viii) Rolling up a mat

(ix) Grinding wheat grains to flour (x) Forming of soil from rocks

11. State whether the following statements are True or False. In case a statement is False, write the correct statement.

(i) Melting of wax is necessary for burning a candle. (True/False)

(ii) Collecting water vapour by condensing involves a chemical change. (True/False)

(iii) The process of converting leaves into compost is a chemical change. (True/False)

(iv) Mixing baking soda with lemon juice is a chemical change. (True/False)

12. Are the changes of water to ice and water to steam, physical or chemical? Explain.

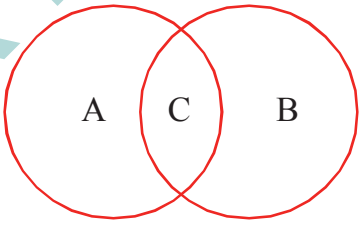
13. Natural factors, such as wind, rain, etc., help in the formation of soil from rocks. Is this change physical or chemical and why?

AP SCERT

14. Read the following story titled 'Eco-friendly Prithvi', and tick the most appropriate option(s) given in the brackets. Provide a suitable title of your choice for the story.

Prithvi is preparing a meal in the kitchen. He chops vegetables, peels potatoes, and cuts fruits (physical changes/chemical changes). He collects the seeds, fruits, and vegetable peels into a clay pot (physical change/chemical change). The fruits, vegetable peels, and other materials begin to decompose due to the action of bacteria and fungi, forming compost (physical change/chemical change). He decides to plant seeds in the compost and water them regularly. After a few days, he notices that the seeds begin to germinate and small plants start to grow, eventually blooming into colourful flowers (physical change/chemical change). His eff orts are appreciated by all his family members.

15. Some changes are given here. Write physical changes in the area marked 'A' and chemical changes in the area marked 'B'. Enter the changes which are both physical and chemical in the area marked 'C'.



Process of burning a candle; Tearing of paper; Rusting; Curdling of milk; Ripening of fruits; Melting of ice; Folding of clothes; Burning of magnesium and Mixing baking soda with vinegar.

16. The experiments shown in Fig. 5.11a, b, c, and d were performed. Find out in which case(s) did lime water turn milky and why?

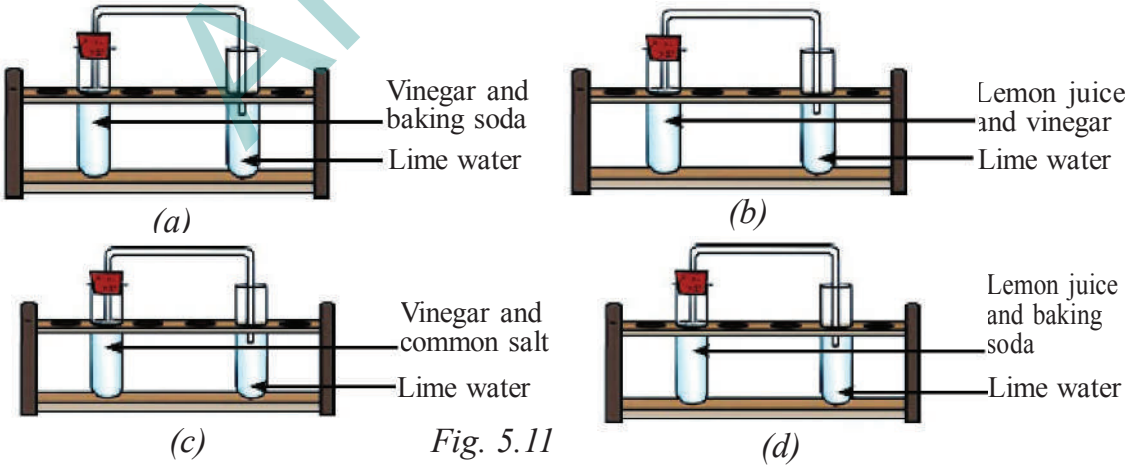


Fig. 5.11

17. Is curdling of milk a physical or chemical change? Justify your statement.

AP SCERT

Exploratory Projects

- Write a message on a piece of paper using lemon juice as ink and let it dry. The message will become invisible. Now use a warm iron over the paper (or hold the paper over the flame of a candle, taking care that it does not catch fire). The invisible letters turn dark brown as the paper gets warm. Can any of these changes be reversed?

⚠ Caution — Perform this activity under the supervision of an adult.

- Observe the activities going on in the kitchen and note any changes that can be reversed. Are these physical or chemical changes?
- Yeast is added while baking bread to make it fluff y and soft. How does yeast work? Try and find out!
  - Take a small bottle, some sugar, fresh yeast, water, and a balloon. Make a sugar solution in the bottle by mixing two teaspoons of sugar and a small amount of water. Now add a spoonful of yeast and cover the mouth of the bottle with a balloon. Leave it undisturbed for about an hour.
  - What do you observe?
  - Carefully take off the balloon, holding its mouth tightly closed and attach it to another small bottle containing freshly prepared lime water. Shake the bottle so that the contents of the balloon get mixed with lime water.
  - What do you observe?
  - What can you conclude from this experiment?
  - Identify all the changes occurring in the experiment and state which of them are physical and chemical changes.
- Chameleons change colour to blend in with their surroundings and also when they are angry or sense danger (Fig. 5.12). Is this a change that can be reversed? Explore from the internet or from your school library.

Fig. 5.12: Chameleons

AP SCERT

6 Adolescence

Learners will be able to...

- Understands physical changes before and after attaining teenage.(CG-4)
- Analyze mood swings with reference to hormonal shift.(CG-4)
- Recall components of food that helps for keeping them healthy.(CG-5)
- Create awareness about substance abuse.(CG-5)
- Explain importance of personal hygiene.(CG-5)
- Apply Life skills such as problem solving and decision making.(CG-4)

Latha stood in front of the mirror and felt worried. She had noticed a small red spot on her cheek and some changes in her face. "Why am I looking so different these days?" she murmured sadly.

Her mother noticed her concern and smiled softly. "Latha, don't worry," her mother said kindly. These changes are a normal part of growing up. It happens to everyone at your age. Why don't you ask your teacher about them? Then Latha decided to ask her biology teacher about her changes.

Do any of you have similar doubts? Let us learn about this.

It is quite unlikely that a seedling will develop the ability to produce its own seeds immediately after germination. It needs to grow and reach maturity before it becomes capable of producing seeds. Similarly, animals also need to grow and reach maturity before they can reproduce. Some animals lay eggs that hatch into young ones, while others, like humans, give birth directly to young ones. In both cases, the young ones gradually grow in size and develop over time.

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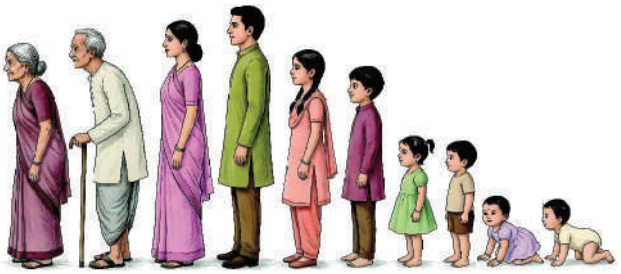
The journey of life of a human can be divided into different stages—infancy, childhood, adolescence, adulthood, and old age. Each person experiences these stages at their own pace, and the duration of each stage may vary from one individual to another. From infancy to adulthood, our bodies undergo various changes. Until around 10–12 years of age, most changes are related to height and weight. After this, other noticeable changes begin to occur, marking the onset of Adolescence. This is a period of rapid growth and development, typically occurring between the ages of 10–19. During adolescence, the body prepares for adulthood.

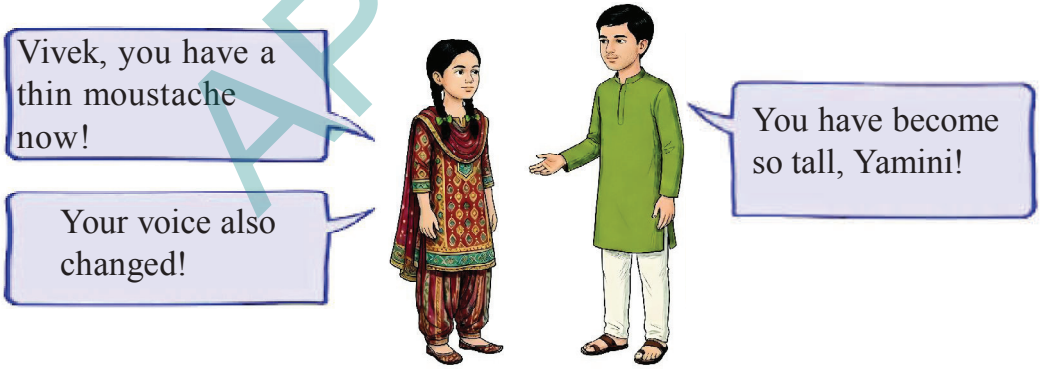


Humans, like most other living beings, can not reproduce immediately after their birth. Their bodies need to grow and reach a stage of maturity to be able to reproduce.

As humans grow and develop, they experience significant physical, emotional, and behavioural changes, along with the ability to reproduce. Some of these changes may be quite clearly observable, while others occur internally and may go unnoticed. In this chapter, you will explore adolescence, understand its importance, and learn how to handle it with a sense of responsibility.

6.1 Growing With Age: The Teenage

During the summer vacation, Vivek visited his grandparents. As he entered the house, his 12-year-old cousin, Yamini came running to greet him.



Let us try to understand this interesting conversation between Vivek and Yamini.

Activity 6.1: Let us discuss

- Take a jar and some paper slips.
- Write down the changes you can notice among students as they go from Grades 5 to 8. These could be related to height, strength, behaviour, or any other aspect. Please avoid writing names on the slips.

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- Fold the slips and place them in the jar.
- Mix all the slips received from the students in the class and unfold the collected slips one by one. Based on the information on the slips, discuss the changes with the students in the class.

What were the most commonly observable changes among students, as mentioned on the slips? List these in Table 6.1.

Table 6.1: Most common changes during growing up

S.No.	Change	Your observations
1.	Height	
2.	Weight and strength	
3.	Appearance	
4.	.....	

Have you also experienced some of these changes? If yes, then it is because you are also reaching this stage gradually. This stage starts around 10 years of age and can continue up to the age of 19. It is usually a stage of development between childhood and adulthood, and is called **adolescence**.

While analysing Table 6.1, you might have noticed the following:

Increase in height

From birth, our body undergoes continuous growth and development including an increase in height. However, the increase in height becomes more prominent during adolescence.

Changes in body structure, weight gain, and strength

As boys grow, it might be seen that along with growing taller, they gain weight, their shoulders might become a bit broader, and their chests may get wider.

Girls also undergo changes in height and weight, and other body changes like development of breasts.

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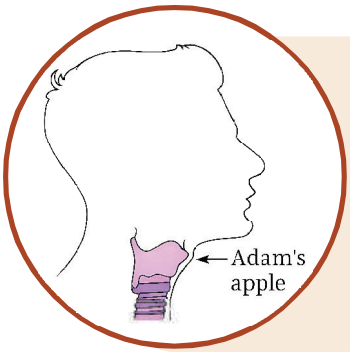

Changes in voice

In adolescent boys, the growth of the voice box leads to a voice that sounds hoarse. The voice box is a structure in our throat that helps us to speak. The growth may be seen as a bump in the throat region and is called the Adam's apple. However, it is not noticeable in every individual. The voice box also grows in adolescent girls but it is not as big as in the boys, leading to only slight changes in voice.

Appearance of hair in different parts of body

Both boys and girls experience the growth of hair in different parts of their bodies, such as the armpits and pubic region.

Boys often develop facial hair, which later grows into a moustache and a beard as they move towards adulthood. Some boys may also develop chest hair and back hair, though few boys may have no significant hair growth. Variations in and timing of appearance of hair growth is completely normal.

Changes in facial skin: emergence of pimples

Another common occurrence during the adolescent years is a skin condition called acne, in which small, reddish pimples appear. These are commonly visible on the face. Acne occurs due to an increase in oily secretions from the skin during adolescence that can clog the skin pores and lead to infections. While acne is a condition, pimples are a manifestation of it.

A key point to remember

Whether it is a change in height, voice, or facial hair, it is important to recognise that the timing, nature, and extent of these changes vary among individuals. These variations are completely normal.

Each person experiences adolescence at his or her own pace, and its duration also varies from one person to another.

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Now, we have understood some of the changes that take place during adolescence, particularly those that are easily observable. Some of these characteristic changes, like change in voice, the growth of facial and chest hair in boys, and the development of breasts in girls are not directly involved in the process of reproduction. However, these characteristic changes help distinguish males from females. For this reason, they are called **secondary sexual characteristics.**

Secondary sexual characteristics are natural signs that the body is preparing for adulthood. They mark the onset of **puberty**. Puberty is the stage in which the body of an adolescent undergoes external and internal changes to develop into an adult capable of reproduction.

6.2 Changes that Indicate Reproductive Capability

Adolescence is marked not only by observable changes but also by internal changes that are not visible from the outside. One such change is the maturation of various parts involved in the process of reproduction.

Both boys and girls experience such changes gradually, and these changes are a natural part of the process of growing up. An important internal change associated with adolescent girls is the onset of the **menstrual cycle**. It recurs generally every 28–30 days and is more commonly known as 'the period'. Many healthy girls may have longer or shorter menstrual cycles ranging from 21–35 days. The menstrual cycle is an important natural process and is one of the signs of good reproductive health. The phase of the cycle when blood discharge occurs from the body is referred to as **menstruation**. It may last for three to seven days. Some girls may feel pain or discomfort in the lower abdomen during these days. Usually, by the age of 45–55, menstruation stops naturally, marking the end of the reproductive capability in a woman's life. This stage is called menopause.

Breaking myths about menstruation

There are many wrong beliefs about menstruation that often lead to unnecessary fear, shame, or even guilt. These beliefs have given rise to certain myths and taboos. Among such myths and taboos, physical isolation of menstruating girls is unfortunately still quite prevalent. Menstruation is a natural process, and such myths have no scientific basis. By encouraging a scientific outlook towards menstruation, we can help society appreciate the need to promote good reproductive health of women and contribute positively towards a healthier lifestyle for women.

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Adolescence is not just about physical changes or changes associated with reproductive capability but also about emotional and behavioural changes. Let us discuss them!

6.3 Emotional and Behavioural Changes in Adolescents

Activity 6.2: Let us list

Take a moment to think if there are any changes in your emotions or behaviour or that of your classmates and friends in the past one or two years. These changes may be exciting, confusing, or both.

Let us list some emotional changes in Table 6.2 along with their probable effects on behaviour and ways for positive growth and development.

Table 6.2: Emotional changes, their probable effects on behaviour, and ways for positive growth and development

Key emotional changes	Probable effect on behaviour	Ways for positive growth and development
Mood swings	Engage in varied activities like music, dance, or sports	Self-exploration and involvement in activities that may lead to creativity and innovation
Strong emotions	Increased sensitivity	Compassion, involvement in social work.
Any other		

While discussing Table 6.2, you may have explored the diverse behavioural changes in adolescents. This is because adolescence is often marked by stronger emotions than childhood. These emotions might affect adolescents' behaviour like taking up/joining social initiatives to support the needy and the disadvantaged, or developing deeper interest in new areas. Understanding how our emotions influence our behaviour and actions, can help us make better choices and respond to situations thoughtfully.

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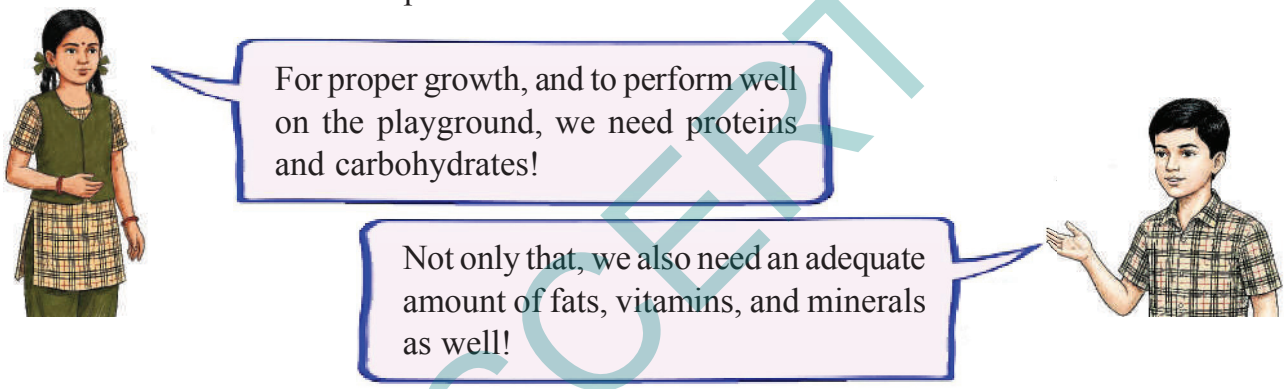
6.4 Making Adolescence a Joyful Experience

The journey of adolescence is a unique experience. Heightened curiosity and excitement during this stage of life give adolescents a new viewpoint towards almost everything around them. Good habits, thoughtful decisions, and small actions can have a powerful positive impact on the overall well-being of adolescents.

Let us know about them!

6.4.1 Meeting nutritional needs

In Grade 6 chapter 'Mindful Eating' you learnt about the need for a healthy diet. Since adolescence is a period of growth and development marked by several changes in the body, a nutritious diet is of utmost importance.



Activity 6.3: Let us list

Based on the locally available foods, fill Table 6.3 with the healthy food sources, nutrients present in them and how these nutrients can help our growth and development.

Table 6.3: Food sources, nutrients present in them, and functions of these nutrients

Food Sources	Nutrients we get from them	Functions of these Nutrients
Milk, millets, curd, chesse, and paneer	Calcium, proteisn, fats _____	To help optimal bone growth _____
_____	Proteins _____	To help proper growth, gain strength and improve levels of energy _____
Spinach, Kidney beans and dried fruits like raisins, and flgs	iron _____	To help in the formation of blood

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Science and Society

Adolescents, especially girls, may sometimes suffer from blood-related health problem(s) because of a deficiency of micro(protective) nutrients iron or vitamin B12 in the body.

- Find out about such health problem(s).
- How can we manage iron deficiency in our body?
- Find out about government schemes aimed to prevent such deficiencies.

Know a Scientist

Dorothy Hodgkin (3rd women noble laureate) was a brilliant scientist discovered the 3D structure of vitamin B12 in 1956,and won the Nobel Prize 1964 in the field of chemistry. Did you know that vitamin B12 is required for the proper functioning of the human body? Like most vitamins, it cannot be made in the human body and has to be obtained from the food we eat. Discuss the sources of vitamin B12 with your teacher.

6.4.2 Personal hygiene

Fig. 6.1: Sanitary pad

Besides nutrition, personal hygiene is also crucially important during adolescence. Maintaining body hygiene, particularly in the armpits and the pubic region, may protect us from potential infections.

For girls, maintaining proper hygiene during menstruation is essential for both comfort and health. **Menstrual hygiene** can be maintained using items such as sanitary pads (Fig. 6.1) and reusable cloth pads designed for this purpose.

The government also attempts to provide these products free of charge or at a low price to improve the menstrual hygiene of girls and women. As a society, we should all make efforts to ensure the availability of necessary facilities in schools and public places to promote menstrual hygiene. Collectively, we should move forward, reducing any stigma around sanitary pads and helping in menstrual hygiene.

It is important to dispose of used sanitary pads properly by wrapping them in newspaper and disposing inside a dustbin. This is to ensure community health and environmental cleanliness. These days, biodegradable sanitary pads are also available that are environment-friendly. What are other safety disposal methods for sanitary pads ?

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Science and Society

Shyam Sunder Bedekar is an Indian social innovator and entrepreneur known for his work on menstrual hygiene in rural India. He developed 'Sakhi', a branded, low-cost sanitary pads (priced around Rs 2.50 per piece) and also 'Ashuddhinashak', an eco-friendly and low cost terracotta incinerator to help women in rural areas for the safe and hygienic disposal of the used pads.

Science and Society

To support menstrual hygiene, the government has introduced several initiatives—

- **Menstrual Hygiene Scheme (MHS):** Under this scheme by the Government of India, sanitary pads are provided free of charge or at a reduced price to adolescent girls in rural areas. Awareness programmes are also conducted to educate girls about menstrual hygiene and health.
- **Rashtriya Kishor Swasthya Karyakram (RKSK):** It aims to improve the overall health of adolescents, including menstrual health and hygiene. It encourages peer education, where older students help younger ones learn about these topics.
- **Suvidha Sanitary Napkin Initiative:** Under this initiative, biodegradable sanitary pads are provided at affordable prices through Jan Aushadhi Kendras. The initiative aims to improve access to menstrual hygiene products for women and adolescent girls.
- **Weekly Iron and Folic Acid Supplementation (WIFS):** program, a government initiative in India (in 2012) that provides free weekly iron and folic acid tablets to adolescent boys and girls (aged 10-19) to combat anemia. It targets students in classes 6-12 in government, government-aided, and municipal schools, as well as out-of-school adolescent girls who receive tablets through Anganwadi centers
- **State-Level Initiatives:** Various state governments have their own programmes, such as the 'Shuchi Scheme' in Karnataka and free sanitary napkin schemes in states like Tamil Nadu and Odisha. These programmes aim to distribute free sanitary pads in government schools.
- **Swechha:** Andhra Pradesh launched The Swechha scheme in October 2021, is the state's program that provides free sanitary napkins to adolescent girls in government schools. The Swechha scheme in Andhra Pradesh aims to improve menstrual hygiene, reduce school absenteeism among adolescent girls, and promote their overall health and empowerment.

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6.4.3 Physical activities

Regular exercise and physical activities are also very important during adolescence. Do you exercise regularly or participate in games and sports? What kinds of exercises do you do? These activities will keep your body and mind fit and healthy, build up your stamina and boost your mood (Fig. 6.2).

Fig. 6.2: Physical activities for fitness

6.4.4 Balanced social life

We all live in a society and interact with each other in our day-to-day life. We should all be polite and respectful towards each other (Fig. 6.3). This helps create a favourable and safe environment.

Since adolescence is a stage of life marked by new experiences and emotions, we must be thoughtful and responsible while interacting with others — whether in person or through social media. This is the time adolescents may feel attracted to their peers, and mimic their behaviour. Today, they often interact with each other online.

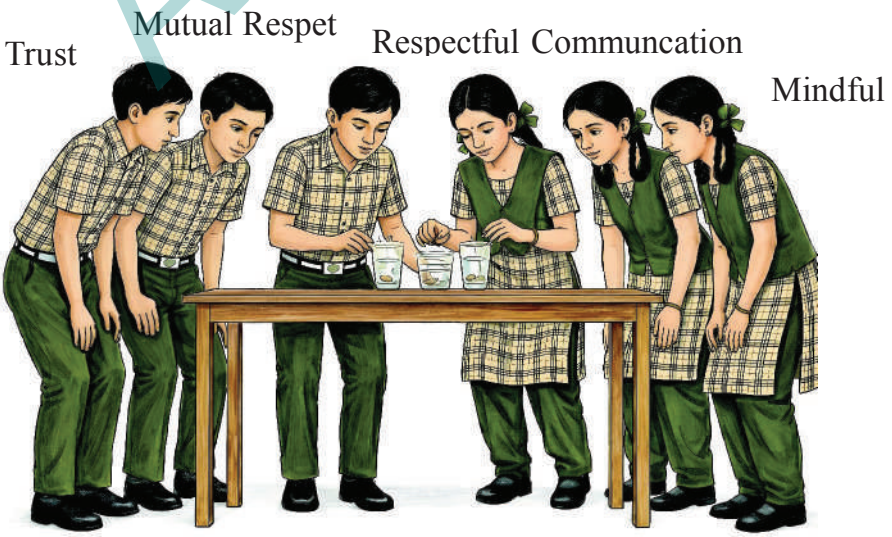

Fig. 6.3: Collaborative learning in action

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Fig. 6.4: Cyberbullying

Modern technologies have made online platforms available for all to obtain information, make connections, interact, and share information with each other. We should use these platforms responsibly for the collective well-being of all. Sometimes, we, knowingly or unknowingly, use social media platforms carelessly. Seeking guidance from elders and teachers can help use these platforms positively.

Science and Society

Cyberbullying involves the use of digital devices such as phones, computers, or online platforms to harass others by sending misleading messages, spreading false rumours, or sharing personal information without consent (Fig. 6.4). However, if someone tries to bully you, it is important not to feel scared or helpless. Rather, handle it wisely and seek help from parents and teachers.

Additionally, you should be cautious when uploading any picture online or sharing personal information with strangers.

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Activity 6.4: Let us spread awareness

Work in groups to design posters and pamphlets about various aspects of responsible social media behaviour and paste them at designated places in the school. Also, fill in Table 6.4 based on your collective observations.

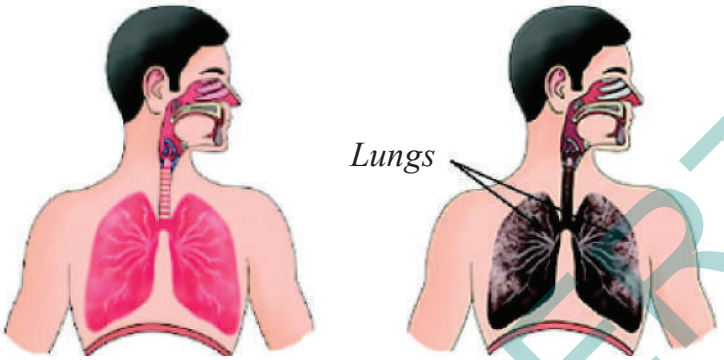
Table 6.4: Dos and dont's to be followed on social media

Do's	Dont's
Be respectful and kind.	Do not share personal photos with strangers/ virtual friends.
Think before posting.	_____
Protect privacy	_____

6.4.5 Avoiding harmful substances - learn to say NO

Some people, including your peers, may tempt, persuade, force or, create pressure on you to consume harmful substances such as tobacco, gutka, cigarettes, beedi, alcohol, or even life-threatening illegal drugs. Since adolescence is marked by curiosity and excitement, adolescents might get influenced by such people and try these substances.

These substances are not just harmful to physical and mental health but are also addictive. This means that once people start consuming them, they develop a strong urge to take them again and again. Over time, they start using them regularly. This is called **substance abuse.**



(a) Before *(b) After*

Fig. 6.5: Condition of the lungs before and after prolonged exposer to bidi / cigarette smoke

Someone who is addicted today, might have started once with 'just one time'!

Say 'NO; to addictive substances the first time and every time!

Using these substances can cause serious health problems, such as breathing difficulties, memory loss, and damage to the lungs (Fig. 6.5), depending on the substance. To stay healthy, it is important to completely avoid these substances and make healthy choices instead. It is important to remain firm and confident in your decision to say 'NO'.

The first step to overcoming addiction is seeking help and support from family and friends, and talking to trusted people, such as parents or teachers. Counselling and medical advice can also be helpful in handling such situations. Remember, your health and your future are in your hands — choose wisely!

Science and Society

Prahari Clubs are school-based student clubs formed to prevent abuse drug and substance among children and to make the school, safe environments.

Some key points:

- The clubs are part of a framework laid out by the National Commission for Protection of Child Rights (NCPCR) and the Narcotics Control Bureau (NCB) for tackling drug/substance abuse
- Department of Education, Andhra Pradesh had issued orders to set up Prahari Clubs in schools (both government and private) for classes from 6 to 12.

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SCIENCE AND SOCIETY

Nasha Mukt Bharat Abhiyaan

The Nasha Mukt Bharat Abhiyaan was launched by the Ministry of Social Justice and Empowerment, Government of India. It intends to reach out to the masses and spread awareness on the issue of avoiding substance abuse through active participation of the youth, women, and the community. The special focus is on the prevention of substance abuse among early-age children.

The Government has launched a National De-addiction Helpline— 14446, to deal with drug addiction and to help drug addicts.

6.4.6 Practicing Life Skills :

Life skills are practical abilities that help individuals manage their daily life and succeed in various aspects of life. The following life skills are needed in adolescence age to maintain their life smoothly. Try to practice these.

S.No	Life Skill	Description	Example
1	**Effective Communication**	Expressing ideas clearly and confidently through words and actions.	Speaking politely to teachers and peers, and listening actively.
2	**Interpersonal Relationships**	Building healthy, respectful, and supportive relationships.	Working cooperatively in group projects and resolving disagreements calmly.
3	**Decision-Making**	Choosing the best option after weighing possible outcomes.	Deciding to spend time studying instead of getting distracted by social media.
4	**Problem-Solving**	Identifying problems and finding practical, positive solutions.	Figuring out how to balance homework, sports, and rest effectively.
5	**Coping with Emotions**	Recognizing and managing strong feelings like anger or sadness.	Taking deep breaths or journaling instead of shouting during anger.
6	**Coping with Stress**	Managing pressure and challenges positively.	Practicing yoga or listening to music to relax before exams.

Think about these skills. Which of these skills do you have? On which one do you want to put more focus?

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6.5 The 'Why' Question for Adolescence

We now understand the different changes in adolescence and also know some ways to handle it with a sense of responsibility.

But I wonder why these changes occur at this stage of life!

Many changes in adolescence, including menstruation and other signs of puberty, are mainly due to hormones — certain chemicals produced in our bodies. **Hormones** play a crucial role in regulating various aspects of growth and development, contributing to the proper functioning of the body. They are produced in different parts of the body and are released at an appropriate time in response to signals from the brain.

Testosterone and estrogens are the hormones that cause physical changes in boys and girls during the adolescence. These hormones influence the mood and the behavior.

By staying informed, seeking support and guidance when needed, and making healthy decisions, you can build a strong foundation for your life ahead.

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Key words

Adolescence	Adam's apple	Puberty
Menstruation	Menstural Cycle	Menstrual hygiene
Secondary sexual Characterisitcs	Substance abuse	Hormones

In a Nutshell

- Adolescence is the period of change from childhood to adulthood. It generally begins around the age of 10 years and usually lasts until 19 years.
- Adolescence is marked by significant and characteristic physical, biological, and emotional changes.
- Features that help to distinguish the male from the female but are not directly involved in reproduction are called secondary sexual characteristics.
- Puberty is the stage in which the body of a child undergoes observable and internal changes to develop into an adult capable of reproduction.
- Adolescence in girls is also marked by start of the menstrual cycle, during which there is a discharge of blood generally after every 28–30 days, a process called menstruation.
- Menstruation begins at puberty and generally ends by the age of 45–55 years.
- Adolescents face several emotional and behavioural changes.
- Eating a balanced and healthy diet, maintaining good personal hygiene, and participating in physical activities help adolescents to stay healthy.
- Addictive substances, such as tobacco, alcohol, and drugs, have adverse effects on the body and mind. It is wise to say 'NO' to these substances and stay away from them.
- Changes that take place in the body during adolescence are primarily controlled by certain chemicals produced in the body. These chemicals are called hormones.
- Life skills are practical abilities that help individuals manage their daily life and succeed in various aspects of life. Life skills are needed in adolescence to maintain their life smooth
- Proper guidance and awareness help adolescents manage physical, emotional, and behavioural changes effectively.

Let Us Enhance Our Learining

1. Ramesh, an 11-year-old boy, developed a few pimples on his face. His mother told him that this is because of ongoing biological changes in his body.
   (i) What could be the possible reasons for the development of these pimples on his face?
   (ii) What can he do to get some relief from these pimples?

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2. Which of the following food groups would be a better option for adolescents and why?

(i)

(ii)

3. Unscramble the underlined word in the following sentences:
   (i) The discharge of blood in adolescent girls which generally occurs every 28–30 days is nstmnoiaretu.
   (ii) The hoarseness in the voice of adolescent boys is due to enlarged iceov xob.
   (iii) Secondary sexual characteristics are natural signs that the body is preparing for adulthood and mark the onset of urtypeb.
   (iv) We should say NO to lahoclo and srugd as they are addictive.
4. Sailu told her friend, "Adolescence brings only physical changes, like growing taller or developing body hair." Is she correct? What would you change in this description of adolescence?
5. During a discussion in the class, some of the students raised the following points. What questions would you ask them to check the correctness of these points?
   (i) Adolescents do not need to worry about behavioural changes.
   (ii) If someone tries a harmful substance once, they can stop anytime they want.
6. Adolescents sometimes experience mood swings. On some days, they feel very energetic and happy, while on other days, they may feel low. What other behavioural changes are associated with this age?
7. While using a toilet, Vani noticed that used sanitary pads were scattered near the bin. She got upset and shared her feelings with her friends. They discussed the importance of menstrual hygiene and healthy sanitary habits. What menstrual hygiene and sanitary habits would you suggest to your friends?
8. Likitha and Vijay were classmates and good friends. On turning 11, Likitha developed a little bulge on the front of her neck. She visited the doctor who gave her medication and asked to take iodine-rich diet. Similarly, a bump was developed on the front of Vijay's neck when he turned 12. However, the doctor told him that it was a part of growing up. According to you, what could be the possible reason for advising Likitha and Vijay differently?

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9. During adolescence, the boys and girls undergo certain physical changes, a few of which are given below.
   (i) Change in voice
   (ii) Development of breasts
   (iii) Growth of moustache
   (iv) Growth of facial hair
   (v) Pimples on the face
   (vi) Growth of hair in the pubic region
   (vii) Growth of hair in armpits
   Categorise these changes in the table given below:

Physical changes during adolescence		
Observed only in boys	**Observed only girls**	**Common in boys and girls**

10. Prepare a poster mentioning the tips for adolescents to live a healthy lifestyle.
11. Ramu struggles to adjust in the hostel with his peer group. What life skills should he acquire?

Exploratory Projects

- Find out about some personalities and organisations working in your locality to improve mental health of youth. Interview them. List at least five questions that you will ask in the interviews.
- Perform a role play on the theme 'Child marriage: A social evil', highlighting how it negatively impacts the overall well-being of children, particularly the health of young girls.
- 21 June is celebrated as International Yoga Day. Organise a small camp with the help of your teachers and practise some asanas.

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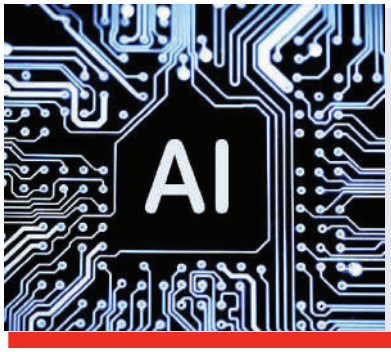
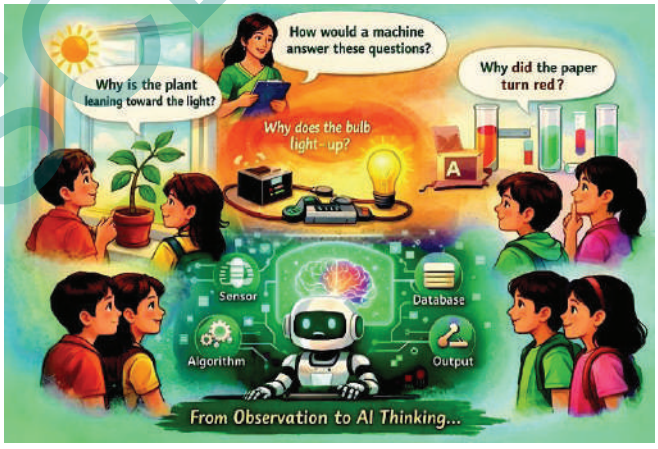


Integrating Artificial Intelligence(AI)

N3D9M1

Learners will be able to...

1. Understand and correctly use AI-related terms such as Artificial Intelligence, sensor, input, output, digital data, algorithm, dataset, pattern recognition, and machine learning while explaining scientific concepts.
2. Explain how observation, experimentation, and data recording in science relate to data collection in AI systems.
3. Describe how classification of acids, bases, metals, non-metals, and types of changes connected to rule-based and data-based AI systems.
4. Differentiate between human observation in experiments and digital detection through sensors.



One day, the Science teacher showed the class three simple situations a plant growing towards sunlight, a bulb glowing only when a circuit was closed, and litmus paper changing colour in a solution. She asked the students why each of these changes happened. The students explained that the plant responded to light, the bulb glowed because the circuit was complete, and the litmus paper changed colour because of the nature of the substance. In each case, they had observed carefully, identified patterns, and explained the cause based on evidence.

The teacher then asked, "If a machine had to answer these questions, how would it do so?" This made the students think differently. Just like humans, intelligent systems also collect input, process information, recognise patterns, and produce output. The scientific thinking used in experiments—observation, classification, and understanding cause and effect—forms the foundation for understanding Artificial Intelligence. This chapter explores how the skills you develop in Science connect with the way intelligent systems work.

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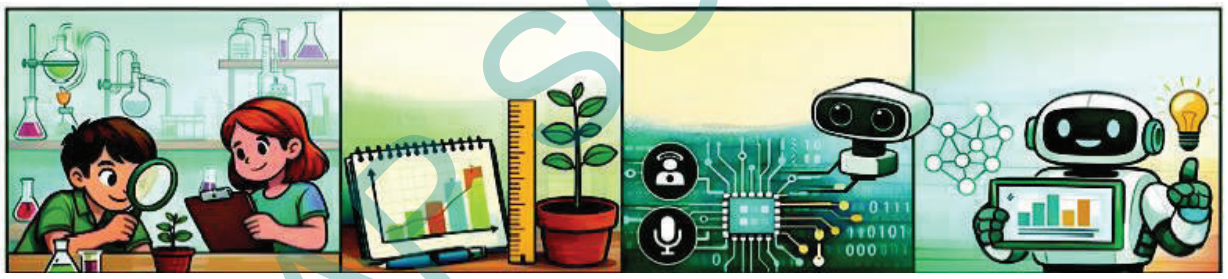
Foundations of AI in Science Learning

Science involves asking questions, forming hypotheses, onducting experiments, recording observations, analysing results, and drawing conclusions based on evidence. Similarly, **Artificial Intelligence (AI)** follows a structured process: **Input '! Data Processing '! Pattern Recognition '! Output**. AI systems collect **Input** through **Sensors**, convert it into **Digital Data**, process the data using **Algorithms**, recognise patterns using **Datasets**, and generate **Output** in the form of predictions or classifications. In many scientific situations, outcomes depend on specific conditions—for example, a bulb glows only if the circuit is complete, and litmus turns red only if a substance is acidic. Such condition-based functioning resembles **Rule-Based Systems** in AI, where fixed instructions determine the result using **Conditional Logic**. This resembles **Data-Based Systems** or **Machine Learning**, where systems learn from **Datasets** to improve **Prediction** through pattern analysis.

Guidance:

1. Begin with scientific concepts before linking to AI.
2. Encourage discussion based on classroom experiments.
3. Ensure students verify AI responses with textbook content.

Example 1: The Wonderful World of Science.



In scientific enquiry, students observe changes during an experiment, measure quantities accurately, record results, and draw conclusions based on evidence. For example, while conducting an experiment to study the effect of sunlight on plant growth, learners collect data by measuring the height of the plant regularly. Similarly, AI systems collect input through sensors, process the data using programmed algorithms, and generate output. Thus, scientific experimentation helps in understanding the process of data collection and analysis in intelligent systems.

Thinking with AI	If a plant's growth is recorded daily, how does this collected data help in identifying a pattern?
Key Words:	**Sensor** – A device that detects changes. **Algorithm** – Step-by-step instructions used to process **data**.

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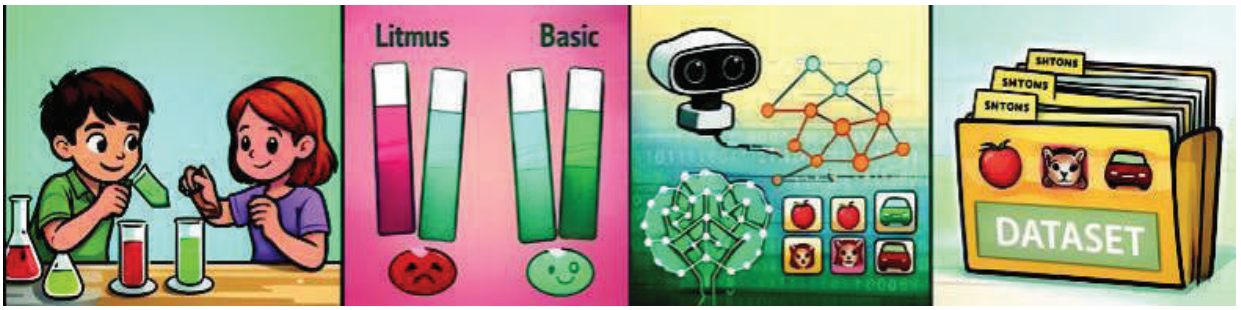
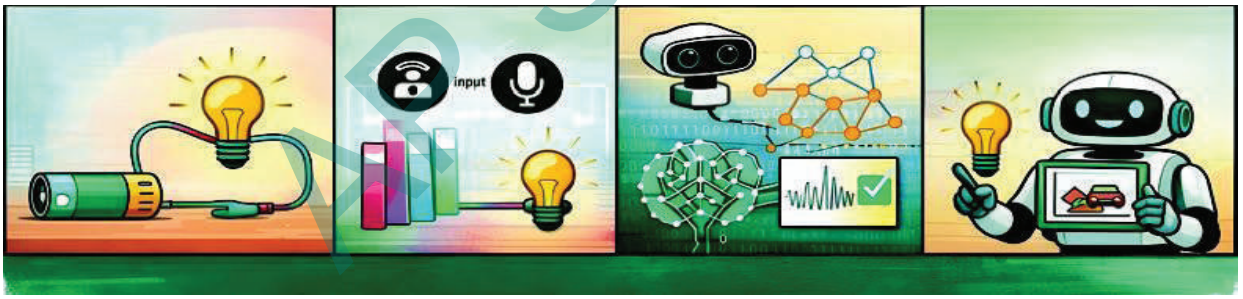
Example 2: Acids, Bases and Salts.



Indicators such as litmus paper are used to identify whether a substance is acidic or basic based on colour change. This method of identifying substances is an example of **classification** based on observable properties. In **AI systems**, classification is performed by analysing **features** and comparing them with stored **data patterns**. The collection of such labelled **data** used for comparison is known as a **dataset**. This helps learners understand how intelligent systems classify information through pattern recognition and machine learning.

Thinking with AI	When litmus changes colour humansobserve and conclude the type of substance. How would a machine classify substances if it is given labelled examples of colour changes.
Key Words:	**Data set** : A collection of labelled data used for training. **Pattern recognition:** Identifying similarities in data.

Example 3: Electric Circuits and their Components.



In an electric circuit, the electric cell acts as a source of energy, wires provide a path for the flow of current, and the bulb glows when the circuit is complete. This demonstrates the relationship between **input** and **output**. Similarly, in **AI systems**, **input** is collected through **sensors**, processed using **algorithms**, and converted into **output** such as signals or actions.

Thinking with AI	In a closed circuit, the bulb glows. How is this similar to the **input–processing–output system** used in **AI**?
Key Words:	**Input** – Information received. **Processing** – Analysing the input **data**.**Output** – Result produced after processing.

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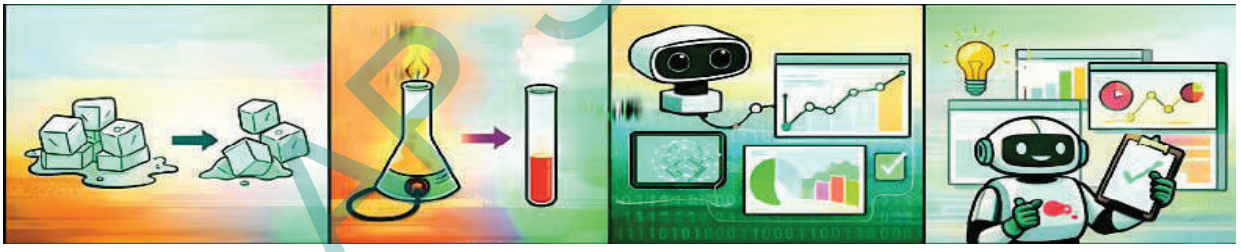
Example 4: Metals and Non-metals

Metals and non-metals are classified based on properties such as malleability, ductility, conductivity, and hardness. These properties help in identifying different materials.

In **AI systems**, objects are recognised using specific **features** such as shape, size, or texture. **Automated systems** use **sensors** to detect these properties and classify materials accordingly. Thus, scientific classification of materials supports the understanding of **feature-based identification**, **data processing**, and **machine learning** in intelligent systems.

Thinking with AI	When materials are grouped based on properties, how might an automated system detect and classify them?
Key Words:	**Feature Detection** – Identifying specific haracteristics. **Machine Learning** – Learning from **data** to improve performance.

Example 5: Changes Around Us



Physical and chemical changes are identified by observing whether a new substance is formed or not. Chemical reactions often involve a cause-and-effect relationship. AI systems analyse similar relationships in data to predict outcomes. Simulation models, predictive analysis, and data transformation are used to represent such changes digitally. Hence, the study of physical and chemical changes helps in understanding predictive modelling in intelligent systems.

Thinking with AI	When a chemical reaction produces a new substance, it shows cause and effect. How does AI use stored data patterns to predict outcomes?
Key Words:	**Predictive Analytics** - Predicting outcomes based on patterns. **Data Transformation** - Converting data into usable form.

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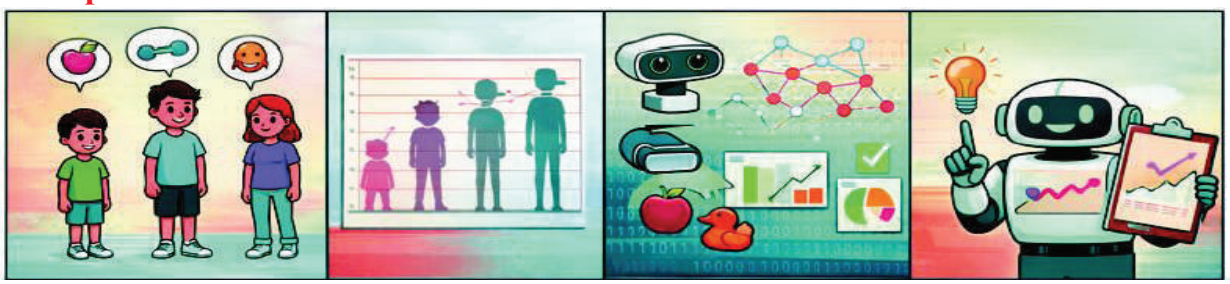
Example 6: Adolescence



Adolescence is a stage of growth and development that involves physical, emotional, and behavioural changes. Growth patterns may vary among individuals.

Thus, studying growth patterns during adolescence supports the understanding of **pattern analysis**, **machine learning**, and **predictive modelling** in intelligent systems.

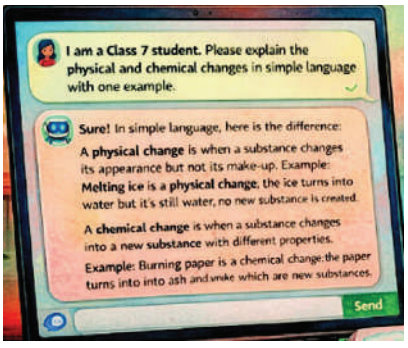
Thinking with AI	Growth patterns differ among individuals. How might AI analyse data from many individuals to identify common patterns?
Key Words:	**Dataset** – Collection of growth records. **Pattern Analysis** – Studying repeated trends. **Predictive Model** – A system that forecasts future outcomes.

Guidance: Before allowing any AI-based activity, instruct learners to read the relevant textbook section thoroughly.Demonstrate how to frame clear, subject-specific prompts including class level, chapter name, and concept.

Responsible use of AI

Strengthens discipline, honesty, and scientific thinking.The tasks given below are designed to strengthen scientific thinking through guided use of Artificial Intelligence tools. These tasks must be performed only under the supervision of a teacher in school or with the guidance of parents at home.

Writing Effective Prompts in Science



A prompt is the instruction or question given to an AI tool.

A good Science prompt should include:

Class level

Chapter name

Clear concept

Request for step-by-step explanation if needed

Example Prompt:

Note:- Clear prompts lead to clear scientific explanations

"I am a Class 7 student. Please explain the physical and chemical changes in simple language with one example.

Do AI Make Mistakes?

AI systems depend on the quality of **data** provided. If the **dataset** is incomplete or incorrect, the **output** may be inaccurate. **AI-generated responses** must always be verified with the textbook. **AI** supports learning but does not replace experiments, observation, or teacher guidance.

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Chapter-wise AI-Supported Exploration:

Chapter	Foundational Level	Analytical Level	Creative Level
The Wonderful World of Science	1. Define observation and experimentation. 2. Identify independent and dependent variables.	1. Differentiate observation and inference. 2. Analyse control and experimental groups.	1. Design an experiment to test plant growth. 2. Compare scientific data collection with AI sensor-based data collection.
Acids, Bases and Salts	1. Identify common acids and bases (lemon juice, soap). 2. Define pH (basic understanding).	1. Compare strong and weak acids (conceptual level). 2. Analyse colour changes using indicator data.	1. Design a natural indicator using flowers. 2. Create a pH comparison chart using collected data
Electric Circuits and their components	1. Draw a simple circuit diagram. 2. Identify circuit components	1. Explain why a bulb glows only in a closed circuit (conditional logic). 2. Compare series and parallel circuits.	1. Build a working circuit model. 2. Compare circuit flow with AI Input-Processing-Output systems.
Metals & Non-metals	1. List properties of metals. 2. List properties of non-metals.	1. Compare physical and chemical properties. 2. Analyse reactivity differences.	1. Prepare a feature-detection classification chart. 2. Design a Venn diagram comparison.
Changes Around Us	1. Define physical change. 2. Define chemical change.	1. Identify signs of chemical reactions (gas, colour change, temperature change). 2. Compare reversible and irreversible changes.	1. Create a concept map of types of changes. 2. Compare chemical reactions with AI pattern-based prediction models.
Adolescence	1. List physical changes during adolescence. 2. Define puberty.	1. Analyse growth patterns using height/weight data tables. 2. Compare male and female developmental changes.	1. Prepare a growth tracking chart. 2. Explain how AI uses datasets to predict growth trends.

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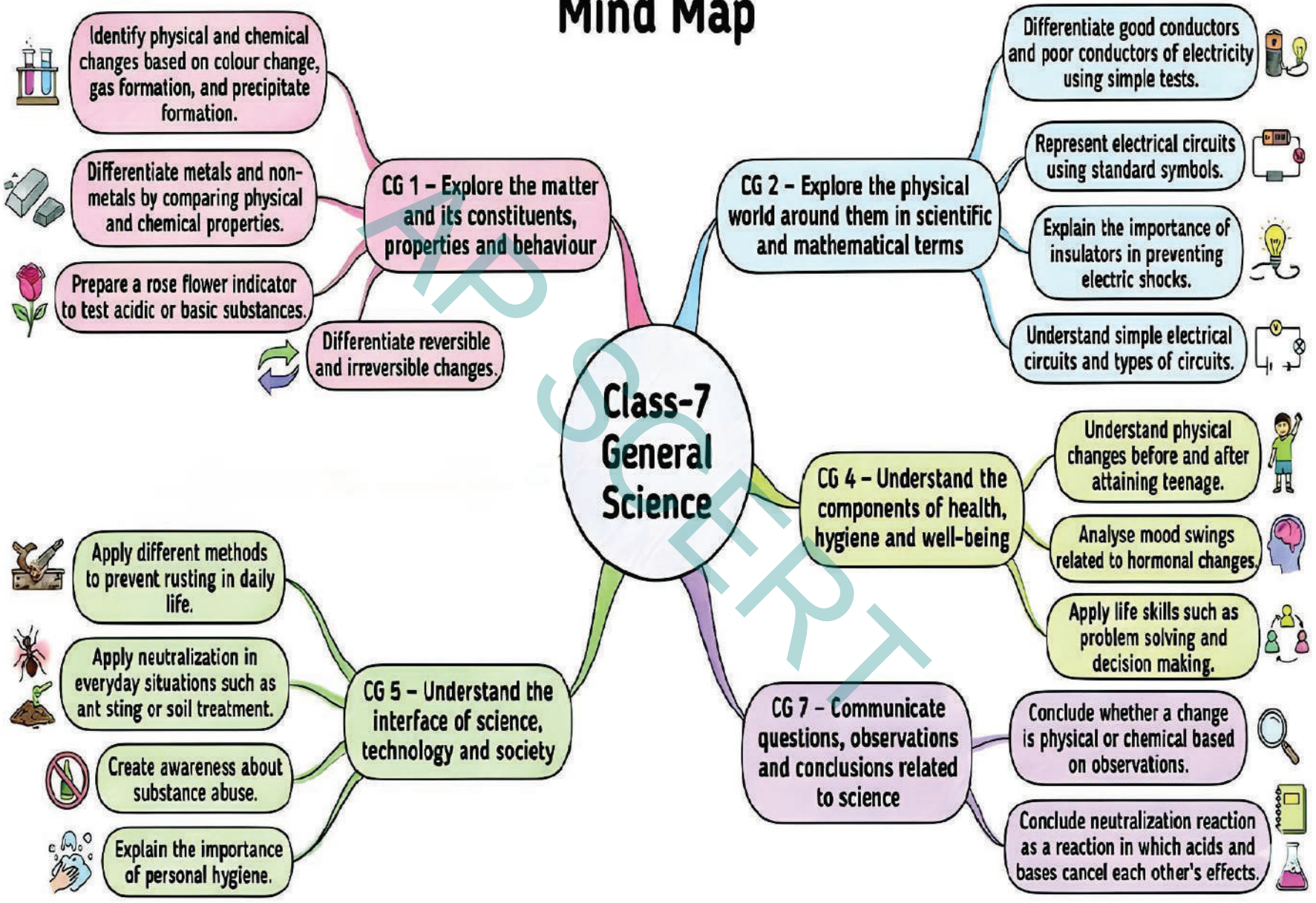
Students can carry out small, community-based interdisciplinary projects with guidance to apply scientific concepts in real-life situations. By observing plants or weather, classifying household substances, studying simple circuits, sorting materials by properties, identifying physical and chemical changes, and analysing growth and diet patterns, learners connect classroom knowledge with everyday experiences.

Guidance: During the concluding discussion, guide learners to reflect on how the first six chapters collectively develop core scientific abilities. Help them articulate how observation, measurement, classification, and comparison are essential both in science learning and in intelligent systems. Encourage small, supervised community-based activities that apply textbook knowledge in real-life situations.

Conclusion: The selected chapters develop core scientific skills such as observation, experimentation, classification, and analysis of growth and change. These same skills form the foundation of **Artificial Intelligence systems**. Scientific thinking prepares learners to understand how machines use **sensors**, process **digital data** through **algorithms**, perform **pattern recognition**, and generate **output** in real-world applications.

Mind Map



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