NEW OXFORD SECONDARY SCIENCE

TEACHING GUIDE

GRADE 8

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Introduction

I. Overview:

In today's rapidly changing world, students must have a solid foundation of general knowledge in order to become well-rounded individuals. History, geography, science, literature, current events, and other subjects are all included in general knowledge. This teacher's guide series is designed for 6th, 7th, and 8th-grade teachers to assist them in facilitating effective learning experiences by providing a comprehensive framework based on the 5 E's lesson plan.

II. The 5 E's Lesson Plan:

The 5 E's Lesson Plan is an inquiry-based instructional model widely used in teaching to promote active learning and engage students in the learning process. Engage, Explore, Explain, Elaborate, and Evaluate are the five E's. This method encourages students to investigate concepts, construct meaning, and apply their learning in real-world situations. Each phase of the 5 E's offers a unique opportunity to deepen students' comprehension and foster critical thinking skills.

1. **Engage:** The Engage phase serves as a hook to draw students in and activate their prior knowledge. It arouses curiosity and provides a framework for learning. Teachers can use thought-provoking questions, multimedia resources, real-life examples, or interactive activities to pique students' interest in the topic of study during this phase. Engaging students from the start prepares them for an exciting and focused learning experience.
2. **Explain:** Students are given opportunities to articulate their understanding and make sense of the concepts they have learned during the Engage phase. Teachers play an important role in facilitating discussions, explaining concepts, and clarifying misconceptions. This phase encourages effective communication skills and assists students in developing a solid foundation of knowledge by organizing their thoughts and clearly expressing their ideas.
3. **Explore:** The Explore phase encourages students to further investigate and investigate the topic. Hands-on activities, experiments, group projects, and research are used to deepen students' understanding through firsthand experiences. This stage encourages teamwork, critical thinking, and problem-solving abilities. Teachers can help students conduct experiments, analyze data, and explore primary and secondary resources in order to gather information and make meaningful connections.
4. **Elaborate:** The Elaborate phase encourages students to broaden their understanding and apply what they've learned in real-world situations. It consists of activities that require students to think critically, solve problems, and make connections outside of the classroom. Project-based learning, case studies, debates, and simulations require students to analyze, synthesize, and create. This stage promotes creativity, independent thinking, and the ability to apply knowledge in a variety of situations.

5. **Evaluate:** During the Evaluate phase, teachers can assess students' learning progress and measure how well they met the lesson objectives. Formative and summative assessments are used to provide feedback and guide future instruction. Quizzes, presentations, projects, and written assignments are all examples of assessments. Teachers can provide personalized and targeted instruction by assessing students' performance and identifying areas of strength and areas that require additional reinforcement.

III. Sixth, Seventh, and Eighth Grade General Knowledge:

General Knowledge is critical to the overall development of students in the sixth, seventh, and eighth grades. It broadens their worldview, fosters their curiosity, and provides them with the knowledge they need to become active and informed citizens. General Knowledge subjects provide a holistic approach to education by fostering interdisciplinary connections and promoting critical thinking skills.

This teacher's guide series will provide a variety of General Knowledge topics appropriate for students in grades 6th, 7th, and 8th, with each topic aligned to the 5 E's lesson plan. It will suggest engaging activities, exploration strategies, explanation techniques, opportunities for elaboration, and evaluation methods. The guide's goal is to inspire educators to create dynamic, interactive learning environments that inspire students to develop a lifelong love of learning and exploration.

IV. Alignment with the Oxford Textbook Series:

This Oxford Teacher Guide series has been thoughtfully designed to work in tandem with the Oxford textbook series, giving educators a comprehensive and cohesive approach to teaching. Teachers can enrich students' learning experiences and deepen their understanding of the subject matter by incorporating the General Knowledge topics from this guide into the existing curriculum based on the Oxford textbooks. This alignment ensures a logical progression of topics, allowing students to gain a broader perspective, make interdisciplinary connections, and build a well-rounded knowledge base that supplements the content covered in the Oxford textbooks. Together, the Oxford Teacher Guide series and the Oxford textbook series form a potent combination that improves students' educational experiences and fosters intellectual growth.

V. How to use this guide:

1. **Familiarize Yourself with the Guide:** Read through the entire guide thoroughly to understand its structure and content. Make yourself familiar with the 5 E's lesson plan and its various phases: Participate, investigate, explain, elaborate, and evaluate.
2. **Plan Your Lessons:** Create a lesson plan for each topic using the 5 E's. Begin with the Engage phase, which aims to pique students' interest and activate prior knowledge. Choose appropriate strategies to engage your students from the start, such as thought-provoking questions, multimedia resources, or interactive activities.
3. **Explore and Discover:** Students proceed to the Explore phase, where they further investigate and explore the topic. To encourage active learning and critical thinking, create hands-on activities, experiments, group projects, or research projects. Give students opportunities to gather information, analyze data, and make connections.
4. **Explain and Clarify:** Move on to the Explain phase, where students express their understanding and make sense of what they've learned. Facilitate discussions, explain things, and clear up any misconceptions that may arise. Encourage students to ask questions, express their opinions, and participate in meaningful discussions.

5. **Elaborate and Apply:** In the Elaborate phase, students extend their understanding and apply what they've learned in real-world situations. Make it possible for students to think critically, solve problems, and make connections outside of the classroom. Encourage them to participate in project-based learning, case studies, debates, or simulations that require them to analyze, synthesize, and create.
6. **Evaluate and Assess:** At the end of each lesson, evaluate students' learning progress and measure their achievement of the lesson objectives. To provide feedback and guide future instruction, use a variety of formative and summative assessments, such as quizzes, presentations, projects, or written assignments. Identify and address areas for improvement in subsequent lessons.
7. **Adapt and Personalize:** Feel free to adapt and personalize the lessons to meet your student's specific needs and learning styles. To cater to diverse learners and create an inclusive classroom environment, modify activities, assessments, and resources.
8. **Reflect and Iterate:** Reflect on your teaching practice and the effectiveness of your lessons on a regular basis. Seek feedback from students and colleagues to improve and refine your instruction over time. Iterate on the lessons in response to feedback to improve student engagement and learning outcomes.

Progression Grid:

A comprehensive progression grid outlines the sequential development of concepts across the grades in the Teacher Guide. This progression grid is a useful tool for educators, highlighting the logical flow of topics and the increasing complexity of ideas as students' progress from sixth to eighth grade. The grid enables teachers to visualize the interconnectedness of concepts and identify the foundational knowledge that students will need to build on in subsequent grades. Educators can ensure a scaffolder learning experience in which students gradually deepen their understanding and skills over time by following the progression grid. The grid also helps educators anticipate and address potential gaps or overlaps in the content covered, which aids in curriculum planning. Overall, the progression grid provided in this guide enables teachers to create cohesive and coherent lessons that maximize student learning and promote a smooth educational journey.

Breakdown of the Academic Year:

The breakdown of the academic year provided in the guide allows for a systematic progression of topics throughout the academic year. Each term focuses on a specific set of chapters that cover a wide range of general knowledge topics. It allows for in-depth exploration, discussion, activities, and assessments within each chapter. Teachers can modify the pace and chapter allocation based on the needs of their specific curriculum and students.

PROGRESSION GRID		
Biology		
Grade VI	**Grade VII**	**Grade VIII**
Unit 1: Cellular Organization.	Unit 1: Plant Systems	Unit 3: Variations, Heredity, and Cell Divisions.
Unit 2: Reproduction in Plants	Unit 2: Human Respiratory and Circulatory System.	Unit 1: Ecology
Unit 3: Balanced Diet	Unit 3: Immunity and Diseases	Unit 4: Biotechnology
Unit 4: Human Digestive System		Unit 2: Human Nervous System

Chemistry		
Grade VI	**Grade VII**	**Grade VIII**
Unit 5: Matters as Particles	Unit 4: Structure of an atom.	Unit 5: Periodic Table
Unit 6: Elements and Compounds	Unit 5: Physical and Chemical Changes. Unit 6: Chemical Bonds	Unit 6: Chemical Reactions
Unit 7:Mixtures	Unit 7: Solutions	Unit 7: Acids, Bases and Salts.

Physics		
Grade VI	**Grade VII**	**Grade VII**
Unit 8: Energy	Unit 8: Force and Motion. Unit 9: Waves and Energy	Unit 8: Force and Pressure.
Unit 9: Electricity	Unit 10: Heat and Temperature.	Unit 9: Reflection and Refraction of Light.
Unit 10: Magnetism	Unit 9: Waves and Energy	Unit 10: Electricity and Magnetism

Space Sciences		
Grade VI	**Grade VII**	**Grade VIII**
Unit 11: Solar System	Unit 11: Earth and Space	Unit11: Our Universe

Technology in Everyday Life		
Grade VI	**Grade VII**	**Grade VIII**
Unit 12: • Grow seasonal plants and vegetables in earthen pots and demonstrate the effect of use of fertilizers on the growth of plants. • Prepare yogurt and cheese from milk to demonstrate the beneficial microorganisms. • Design a solar oven to convert solar energy into heat energy. • Assemble a circuit to demonstrate the working of an electric bell.	**Unit 12:** • Design a model to demonstrate a drip and sprinkle irrigation system for the conservation of water. • Use different techniques for preserving foods like orange juice, apples, and pickles. • Make a simple stethoscope. • Make a sanitizer using suitable substances.	**Unit 12:** • Make bioplastic from milk and vinegar as an application of biotechnology. • Make a toothpaste, soap and detergent as an application of acid and bases in daily life. • Assemble a concave mirror type solar cooker to convert solar energy into heat energy. • Assemble and operate simple wind turbine to produce electricity. • Demonstrate the working of a UPS and use it to operate a fan or an energy bulb.

ACADEMIC YEAR BREAKDOWN

Term 1:

Chapter 1: Ecology
Chapter 2: The Nervous System
Chapter 3: Variations, Heredity, and Cell Division
Chapter 4: Biotechnology

Term 2:

Chapter 5: Periodic Table
Chapter 6: Chemical Reaction
Chapter 7: Acids, Bases, and Salts
Chapter 8: Forces and Pressure

Term 3:

Chapter 9: Reflection and Recfraction of light
Chapter 10: Electricity and Magnetism
Chapter 11: Our Universe
Chapter 12: Technology in Everyday Life

CHAPTER 01 Ecology

Student Book Pages 10–21

Learning outcomes:

- describe the role of living things in cycling oxygen and carbon through an ecosystem, citing the processes of respiration, photosynthesis and combustion.
- relate how oxygen and carbon cycles are complementary processes that bring balance and symmetry to life on earth.
- describe global warming and explain how threats to the carbon-oxygen balance such as overpopulation, reliance on fossil fuels, and deforestation are contributing to global warming and climate change.
- Describe how energy flows from producers to consumers, and how only part of the energy flows from one level of the pyramid to the next.
- draw a food web diagram to illustrate the food relationships between organisms.
- describe and illustrate through examples key ecological relationships between organisms, including competition, predation and symbiosis
- predict how changes in an ecosystem (e.g., changes in the water supply, the introduction of a new population, hunting, migration) can affect available resources, and thus the balance among populations.
- hypothesise what would happen in the ecosystem if the population of one of the participants in different ecological relationships is affected.
- explain ways in which human behaviour (e.g., replanting forests, reducing air and water pollution, protecting endangered species) can have positive effects on the local environment.

Keywords

producers, consumers, decomposers, autotrophs, herbivores, carnivores, omnivores, energy pyramids, food webs, respiration, photosynthesis, combustion, fossil fuels, global warming, climate change, competition, predation, symbiosis, replantation, waste management, recycling.

Overview of the Unit:

- An ecosystem is a functional unit of ecology in which living organisms interact with one another and with their surroundings. An ecosystem, in other words, is a series of interactions between living things and their surroundings.
- The oxygen cycle is a cyclic process in which oxygen is continuously circulated through the biosphere's living and non-living components.
- Oxygen is one of the essential elements required for life on Earth to exist. It is primarily needed for:
  - Respiration
  - Photosynthesis
  - Combustion
  - For aquatic life
  - Organic waste decomposition
- The carbon cycle introduces carbon into the ecosystem. The carbon cycle transports carbon from the atmosphere to the Earth and its organisms and back again. It is nature's method of recycling carbon atoms, which travel from the atmosphere into organisms on Earth and then back into the atmosphere.
- Global warming is defined as an increase in the average surface temperature of the Earth caused by greenhouse gases that accumulate in the atmosphere like a thickening blanket, trapping the sun's heat and warming the planet.
  - Global warming is largely caused by an excess of these gases and fossil fuels (natural oil, gasoline, coal).
  - Today, the atmosphere contains more carbon dioxide than at any time in the last 800,000 years.
  - Global climate change is already having an impact on the environment. Glaciers have shrunk, ice on rivers and lakes has broken up earlier, plant and animal ranges have shifted, and trees have begun to bloom earlier.
- A food chain is a chain that depicts the feeding relationship between species. Because plants can produce their own food, they are frequently the first link in the food chain. This sort of link on the food chain is termed to as a producer.The primary consumer is the first animal to consume the producer.
- The following actions can help save the environment:
  - try lowering your energy and water usage
  - alter your eating and travel habits to save natural resources
  - and reduce, reuse, and recycle to live more sustainably

Lesson Plan 1 Ecosystem	Student Book pages 10-11	Time 45 Minutes	Workbook pages -

Objective:

Describe ecosystem and its component.

Keywords

- Ecosystem
- Biotic factors
- Abiotic factors

Engage:

Ask students to think of a forest and name what is found there. Build an ecosystem on board with the help of their responses.

Useful Link

https://www.youtube.com/watch?v=sKJoXdrOT70.

https://mrnussbaum.com/habitat-maker-online-game

Explain:

- Explain ecosystem and its components with the help of example of forest.
- Show students the following video.

Explore:

- Ask students to create their own habitat by using the following link.
  https://mrnussbaum.com/habitat-maker-online-game

Elaborate:

- Ask students to name biotic and abiotic components in their ecosystem.
- Carry out Discuss and Answer page 10 of student book.

Evaluate:

Complete Q5(i-ii) on page 24 of student book.

Lesson Plan 2 Oxygen and Carbon Cycle in an Ecosystem	Student Book pages 12-14	Time 45 Minutes	Workbook pages 8

Objective:

- describe the role of living things in cycling oxygen and carbon through an ecosystem, citing the processes of respiration, photosynthesis and combustion.
- relate how oxygen and carbon cycles are complementary processes that bring balance and symmetry to life on earth

Keywords

Atmosphere

Engage:

- Begin with the What Contains Carbon and Oxygen? activity to learn about carbon and oxygen and their various forms. Ask students to recall items in their daily lives that contain carbon and oxygen. Make a list of these items and post it on the board.

Useful Link

https://youtu.be/pGWJ9GgDNhM

- Explain to your students that the carbon or oxygen contained in anything does not remain there indefinitely. The carbon cycle or oxygen cycle is the movement of carbon or oxygen atoms from one thing to another.

Explain:

Draw the diagrams of the oxygen and carbon cycles on the board to explain them to the students.

The oxygen cycle is a cyclic process in which oxygen is continuously circulated through the biosphere's living and non-living components.

The oxygen cycle includes the following steps:

Stage 1: In the presence of sunlight, all green plants absorb carbon dioxide gas from the atmosphere to form carbohydrates and release oxygen into the atmosphere via photosynthesis. The released oxygen is a byproduct of photosynthesis.

Stage 2: All aerobic organisms use the free oxygen in the atmosphere to produce carbon dioxide, water, and energy through respiration.

Stage 3: During respiration, all aerobic organisms take in oxygen and expel carbon dioxide into the atmosphere. Photosynthesis is carried out by plants using exhaled carbon dioxide. During photosynthesis, oxygen is released which is used by living organisms. The cycle continues, and the levels of oxygen and carbon dioxide in the atmosphere are balanced.

Stage 4: Combustion contributes to the oxygen cycle as well. During combustion, oxygen reacts with carbon to produce carbon dioxide gas.

Through the carbon cycle, the element carbon enters the ecosystem. The carbon cycle transports carbon from the atmosphere into the Earth and its organisms and back again.

The following are the steps involved in the carbon cycle process:

Step:1 A small amount of carbon dioxide serves as a carbon source for green plants to perform photosynthesis. During photosynthesis, green plants convert atmospheric carbon dioxide into a biologically usable form of carbon, glucose.

Step:2 Animals consume the leaves of these plants to meet their carbon requirements and release carbon dioxide into the atmosphere through respiration.

Step:3 The glucose stored in plants is broken down during respiration, releasing carbon dioxide into the atmosphere.

Step:4 Microorganisms decompose dead plants and animals, releasing carbon dioxide into the atmosphere as a byproduct.

Step:5 The combustion of fossil fuels such as coal and oil emits carbon dioxide into the atmosphere.

Explore:

Tell students that they will be performing a carbon cycle role-play in this activity to learn how carbon moves from one place to another.

Things to be needed:

- Carbon is represented by 14-28 of a small, lightweight object (e.g. ping pong balls.)
- Carbon Cycle Role-Play Cards (7 total, one per group)
- necessary, use chalk to draw regions.

Role Play:

- If you're using an outdoor area, mark out the regions shown below with chalk.
- If you are in a classroom, draw a picture of the three regions on the board and designate

different areas of the classroom to represent the ocean, land, and atmosphere.

- Divide the students into 7 groups and give each group the appropriate role-play card. Each group will be a cast of actors who will take on a different role in the carbon cycle (atmosphere, water, algae, marine snail, sediments & rocks, trees, or caterpillars).
- Give each group 2-4 ping pong balls and explain that they represent carbon atoms.
- Allow students in each group to review their role play card to determine their role in the carbon cycle and decide as a group how they will move their carbon using their "Options for carbon movement."
- Explain that they can only give their carbon to one other group, or that if they have plenty, they can give it to more than one.
- Explain that carbon exists simultaneously in all of these things and that only a portion of the carbon in each thing moves. As a result, when each group moves its carbon, it cannot give away all of its carbon: it must retain at least one carbon atom.
- While moving their carbon to explain the carbon movement that they have chosen.
- Ask each group, one at a time, to give their carbon to another group (or groups).

Repeat the role-play, this time for an oxygen cycle.

Elaborate:

- Have the class discussion on the Human Impacts on the Carbon Cycle and Oxygen Cycle.
- Explain to students that they simply acted out the carbon and oxygen cycle without human involvement, but humans have a significant impact on the carbon and oxygen cycles through their activities.
- Students should guess which movement corresponds to which of the human activities. For example
- For energy, humans extract and burn fossil fuels (carbon moves from the sediments and rocks where fossil fuels are buried into the atmosphere).
- Humans cut and burn trees in order to use land for farming, ranching, or construction (carbon moves from the land plants into the atmosphere).

Evaluate:

Ask students to do Q13 on page 8 of workbook.

Home Assignment:

Give worksheet 2 to complete at home.

Lesson Plan 3	Student Book pages	Time	Workbook pages
Global Warming	13-14	40 Minutes	8

Objective:

describe global warming and explain how threats to the carbon-oxygen balance such as overpopulation, reliance on fossil fuels, and deforestation are contributing to global warming and climate change.

Engage:

Begin by having students write a definition of global warming.When all students have finished their definitions, ask them to share them with the class for discussion. Write important ideas on the board.

Keywords

Fossil fuel
Greenhouse gases
Overpopulation

Explain:

Useful Link

https://youtu.be/Y3gqoDUtmt4

The phenomenon of global warming is the gradual increase in temperature near the earth's surface. This phenomenon has been observed over the last century or two. This change has disrupted the earth's climatic pattern.

- There are several causes of global warming, all of which are harmful to humans, plants, and animals. These causes could be natural or the result of human activity. It is critical to understand the negative effects of global warming in order to address the issues.
- The earth's temperature has risen dramatically as a result of global warming.
- Global warming has harmed coral reefs, potentially resulting in the extinction of plants and animals.
- Climate change has resulted from global warming.
- Heat and humidity patterns change as a result of global warming. This has resulted in the spread of mosquitos, which carry and spread diseases.
- Several plants and animals lose their habitats as a result of global climate change.

- The major causes of global warming are as follows:
- Man-made Causes: There are several causes of global warming that are caused by human.
  - For many domestic and commercial purposes, forests are being depleted. This has resulted in an environmental imbalance, which has contributed to global warming.
  - Vehicles run on fossil fuels, which emit a lot of carbon dioxide and other toxins into the atmosphere, raising the temperature.
  - The excessive use of air conditioners and refrigerators has resulted in the release of CFCs into the environment, which has a negative impact on the ozone layer.
  - The harmful emissions from factories contribute to the planet's rising temperature.
  - Carbon dioxide and methane gas are produced by a variety of farming activities.
  - More people breathing means more people breathing. This causes an increase in carbon dioxide levels.
- Natural Causes:
  - Volcanoes are a major natural contributor to global warming.
  - Permafrost is frozen soil that has been trapped in it for several years and is found beneath the Earth's surface. It can be found in glaciers. As permafrost melts, gases are released back into the atmosphere, raising Earth's temperature.
  - Forest fires produce a large amount of carbon-containing smoke.Explan:

Explore:

Things to be needed:

- Two paper cups
- Large glass jar
- Soil
- Thermometer
- Poster boards
- Markers
- Tell students that you will conduct a science experiment as a class to demonstrate how global

warming works.

- Fill the two paper cups halfway with soil. Mark one cup as '1' and the other as '2.'
- Place the thermometer in cup number two and take both cups outside. Allow them to sit in the sun for at least ten minutes.
- Check the temperatures of cups 1 and 2. Both should be the same temperature.
- Students should be told that the cups represent the Earth.
- Insert the thermometer into cup 2. Place the glass jar on top of cup 1. Allow 10 minutes.
- While you wait, explain to students that the glass jar represents greenhouse gases found in our own atmosphere.
- Assign students the task of predicting what will happen to the temperature of cup 1 after 10 minutes. As a class, go over the responses.
- Check the temperatures of cups 1 and 2. Cup 1 should be significantly hotter than Cup 2. Explain that this is due to the greenhouse gases' ability to trap heat in the atmosphere.
- Explain how this is actually happening to our planet.

Elaborate:

Discuss the sources of greenhouse gases.

Evaluate:

- What do you think our planet will look like in the future if global warming continues to worsen?
- What steps can we take to slow global warming?
- Ask students to do Q6(vi) on page 24 of student book.

Home Assignment:

- Complete Q14 page 8 of workbook.

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
Energy Flow in Ecosystem	14-16	40 Minutes	-

Objective:

Describe how energy flows from producers to consumers, and how only part of the energy flows from one level of the pyramid to the next.

Keywords

Food chain
Consumers
Producer
Decomposer
Food web

Engage:

- Begin the lesson by having your students explain why they eat food. Allow multiple students to respond and write their responses on the board. If you hear the word "energy," circle it. If not, write it down and circle it on the board.
- Tell your students that the main reason they need food is to provide their bodies with energy to get through the day. Remind your students that energy does not create or destroy itself, but rather changes form or location, such as from one living organism to another.

Explain:

Useful Link

https://youtu.be/LnPRHcp5_vo

- The flow of energy in the ecosystem is one of the most important factors in the survival of such a large number of organisms.
- The ecosystem's producers and consumers can be classified into different feeding groups,

which are referred to as trophic levels or feeding levels.

- The first trophic level is represented by producers (plants).
- The second trophic level is represented by herbivores (primary consumers).
- The third trophic level is represented by primary carnivores (secondary consumers).
- The final level is represented by top carnivores (tertiary consumers).
- The sun is the primary source of energy for almost every ecosystem on Earth. Primary producers use energy from the sun to produce their own food in the form of glucose, which is then eaten by primary consumers, who are then eaten by secondary consumers, and so on, so that energy flows from one trophic level, or level of the food chain, to the next.
- A food chain is the simplest way to demonstrate this energy flow. Each link in the chain represents a new trophic level, and the arrows represent the flow of energy along the chain. The primary producer is always at the bottom of a food chain. Plants are the most important primary producers in terrestrial ecosystems, while phytoplankton are the most important primary producers in marine ecosystems. In their respective ecosystems, both produce the majority of the nutrients and energy required to support the rest of the food chain.
- Use charts and posters to explain the flow of energy through ecosystems. Posters may show:
    - o Food chains
    - o Food webs or
    - o Food pyramids

Explore:

- Ask students to scratch their heads and think deeply. Consider all of the ecosystems. There are deserts, lakes, forests ponds, logs, and many other ecosystems. Then concentrate on a single ecosystem or area. Make a list of the biotic organisms that live in that system.
- Then, ask the students to predict and construct their food chain...once finished, ask them which organism is at the top of the food chain? Who is most likely to be consumed first?
- Predictions made by students should be recorded in their individual sheets.

Elaborate:

- Students will be taken to the computer lab, where they will conduct research on the living things they have used in their food chain.
- Students will document their findings and draw conclusions.

Evaluate:

- Ask students to do Concept Check page 16 of student book.
- Carry out Discuss and Answer page 17 of student book.

Home Assignment

- Provide worksheet 1.
- Do Q3-4 on page 23-24 of student book.

Lesson Plan 5	Student Book pages	Time	Workbook pages
Symbiosis, Mutualism and Parasites	17-18	40 Minutes	6

Objective:

- describe and illustrate through examples key ecological relationships between organisms, including competition, predation and symbiosis.
- Hypothesize what would happen in the ecosystem if the population of one of the participants in different ecological relationships is affected.

Keywords

Predator
Prey
Mutualism
Symbiosis
Parasite
Host
Competition

Resources:

- Whiteboard or projector
- Markers or chalk
- Pictures/diagrams of organisms and ecosystems
- Sticky notes
- Small toy animals (optional)

Useful Link

https://youtu.be/uO_MXis2uRk

Engage: (5min):

- Begin with a provocative question: "What would happen if all of the predators disappeared from an ecosystem?"
- Encourage students to talk about their initial ideas in pairs or small groups.
- Share some of their ideas with the entire class to pique their interest.

Explain: (10 min):

- Introduce the concept of ecological relationships, focusing on competition, predation, and symbiotic relationships.
- Define each of these connections:
- Competition: Organisms fighting for the same resources, like food or territory.
- Predation: The relationship between a predator that hunts and kills prey.
- Symbiosis: Close, long-term interactions between two different species.
- Give examples of each relationship and draw them on the board.

Explore: (15 min):

- Divide the class into groups and assign a different ecological relationship scenario to each group.
- Group 1: Competition for the same type of insect prey between two bird species.
- Group 2: Predation, where wolves hunt rabbits in a forest ecosystem.
- Group 3: Symbiosis, such as the relationship between bees and flowers.
- Ask each group discuss and draw diagrams depicting their assigned relationship.
- Ask them to present their diagrams to the class and explain each relationship.

Elaborate: (10 min):

- Give an example: "What if a disease suddenly affects all the wolves in the ecosystem?"
- Discuss in class how this may affect the ecosystem, taking into account the effects on predation and the rabbit population.

- Encourage students to come up with additional scenarios involving changes in the population sizes of one or more participants in ecological relationships.

Evaluate: (5 min):

- Distribute a worksheet with various scenarios and ask students to predict the potential effects on the ecosystem if one population is harmed. As an example:
- What if the rabbit population unexpectedly doubled?
- What would happen if a new bird species entered the insect-eating competition?
- What would happen if the flowers in a symbiotic relationship were unable to produce nectar?
- As a class, go over and discuss their responses.
- Ask them to do Q7 on page 24 of student book.

Home Assignment:

- A real-world example of an ecological relationship (competition, predation, or symbiosis) in your local environment. Explain the significance of this relationship and speculate on what might happen if one of the participants suffered a significant setback.
- Do Q9 on page 6 of workbook.

Lesson Plan 6	**Student Book pages**	**Time**	**Workbook pages**
Human Behaviour to Save Environment	21	40 Minutes	-

Objective:

Explain ways in which human behaviour (e.g., replanting forests, reducing air and water pollution, protecting endangered species) can have positive effects on the local environment.

Keywords

Reforestation
Reduce
Endangered

Resources::

- Whiteboard or projector
- Markers or chalk
- Pictures/diagrams related to environmental issues (e.g., deforestation, pollution)
- Sticky notes
- Laptops/tablets for research (optional)

Useful Link

https://youtu.be/belXC_IoW4o

Engage: (5 min):

- Begin with an alarming statistic or visual representation of environmental issues (for example, images of pollution, deforestation, or the effects of climate change).
- Request that students share their initial thoughts on why these issues arise and the role that human behaviour plays in them.

Explain: (10 min):

- Provide an overview of key environmental concepts and terms:
  - o Sustainability
  - o Carbon footprint
  - o Renewable vs. non-renewable resources

  - Conservation
  - Biodiversity
- Discuss the environmental impact of human behaviour, including topics such as overconsumption, waste, and greenhouse gas emissions.

Explore: (15min):

- Divide the class into small groups and assign each a different environmental issue (for example, air pollution, water pollution, or deforestation).
- Ask each group to conduct research on the causes, consequences, and potential solutions to their assigned issue.
- Make a brief presentation or poster summarizing each group's findings.

Elaborate: (10 min):

- Facilitate a class discussion on the broader implications of these environmental issues following the group presentations.
- Discuss the significance of both individual and collective action in addressing these issues.
- "Imagine you are an environmental activist tasked with proposing strategies to encourage people to adopt eco-friendly behaviours."

Evaluate: (5 min)

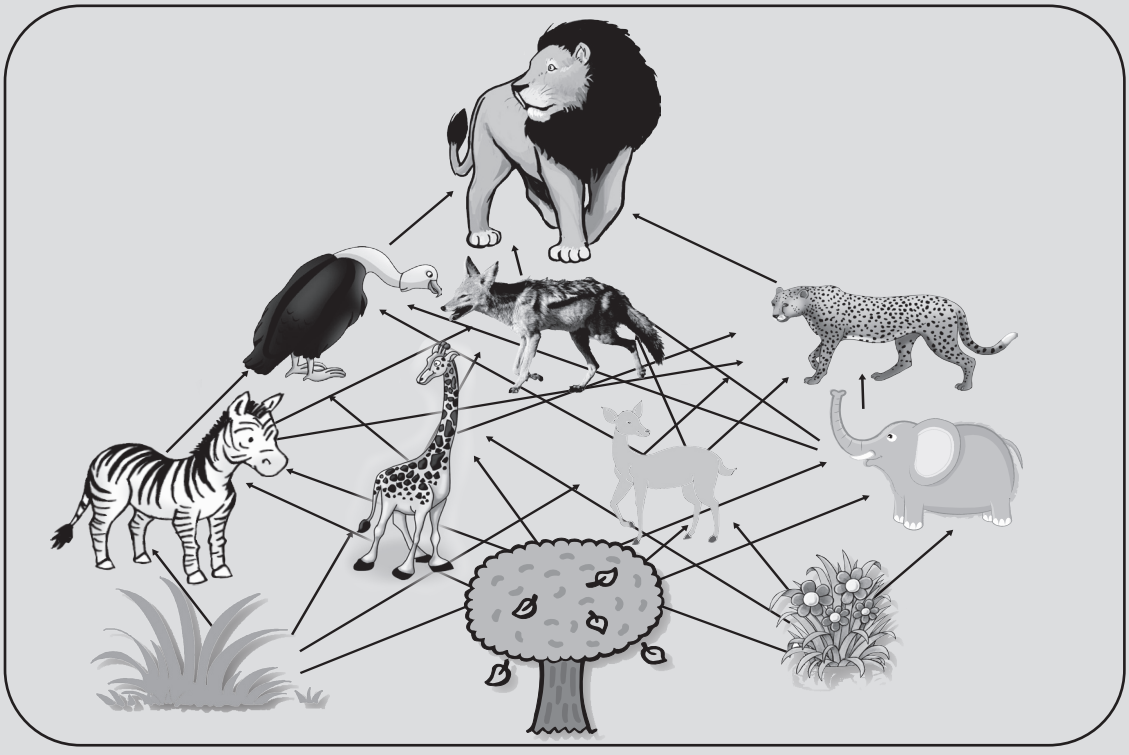
- Assign the task of brainstorming and presenting three actionable ideas to promote environmentally friendly behaviours in their school or community to students.
- Each concept should address a specific issue raised in class (for example, reducing plastic waste or conserving water).
- Encourage them to think about STEM-based solutions, such as technological or engineering innovations.

Home Assignment:

- Describe one eco-friendly action you can take personally to reduce your environmental impact, explaining why it is important for the environment.
- Do project 3 on page 25 of student book.

Worksheet 1:

Identify four possible food chains from the given food web image.



Chain I

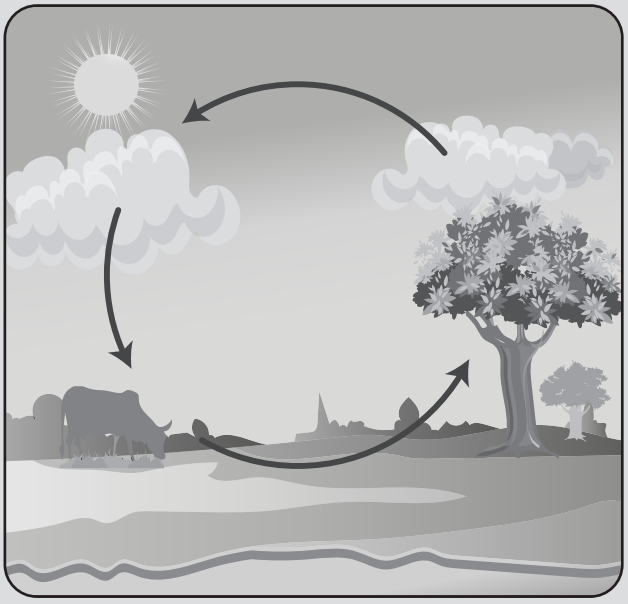
Chain II

Chain III

Chain IV

Worksheet 2:

Label the following image:

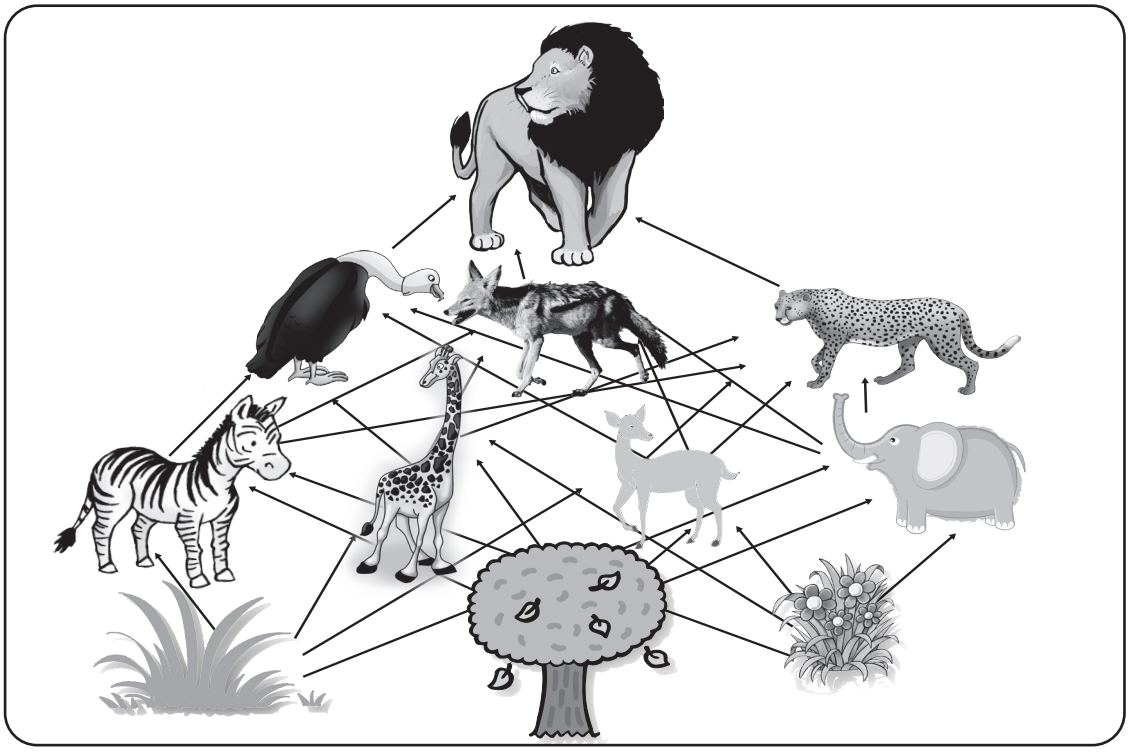


Describe Oxygen Cycle.

Describe Carbon Cycle.

Answers for Worksheet 1:

Identify four possible food chains from the given food web image.



Chain I

Plants-Zebra-Wolf-Lion

Chain II

Plants-Elephant-Tiger-Lion

Chain III

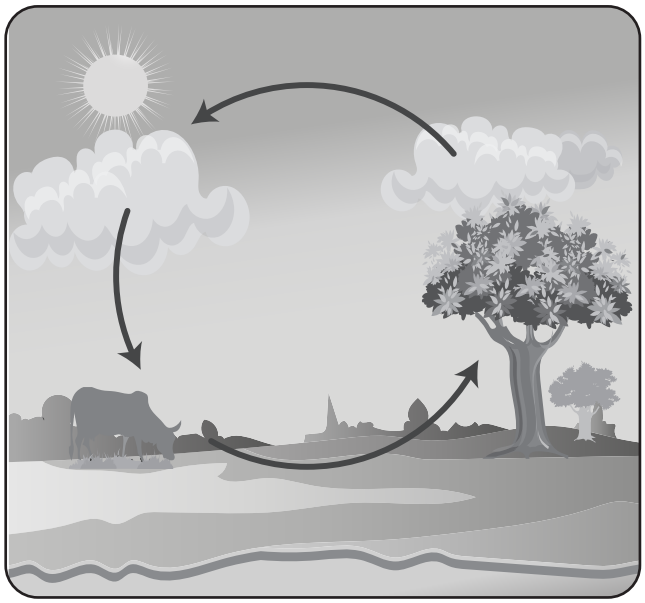
Plants-Deer-Wolf-Lion

Chain IV

Plants-Giraffe-vulture-Lion

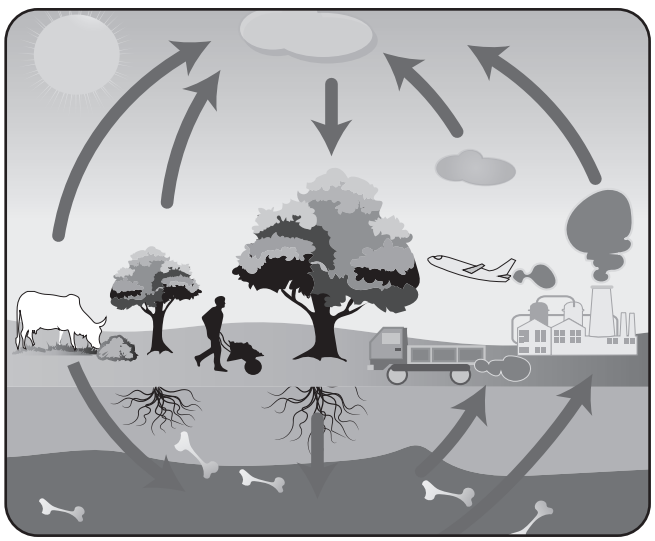
Answers for Worksheet 2:

Label the following image:



Describe Oxygen Cycle.

The oxygen cycle depicts how oxygen flows through various parts of our vast ecosystem.



Describe Carbon Cycle.

The carbon cycle describes the continuous movement of carbon atoms from the atmosphere to the Earth and then back into the atmosphere.

Exercise Answers

1. Choose the correct answer:

i. All the plants and animals living in one place, such as a park, make up the:

b) community

ii. Animals which eat plant food are called:

a) primary consumers

iii. The main decomposers which bring about the decay of dead organisms are:

c) bacteria and fungi

iv. Bacteria and fungi in an ecosystem:

d) release nutrients from dead plants and animals

v. A lichen, which consists of a fungus and an alga living together for the benefit of both, is an example of:

b) mutualism

2. Fill in the blanks:

i. Everything around a living thing that affects its way of life is called its __environment__.

ii. Climate, soil, and __topography__ are the physical environment of a living thing.

iii. __Producers__ can make their own food.

iv. A plant or an animal which lives at the expense of another living thing is a __parasite__.

v. During __transpiration__, extra carbon dioxide and water produced by plants come out from the stomata in its leaves.

3. Write the names of the following organisms in the correct column:

Producers	Primary Consumers	Secondary Consumers	Parasites	Scavengers	Decomposers
buttercup plant, mushroom	cow, caterpillar, earthworm, lettuce	lion, crow, fox, tapeworm, flea	tapeworm, flea, leech	crow, fox	earthworm, bread mold, mushroom

4. **i.** Three separate food chains from the given food web:

- Grass → Rabbit → Fox
- Grass → Rabbit → Owl
- Dead Plant → Earthworm → Crow

ii. The fox competes with the owls for food.

iii. If all the hawks died out, the population of foxes might increase because hawks are predators of foxes. Without hawks hunting them, foxes could have more resources and less predation pressure.

iv. If all the plants are removed from the given food web, it would disrupt the entire ecosystem. Herbivores like rabbits and deer would lose their food source, leading to a decline in their populations. This, in turn, would affect the populations of predators like foxes and owls. It would cause a ripple effect throughout the ecosystem.

3. Short Answer Questions:

i. The biotic environment includes all living organisms and their interactions.

ii. The physical environment of a living organism includes factors such as climate, soil, topography, and abiotic factors that influence its surroundings.

iii. Symbiosis refers to the interaction between two different species living in close proximity, often with one or both species benefiting from the relationship.

iv. Herbivores are animals that primarily consume plant material. Examples include cows and rabbits.

v. Deforestation is the process of clearing or removing forests or trees, typically due to human activities, leading to the loss of forested areas.

vi. Migration is the seasonal movement of animals from one region or habitat to another, often for breeding or seeking more favorable conditions.

6. Long Answer Questions:

i. Animals depend upon plants, including trees, even if they do not eat those plants because plants provide oxygen, offer habitats and shelter, and form the base of the food chain. Animals rely on plants for oxygen production and as a source of food for herbivores. Trees also provide habitats for various species and contribute to the overall health of ecosystems.

ii. Human beings have a significant effect on both the physical and biotic environment of organisms. Human activities such as deforestation, pollution, and urbanization impact the physical environment, while activities like hunting, habitat destruction, and introduction of invasive species affect the biotic environment.

iii. Herbivorous animals are generally poor fighters because their adaptations are primarily for defense, such as speed, camouflage, or protective structures (e.g., horns, spines). They have evolved to efficiently escape predators rather than engage in confrontations.

iv. Carnivores often live on their own because they need to hunt and capture prey to meet their dietary requirements. Living alone allows them to reduce competition for food resources. Herbivores, on the other hand, often live in groups to increase their chances of finding food and for protection against predators.

v. A habitat is the specific place or type of environment where an organism or community of organisms lives. An ecosystem, on the other hand, includes all living organisms in an area and their physical and chemical interactions within their environment.

vi. Global warming refers to the long-term increase in Earth's average surface temperature due to the accumulation of greenhouse gases in the atmosphere, primarily from human activities such as burning fossil fuels. Its effects include rising sea levels, altered weather patterns, and disruptions to ecosystems.

vii. Negative effects of overhunting include the decline or extinction of species, disruption of ecosystems, loss of biodiversity, and potential ecological imbalances.

6. Think About It Questions:

i. Parasites may have special problems not usually met with by other plants and animals because they rely on a host organism for survival and reproduction. They must find and attach to a suitable host, avoid host defenses, and extract nutrients without killing the host prematurely.

ii. If all the bacteria on this planet suddenly died, it would have catastrophic consequences for ecosystems and nutrient cycling. Bacteria play crucial roles in decomposition, nutrient

recycling, and soil fertility. Without them, organic matter would accumulate, leading to the depletion of resources and disruptions in ecosystems.

Activities:

1. Investigating Decomposers in Food and Product Production:
   - Cheese and yogurt production: Bacteria are essential in the fermentation process of milk to produce these dairy products.
   - Tanning of hides: Enzymes from bacteria help break down proteins and prepare hides for leather production.
   - Making vinegar: Acetic acid bacteria transform ethanol into acetic acid, creating vinegar.
   - Bread and certain cakes: Yeast, a type of fungus, acts as a leavening agent by fermenting sugars and producing carbon dioxide gas.
   - Production of chemicals and antibiotics: Microorganisms, including bacteria and fungi, are used in biotechnological processes to synthesize various compounds, including antibiotics and industrial chemicals.
2. Investigating Tree Communities:
   - Large trees like oak trees support diverse communities of organisms, including mosses, lichens, fungi, insects, spiders, beetles, and other invertebrates.
   - These organisms depend on the tree for food, shelter, and protection, creating a complex web of interactions.
   - Students can study these communities by observing the tree's bark and leaves throughout the year, noting both permanent residents and temporary visitors.
3. Building Ecosystem Models:
   - Provide learners with resources and materials to build models of different ecosystems (e.g., forest, pond, desert, urban housing society).
   - These models can help students visualize the components and relationships within different ecosystems.
4. Human Impact on Ecosystems:
   - Assign pairs of students to research and observe specific ecosystems (e.g., forest, mountain range) and assess the human impact, considering whether it is positive or negative.
   - Encourage students to find real-life examples of recent environmental impacts, such as deforestation, pollution, or habitat destruction, and discuss their consequences.
5. Understanding Oxygen and Carbon Cycles:
   - Conduct an activity where learners design and decorate chart papers to illustrate the chain of events in the oxygen and carbon cycles.
   - This visual representation can help students understand the flow of these essential gases in ecosystems.
6. Researching Environmental and Ecological Disasters:
   - Divide students into groups and assign each group a specific environmental or ecological disaster (e.g., tsunami, forest fires, oil spills).
   - Ask them to research the causes, consequences, and potential mitigation strategies for the assigned disaster.
   - Encourage students to explore real-life case studies and provide recommendations to address and prevent such disasters.

CHAPTER 02

The Nervous System

Student Book Pages 26-36

Learning outcomes

- Describe the structure of the cerebrum, its division into two hemispheres (left and right) and the role of each hemisphere in the control of the body.
- Explain and represent how messages flow through the body from and to the brain, and how the brain collaborates with the sensory organs to regulate this process.
- map the various steps in the transmission of messages through the body and to the brain via a reflex arch.
- describe the role and function of neurons in transmitting messages through the body.
- Create a plan of activities and exercises they can do to maintain a healthy brain.
- Predict what would happen if a nerve connection broke.
- match various body functions with the relevant part of the brain that controls or regulates them (For instance, associating breathing with the brain stem).

Keywords

central nervous system, peripheral nervous system, brain, spinal cord, neurons, motor neurons, sensory neurons, signal, cerebrum, cerebellum, brainstem, sensory organs, neurodiversity, neurological conditions, sensory pathways

Overview of the Unit

- The central nervous system (CNS) is the component of the nervous system that includes the brain and spinal cord. Because the brain integrates received information and coordinates and influences the activity of all parts of the bodies of animals, it is named the CNS. It is a structure made up of nervous tissue that runs from the rostral (nose end) to the caudal (tail end) axis of the body, with an enlarged section at the rostral end that is a brain.
- The brain is a mass of nerve tissue located in the anterior end of an organism. The brain integrates sensory information and directs motor responses; it is also the centre of learning in higher vertebrates. The human brain weighs about 1.4 kg (3 pounds) and is made up of billions of neurons.
- Neurons are the cells in our bodies that transmit electrical signals through the nervous system. The ability to move or feel the world around us all begins with a neuronal impulse. This procedure enables us to see, taste, touch, and move. Highly specialised neurons are used to transmit signals and coordinate the body in order to instantly facilitate these bodily processes.
- A voluntary action is one that you initiate through your own conscious decision. The cerebral cortex (brain) sends impulses to effectors (muscles or glands) via the spinal cord, relay neurons, and motor neurons. Because this action is controlled by the will, it is referred to as a voluntary action.
- Reflex actions (involuntary actions):
- Involuntary actions, as the name implies, are the polar opposites of voluntary actions; a reflex action is not controlled by the will. In this case, your spinal cord takes complete control, overriding your conscious mind. Spinal reflexes are actions controlled by the spinal cord, such as scratching.

Lesson Plan 1	Student Book pages	Time	Workbook pages
The Nervous System	26-28	45 Minutes	12

Objective:

Describe the structure of the cerebrum, its division into two hemispheres (left and right) and the role of each hemisphere in the control of the body.

Keywords

Central nervous system
Peripheral nervous system

Engage (5 min):

- Engage students in the topic by asking them to turn and talk to a partner, sharing their knowledge of the human brain.

- Label a piece of chart paper 'The Human Brain' and write the subtitle 'What we know about the human brain' as they speak.
- Request that partners share what they discussed and list it on the chart paper.
- As you write the subheading 'What we want to learn about the human brain,' have students discuss what they want to learn with their partners.
- Record students' responses in the form of questions.

Explain: (10 min):

- The teacher will start the lesson by blowing up a balloon. The teacher will ask the class if they can think of any organs that are similar to the balloon and how it was inflated.
- The students should be able to come up with an answer: the lungs.

Useful Link

https://youtu.be/0yXMGQaVVXg

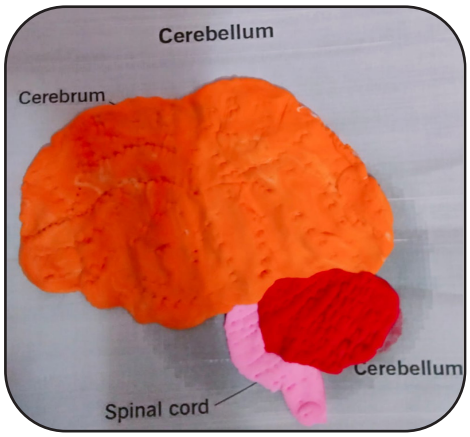
Explain: (10 min):

- An adult brain weighs between 1.0 kg and 1.5 kg on average. It is primarily made up of neurons, which are the basic building blocks of the brain and nervous system. According to recent estimates, the brain contains anywhere from 86 billion to 100 billion neurons.
- The central nervous system is made up of the brain and the spinal cord. It is in charge of thoughts, interpretation, and the source of control for body movements.
- The skull protects the brain by providing frontal, lateral, and dorsal protection. The skull is made up of 22 bones, 14 of which are facial bones and the remaining 8 are cranial bones. The brain is anatomically contained within the cranium and is surrounded by cerebrospinal fluid.
- Human Brain Components
- The major components of the human brain are as follows:
- The forebrain is the largest part of the brain.
- It is located in the front of the brain. The following are forebrain components:
  - Cerebrum
  - Hypothalamus
  - Thalamus
- Midbrain: The brain's smallest and most central region.
- The midbrain is made up of:
  - Tectum
  - Tegmentum
- The hindbrain is the lower portion of the brain.
- The hindbrain is made up of the following parts:
  - Cerebellum
  - Medulla
  - Pons
- Use the 3-D model of the human brain to explain the different parts of the brain and their functions.

Explore: (10 min):

Things to be needed:

- Picture or diagram of the brain for reference
- Clay or Playdough
- Paper Plate
- Marker
- Paper
- Toothpicks



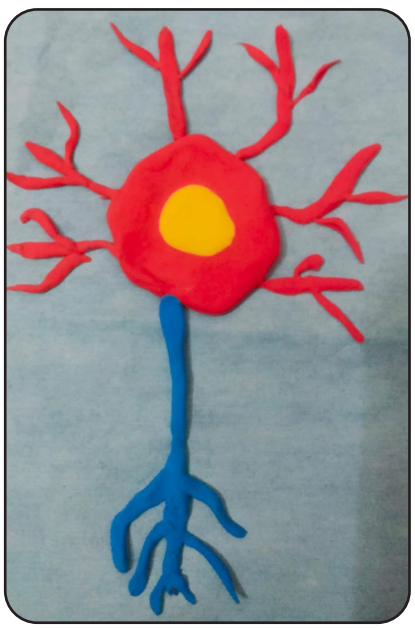
What to do:

- Students will create a brain model out of playdough.
- Tell them that different colours can be used to represent different parts of the brain.
- Tell them not to be concerned if the brain shape isn't exactly right. They should be more concerned with the location of these brain areas.
- To label the main parts of the brain, use the paper tags and tooth picks.

Elaborate: (10 min)

With the play dough make the brain cell model.

- Make a round blob of the first colour.
- Then make a snake.
- Pinch off a few long strands and tie them to the round blob.
- Roll the snake thinner now, pinching off pieces and attaching them to the first bits.
- Using the second colour, add a small flat bit to the centre of the flat disc.
- Make a long snake of the third colour. Cut half of that off and attach it to the centre blog.
- Now roll the snake thinner, breaking off pieces and attaching them in a spider-web pattern.
- Now use this brain cell model to discuss how information travels from its source to your brain.



Evaluate: (5 min)

- Worksheet 1 will be given to the students.
- Ask students to answer Q4 (a and b) and Q5(iv and vi).

Home Assignment:

Complete Q3 on page 12 of workbook.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Body Functions with The Relevant Part Of The Brain	27	45 Minutes	15

Objective:

Match various body functions with the relevant part of the brain that controls or regulates them (For instance, associating breathing with the brain stem).

Useful Link

https://youtu.be/Z48xmSxo8Co

Resources:

- Whiteboard or projector
- Markers or chalk
- Diagrams of the brain with labeled regions
- Sticky notes
- Optional: Brain models or images for hands-on exploration

Engage (5 min):

- Begin by conducting a "Brain Functions Brainstorm." Ask students to name as many body functions as they can in one minute (for example, breathing, memory, vision, and speech).
- Allow students to share their thoughts and ideas during a class discussion about breathing.
- Make a list of their responses on the board.

Explain (10 mins):

- Introduce the brain's structure and explain how different regions are responsible for different functions.
- Discuss the frontal lobe (cognition, personality), parietal lobe (sensory perception), occipital lobe (vision), temporal lobe (hearing, memory), and brainstem (vital functions such as breathing and heartbeat).
- Give brief explanations for the functions of each region.

Explore (15 mins):

- Divide students into small groups and distribute sticky notes to each group.
- Give each group a list of body functions (for example, breathing, vision, language, and heartbeat) and ask them to match them with the relevant brain region on the sticky notes.
- Encourage groups to work together and discuss their options.
- After that, have each group stick their sticky notes to a large diagram of the brain.

Elaborate (10 min):

- Present to the class a series of brain teasers or riddles that require students to think critically and solve puzzles.

- Encourage students to work independently or in small groups to solve as many brain teasers as they can in the allotted time.
- To engage students at different levels, make sure the brain teasers vary in complexity.
- After 10 minutes, have students share their answers and discuss their problem-solving strategies.
- Connect this activity to the lesson objective by emphasizing how these brain teasers test cognitive functions associated with various brain regions, emphasizing the importance of mental stimulation for brain health.

Evaluate: (5 min)

Complete Q8 on page 15 of workbook.

Example Questions:

1. Which brain region is primarily responsible for processing visual information and enabling our sense of sight?
   - **a.** Frontal lobe
   - **b.** Parietal lobe
   - **c.** Occipital lobe
   - **d.** Temporal lobe
2. Damage to the cerebellum can most significantly impact which of the following functions?
   - **a.** Memory and learning
   - **b.** Balance and coordination
   - **c.** Language comprehension
   - **d.** Emotion regulation

Home Assignment:

- Choose a specific body function or activity that interests you (for example, memory, language, or coordination).
- Conduct research and write a brief presentation or report explaining the brain regions responsible for regulating or controlling that function and how they are linked. To illustrate your findings, use diagrams or visuals.

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
Nerve Cells and Nerves	28-29	45 Minutes	-

Objective:

describe the role and function of neurons in transmitting messages through the body.

Keywords

Nerve cell
Synapse
Effector

Engage: (5 mins)

- Talk about neurons: using analogy:
- When you were born, your brain was filled with neurons, which are tiny cells. Your brain sends messages from one neuron to another as you learn. If you repeat a task enough times, your brain will eventually form a connection (or path) between neurons. This simplifies activities and allows you to perform them better and better.

Useful Link

https://youtu.be/n0Zc01e1Frw

- Creating new neural pathways between brain cells is analogous to constructing a bridge to cross a ravine. You can use an analogy: Creating new neural pathways between brain cells is similar to constructing a bridge to cross a ravine.

Explain: (10 mins)

- Neurons are the cells that make up the brain and nervous system. They are the basic unit that send and receive signals that allow us to move our muscles, feel the external world, think, form memories, etc.
- However, looking through a microscope reveals that not all neurons are the same. This is very difficult to tell how many types of neurons are present in the brain. However, in the spinal cord, there are three types of neurons: sensory, motor, and interneurons.
- Sensory neurons are nerve cells that are activated by sensory input from the environment. For example, if you touch a hot surface with your fingertips, the sensory neurons will fire and send signals to the rest of the nervous system about the information they have received.
- The spinal cord's motor neurons are part of the central nervous system (CNS) and connect to muscles, glands, and organs throughout the body. These neurons direct all of our muscle movements by transmitting impulses from the spinal cord to skeletal and smooth muscles (such as those in your stomach). As a matter of fact, there are two different kinds of motor neurons: lower motor neurons, which travel from the spinal cord to muscles, and upper motor neurons, which travel from the brain to the spinal cord.
- Interneurons, as the name implies, are the ones in the middle, connecting spinal motor and sensory neurons. Interneurons can communicate with one another as well as transfer signals between sensory and motor neurons, forming circuits of varying complexity. They, like motor neurons, are multipolar.
    - Draw the labeled diagrams of types of neurons on the board and explain them to the students.
    - Explain the topic with the help of the related video.

Explore: (15 mins)

Make groups of four to five students and ask them to make a poster on the types of neurons. Use different coloured markers to differentiate the labeling.

Elaborate: (10 mins)

Each group will give a presentation of their poster in front of the class.

Evaluate: (5 mins)

- Students will be given worksheet 2 to complete on their own.
- Ask students to answer Concept Check page 29.

Home Assignment:

- Make a 3-D Model of a neuron.
- Do 4c on page 35 of student book.

Lesson Plan 4 Receptors	Student Book pages 30	Time 45 Minutes	Workbook pages -

Objective:

Explain and represent how messages flow through the body from and to the brain, and how the brain collaborates with the sensory organs to regulate this process.

Keywords

Receptor cells
Stimuli
Sense organS

Resources:

- Whiteboard or projector
- Markers or chalk
- Pictures/diagrams of the brain, neurons, and sensory organs
- Sticky notes
- Small objects for sensory activities (e.g., feathers, cotton balls)
- Optional: computer or tablet for interactive simulations

Useful Link

https://youtu.be/vjFes5l07c0

Engage: (5 mins)

- Begin with a straightforward question: "How do you think your brain knows when to move your hand away from something hot?"
- Encourage students to have a brief discussion in which they can share their initial thoughts and ideas about how messages travel in their bodies.

Explain: (10 mins)

- Introduce the nervous system, focusing on the brain and its role as the body's control center.
- Explain how specialized cells called neurons transmit messages throughout the body.
- Discuss how different intensities of exercise can affect pulse rate.
- Describe how neurons use electrical impulses to transmit messages.
- To demonstrate the brain, neurons, and sensory organs, use diagrams and simple visuals.

Explore: (15 mins)

- Carry out a sensory activity: Give one student a blindfold and a small object (e.g., a feather or a cotton ball). Allow them to describe the texture, weight, and shape of the object without seeing it.
- Discuss how sensory organs such as the skin contribute to information transmission to the brain.
- Ask students to think about other sensory organs (such as the eyes, ears, tongue, and nose) and how they help them perceive their surroundings.
- Use an interactive online simulation if you want to show how electrical messages travel along neurons in response to sensory input.

Elaborate: (10 mins)

- Assign each pair of students a different sensory organ (e.g., eyes, ears, skin).
- Request that each pair conduct research and prepare a short presentation explaining how their assigned sensory organ transmits information to the brain.
- Encourage students to use diagrams or models to help them understand the process.

Evaluate: (5 mins)

- Each pair should present their findings to the class.
- After the presentations, hold a class discussion about how the brain and sensory organs work together to process and respond to information.
- Inquire of students why this coordination is necessary for our survival and daily activities.

Home Assignment:

1. Keep a written record for a day, noting down sensory experiences (e.g., what you see, hear, smell, taste, and touch).
2. Consider how your brain processes sensory information and how it influences your decisions and emotions.
3. In a paragraph, summarize your observations and reflections.

Ask students to attempt Q5(i-iii) on page 36 of student book.

Lesson Plan 5	**Student Book pages**	**Time**	**Workbook pages**
Reflexes	31-32	45 Minutes	-

Objective:

map the various steps in the transmission of messages through the body and to the brain via a reflex arch.

Keywords

Response
Reflexes

Resources:

- Whiteboard or projector
- Markers or chalk
- Diagrams of a reflex arc
- Sticky notes
- Soft rubber mallet (for optional activity)

Useful Link

https://youtu.be/Nn2RHLWST-k

Engage: (5 mins)

- Begin with a demonstration: Tap your own knee lightly with a rubber mallet to demonstrate a simple reflex action.
- Request that your students observe and explain what happened when you tapped your knee. Encourage them to consider how quickly the body responds.

Explain: (10 mins)

- Introduce the concept of a reflex arc, which is the neural pathway that regulates reflex actions.
- Explain the following reflex arc components: sensory receptor, sensory neuron, interneuron (optional), motor neuron, and effector.
- Use diagrams to demonstrate the structure of a reflex arc and its role in quickly transmitting messages.

Explore: (15 mins)

- Divide the class into small groups and give each group a diagram of a reflex arc with blank labels.
- Ask them to collaborate to correctly label each component and discuss their role in the reflex arc.

- Allow groups to present their labelled diagrams to the class and explain the reflex action process.

Elaborate: (10 min)

- Create a hypothetical situation: "Pretend you are a medical illustrator. Create a detailed, artistic representation of a reflex arc, emphasizing each component as well as the path messages take."
- Allow students to create digital illustrations using tablets or computers, or provide art supplies.

Evaluate: (5 min)

- Give your students various scenarios that require reflex actions (for example, touching a hot stove or hitting your knee with a mallet).
- Ask students to describe each reflex action and identify the sensory receptor, sensory neuron, interneuron (if applicable), motor neuron, and effector involved.
- Discuss their responses as a class.
- Provide worksheet 3
- Ask students to attempt Q3 on page 35 of student book.

Home Assignment:

- Make a visual representation of a reflex arc (drawing or diagram), labeling and explaining the function of each component. In addition, investigate and describe a real-life example of a reflex action in the human body, as well as its significance.
- Ask students to attempt Q6(iii-iv) on page 36 of student book.

Lesson Plan 6	**Student Book pages**	**Time**	**Workbook pages**
What Would Happen If a Nerve Connection Broke	32	45 Minutes	17

Objective:

Predict what would happen if a nerve connection broke.

Keywords

Nerve connection
Signals
Nerve impulses

Resources:

- Whiteboard or projector
- Markers or chalk
- Diagrams of nerve cells and the nervous system
- Sticky notes
- Small objects for sensory activities (optional)

Useful Link

https://youtu.be/28QavtVZa-o

Engage: (5 mins)

- Begin with a thought-provoking question: "What do you think might happen if a nerve connection between your brain and a specific body part were to break?"
- Allow students to discuss their initial ideas and hypotheses in pairs or small groups.

Explain: (10 mins)

- Introduce the nervous system and its role in message transmission throughout the body.
- Explain the structure of nerve cells (neurons) and their function in signal transmission.
- Discuss how nerve connections affect sensory perception, motor control, and overall body function.

Explore: (15 mins)

- Divide the class into small groups and give each group a scenario involving a possible broken nerve connection (e.g., a severed spinal cord, damaged peripheral nerves).
- Ask each group to discuss and think about the possible consequences and effects on sensory perception and motor control.
- Allow each group to present their findings to the class, with an emphasis on the predicted outcomes.

Elaborate: (10 mins)

- Students should be divided into small groups.
- Provide STEM materials such as pipe cleaners (for dendrites), modelling clay (for the cell body), and straws (for the axon) to each group.
- Explain to them that their task is to create a model of a neuron chain, connecting brain to specific part of body.
- Discuss how nerve connections work as a class, including the role of neurons, and how damage to these connections can affect sensory perception and motor control.

Evaluate: (5 mins)

- Assign students the task of conducting research on a real-world case of nerve damage or a medical condition that causes nerve connection problems.
- Instruct them to write a brief report summarizing the condition, its causes, and the effects on sensory perception and motor control.

Home Assignment:

- Research and write a brief report on a real-life case of nerve damage or injury, including the causes and effects on sensory perception or motor control.
- Do Q12 on page 17 of workbook.

Lesson Plan 7	**Student Book pages**	**Time**	**Workbook pages**
Plan of Activities and Exercises They Can Do to Maintain A Healthy Brain	32	45 Minutes	-

Objective:

Create a plan of activities and exercises they can do to maintain a healthy brain.

Resources:

- Whiteboard or projector
- Markers or chalk
- Pictures/diagrams of the brain
- Sticky notes
- Access to the internet for research (optional)

Keywords

Healthy brain
Activities
Mentally active

Engage: (5 mins)

- Start with a fun brain teaser or puzzle to spark students' interest in brain health.
- Ask students what they know about brain health and why it is important.

Explain: (10 mins)

- Introduce the concept of brain health and its relationship to overall health.
- Discuss the significance of factors such as nutrition, physical activity, mental stimulation, and sleep in promoting brain health.
- Explain the structure and functions of the brain using diagrams or visuals.

Explore: (15 mins)

- Divide the class into small groups and assign one aspect of brain health to each group (nutrition, physical activity, mental stimulation, or sleep).
- Request that each group generate a list of activities and exercises related to their assigned aspect that can contribute to brain health.
- Allow each group to present their ideas to the class.

Elaborate: (10 min)

- "Imagine you're a health consultant, and a client wants to improve their brain health." Create a weekly schedule of activities and exercises for them."
- Assign each student the role of a health consultant and ask them to develop a weekly plan based on group discussions, incorporating a variety of nutrition, physical activity, mental stimulation, and sleep-related activities.

Evaluate: (5 min)

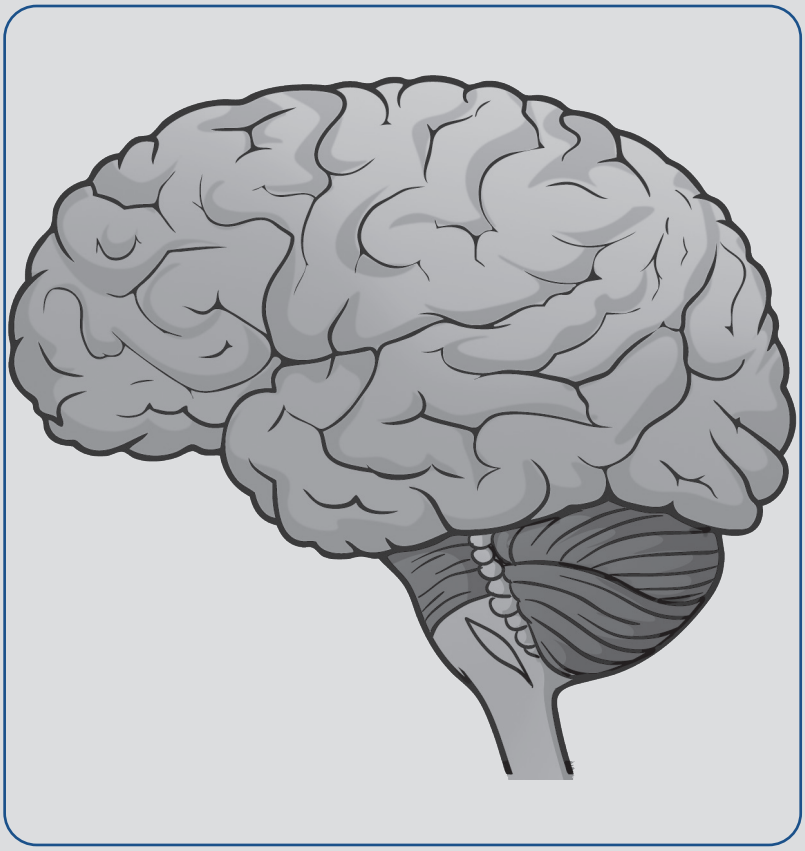
- Allow students to present their brain-healthy strategies to the class.
- Facilitate a brief discussion on the effectiveness of the proposed plan in maintaining brain health after each presentation.
- Instruct the class to identify commonalities and differences in the plans, as well as the importance of balancing the various aspects of brain health.

Home Assignment:

Create a one-page digital or physical infographic summarizing the key activities and exercises for brain health, emphasizing the importance of nutrition, physical activity, mental stimulation, and sleep.

Worksheet 1:

Label and Write down the functions of the main parts of the brain:



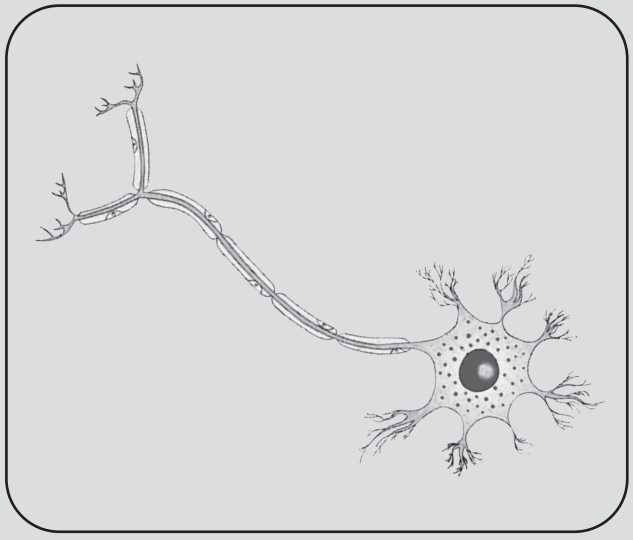
Functions:

Worksheet 2:

What are the function of Dendrites?

What is the function of Axon?

Draw the arrows to show the direction of impulses.



What are the three types of neurons?

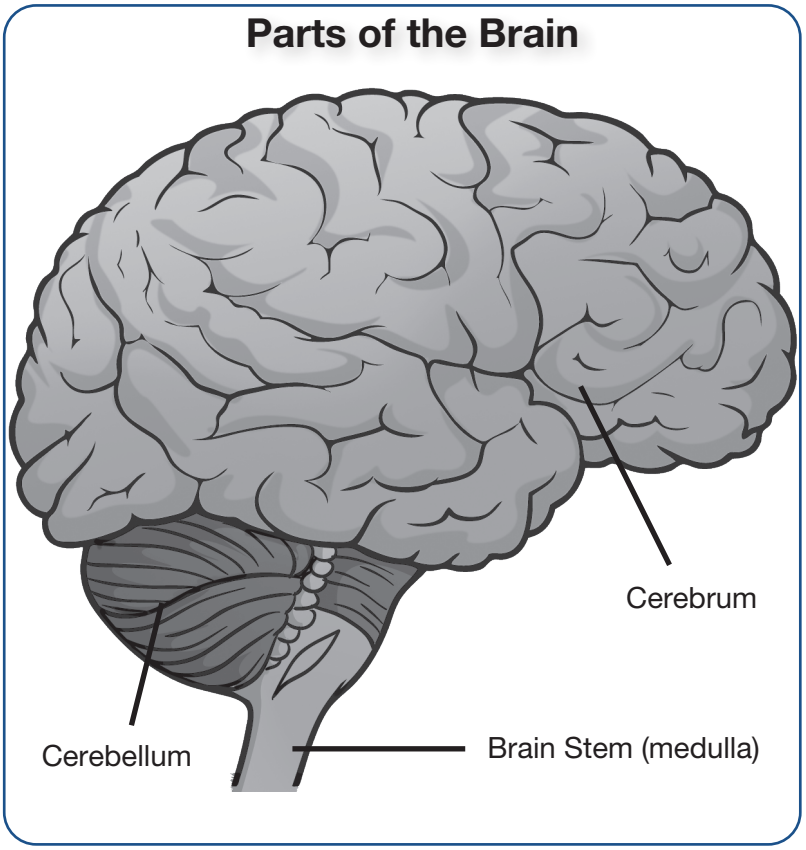
Worksheet 3:

Complete the table below:

Feature	Voluntary Action	Involuntary Action
Nature		
Controlled by:		
Examples		
Nature		
Role		
Speed of Action		

Answers for Worksheet 1:

Label and Write down the functions of the main parts of the brain:



Functions:

1. Sense of vision, hearing and smell -Skeletal muscle movement-intelligence, judgement

2. Posture-Blanace and coordination

3. Digestion-breathing, blood pressure- swallowing, vomiting-changes in hear rate

Answers for Worksheet 2:

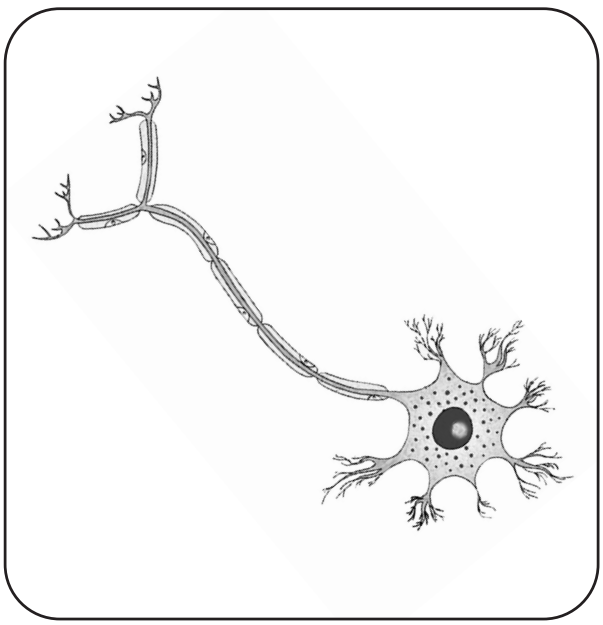
What are the function of Dendrites?

Dendrites collect information from other cells.

What is the function of Axon?

Axon is a long fiber which carries information away from the cell body, sometimes over long distances.

Draw the arrows to show the direction of impulses.



What are the three types of neurons?

1. Sensory Neurons
2. Motor Neurons
3. Interneurons

Answers for Worksheet 3:

Complete the table below:

Feature	Voluntary Action	Involuntary Action
Nature	Conscious thought	Does not involve thought
Controlled by:	Brain	Spinal Cord
Examples	We will nod our heads to say 'yes' nonverbally.	Skeletal muscle e.g. Knee jerk
Role	Respond with the benefit of experience and logic.	Respond quickly to save from danger.
Speed of Action	Slow response as the cerebrum needs time to think before an action is taken.	Rapid response as the cerebrum is not involved.

Exercise Answers

1. Choose the correct answer:

i. The central nervous system is made up of:

c) the brain and the spinal cord

ii. The human brain weighs about:

c) 1.5 kg

iii. The brain contains billions of:

d) nerve cells

iv. The largest part of the brain is the:

b) cerebrum

v. The body's automatic activities such as breathing and digestion are controlled by the:

c) brain stem

2. Fill in the blanks:

i. A nerve consists of a bundle of __ nerve fibers__.

ii. The gaps between nerve cells or neurons are called __synapses__.

iii. The body's automatic activities such as breathing and digestion are controlled by the __ medulla oblongata__.

iv. Special types of action, like sneezing and blinking, which you cannot control are called __ reflexes__.

v. A boy blinks when he gets dust in his eye is an example of __a reflex action__.

3. The nervous system is a complicated network of branching nerves. Look at this simplified diagram of the nervous system

a) i. brain

ii. Spinal cord

iii. nerves

b) The central nervous system (CNS) is made up of two parts: the brain and the spinal cord.

c) The stimulus in this action was the pain or discomfort caused by standing on a drawing pin.

d) Sensory nerves have specialized receptors at one end to sense or detect stimuli. These receptors can include nerve endings that respond to pressure, temperature, or pain.

e) The type of action where Anila lifted her foot without thinking is called a "reflex action."

f) i. A similar reflex action occurs when dust blows into your eyes, causing you to blink to protect your eyes.

ii. When food accidentally gets into your windpipe, you may cough involuntarily to try and expel the food and prevent it from entering your lungs.

4. Look at the following diagram:

b. Write the function of each part of the brain:

Cerebrum:

- The cerebrum is in charge of conscious thought processes, reasoning, and higher cognitive functions.
- Regulates voluntary muscle movements.
- Language, memory, and problem-solving centres are housed here.

Cerebellum:

- Controls and coordinates motor movements, balance, and posture.
- It aids in muscle memory and motor learning.

Medulla oblongata:

The medulla oblongata regulates involuntary functions such as breathing, heart rate, and blood pressure.

Spinal Cord:

The spinal cord transmits nerve signals between the brain and the body, controls reflexes, and contributes to coordination and sensory processing.

Short Answer Questions:

i. A stimulus is a detectable change in the internal or external environment that triggers a response.

ii. An action taken as a result of a stimulus is called a response.

iii. The five main sense organs and the senses to which they respond are:

- Eyes (sight)
- Ears (sound)
- Nose (smell)
- Skin (touch, pain, pressure)
- Tongue (taste)

iv. The two parts of the central nervous system are:

- Brain
- Spinal cord

v. Reflexes are important because they allow the body to respond rapidly to potential threats or harmful stimuli without the need for conscious thought or decision-making.

vi. The main functions of the cerebrum, cerebellum, and medulla oblongata are as follows:

- Cerebrum: Responsible for higher cognitive functions, such as thinking, memory, and voluntary muscle control.
- Cerebellum: Coordinates voluntary muscle movements, balance, and posture.
- Medulla Oblongata: Regulates essential functions like breathing, heartbeat, and digestion.

Long Answer Questions:

i. The difference between a nerve and a nerve cell (neuron) is that a nerve is a bundle of nerve fibers (axons and dendrites) wrapped in connective tissue, while a neuron is an individual nerve cell that transmits electrical signals. Nerves are made up of many neurons.

ii. Neurons are adapted to carry out their particular job or function in the following ways:

- Dendrites receive incoming signals from other neurons or sensory receptors.
- Axons transmit signals away from the neuron's cell body.
- Myelin sheaths insulate and speed up signal conduction.
- Synapses allow communication with other neurons or cells.
- Neurons can generate and transmit electrical impulses (action potentials).\

iv. A voluntary action is a deliberate movement or behavior that is consciously initiated and controlled by the individual. An involuntary action is an automatic response to a stimulus that occurs without conscious thought or control.

v. The autonomic nervous system (ANS) is a division of the peripheral nervous system that regulates involuntary bodily functions, such as heart rate, digestion, and respiratory rate. It includes the sympathetic and parasympathetic branches.

vi. Coughing when something 'goes down the wrong way' is considered a reflex action. It is an automatic response to protect the airway from potential harm by clearing the obstruction.

Think About It:

i. Arranged activities into two lists:

Voluntary: singing, talking

Involuntary: eating, digesting food, blinking, heart beating, coughing, sneezing

ii. None of the activities fit into both lists.

Complete the Table:

Sense Organ	Sense	Stimulus
Skin	Pressure, pain	Pressure, pain
Tongue	Taste	Chemicals in food/drink
Balance	Movement/position of the head	N/A (Not applicable)
Nose	Smell	Odors
Eyes	Sight	Light
Ears	Sound	Sound waves

Activities:

Activity 1: Model of Nervous System

- Learners create models of neurons using various materials.
- They use different colors to represent different neuron structures.
- They can make neural circuits using these models.

Activity 2: Neuron Chain Tag

- Learners play a game where they act as neurons in a chain, simulating signal transmission.
- The game illustrates how signals travel through a neural circuit.

Activity 3: Brain Break Book

- Learners design and maintain personal brain break books to practice mental health exercises.

Activity 4:Thinking Cap

- Learners create thinking caps labeled with parts of the brain to understand their locations.

Activity 5: Understanding the Complexity of the Brain

- Learners use colored pencils to connect dots on paper, representing the complexity of neural connections

CHAPTER 03

Variations, Heredity and Cell Division

Student Book Pages 37-48

Learning Outcomes:

- describe variation and adaptation in living organisms
- Explain and illustrate the differences between variation and adaptation
- Identify sources of variation from environmental and genetic factors
- Explain how different adaptations affect the chances of survival of different species of organisms
- Recognize Genetics as the study of Heredity and understand and define heredity as the transfer of genetic information that specifies structure, characteristics and function, from parents to offspring
- differentiate between the concept of genes and chromosomes and relate them to how genetic characteristics are inherited
- describe the composition and structure of DNA
- design a model of DNA to demonstrate its structure, functions and various components
- describe cell division and its types – mitosis and meiosis and relate them to the passage of genetic information through reproduction
- explain the process of mitosis and meiosis and identify their key phases

Keywords

heredity, genetics, genes, chromosomes, deoxyribonucleic acids DNA, inherited traits, instincts, learned behaviours, variation, adaptation, cell division, mitosis, meiosis, stimuli

Overview of the Unit:

- The human body is made up of billions of cells. Chromosomes are small thread-like structures found within cells. We have 23 pairs of chromosomes, each with two copies. One set is passed down from our mother and one from our father. All of our genetic information is made up of chromosomes, which can be thought of as an encyclopaedia or set of instructions for how our bodies work. Chromosomes are like individual encyclopaedia volumes. In the form of genes, each contains a portion of our genetic information.
- Genes are the instructions that instruct our bodies on how to function properly. If one of our genes changes, it may affect what that gene is supposed to do and cause various health or medical problems. Genes are made up of deoxyribonucleic acid, or DNA, which is the genetic alphabet's letters. In sperm cells from fathers and egg cells from mothers, DNA is passed down from generation to generation. Consider a gene to be a sentence in a book. If any of the letters change or any of the words are missing, it will affect what the sentence was supposed to say. Similarly, misspellings of any of the genes can influence how they function.
- We are programmed to develop normally if the DNA we inherit contains no mutations. If one of the genes in our DNA (either our mother's or father's) is mutated, we are programmed to develop abnormally.
- Genetic inheritance is the process by which parents pass traits or characteristics to their offspring, such as eye colour and blood type. Some health conditions and diseases can also be passed down through families.
- Adaptation is required for living organisms to survive. Animals that are unable to adapt to changing environmental conditions perish. Genetic changes have resulted in these adaptations. The surviving animals pass on the mutated genes to their offspring. This is referred to as natural selection.
- It is the process by which a cell divides into two daughter cells that share the same genetic material..
- There are two main types of cell division. The first type of cell division is vegetative division, in which each daughter cell duplicates the parent cell, which is known as mitosis. The second is meiosis, which results in the formation of four haploid daughter cells.

Lesson Plan 1	**Student Book pages**	**Time**	**Workbook pages**
Genetics	37	40 Minutes	-

Objective:

Differentiate between the concept of genes and chromosomes and relate them to how genetic characteristics are inherited

Keywords

Gene
Genetics
Chromosomes
Inheritance

Engage: (5 min)

Show students a slide show of different dog colours to activate prior knowledge. Question students about why they think dogs look so different. Then show pictures of dogs with their puppies that look similar. Now, ask them if they've noticed that babies of a certain animal have the same characteristics as their parents. Discuss that today's lesson will explore how various traits are inherited by living things through genetics.

Useful Link

https://youtu.be/a5yzRRvROpE

Explain: (10 min)

Genes and chromosomes are the basic building blocks of all living organisms. Genes are also referred to as DNA, which is the genetic material found in every cell of an organism. Genes are made up of chromosomes. They contain information about hereditary traits as well as other biological processes. To summarise, genes are the source of hereditary traits, and chromosomes are the carriers of information.

Gene	Chromosome
Typically, a gene is found within a single cell.	An organism's chromosome may be found in more than one cell.
A gene typically has a large size.	An organism's chromosome may be smaller or even lacking.
A gene is typically found in a specific region of the cell.	A chromosome does not always reside in the same place.

The characteristics are passed down through genes. Genes code for proteins, which determine all traits such as eye colour, height, and so on. Genes are basic units of heredity that are found on chromosomes. The chromosomes carrying genes segregate during gamete formation, resulting in the inheritance of traits.

Explore: (15 min)

What We Need:

- A minimum of one pair of parents and their genetic son(s) or daughter (s). The more nuclear family members who are available, the better the results.
- Magnification glass

Getting prepared:

- Show drawings or photographs of the three basic fingerprint pattern types to students: loop, arch, and whorl. The ridges in a loop pattern enter from either side, curve up, and usually exit from the same side they entered. The ridges in a whorl pattern are usually circular. The ridges in an arch pattern enter from one side, make a small rise in the centre, and exit on the opposite side.

- Students should become familiar with the different types' appearances so that you can easily identify them. Make them notice the variations on these basic types, such as the "tented arch," which appears to be a more sharply curved version of the typical arch.

What to do:

- Gather family members so you can examine their fingerprints as a group.
- Examine each person's right index finger, which contains their fingerprint, one at a time. Characterize the pattern on the finger as a whorl, arch, or loop by looking at it. You could examine their finger more closely with a magnifying glass.
- Examine the fingerprint patterns of other family members one by one and assign each to one of the three basic patterns.
- Observe, does it look like fingerprint patterns are inherited? To put it another way, do siblings usually have the same fingerprint?
- Draw your conclusions.

Elaborate: (5 min)

Class Discussion:

Discuss the findings of students in class. After discussing the results explain the students that the genetics of how fingerprint patterns are inherited are complicated (multiple genes are involved), and fingerprints are also affected by a person's environment while developing in the womb. As a result, students may have seen some examples of inherited fingerprint patterns (for example, a father having the same pattern type as his son or daughter), but this may not always be the case for individuals you know to be closely related. To see how fingerprint patterns are inherited more clearly, we would need to use a much larger sample size. Because each person's fingerprint is unique, and not even identical twins - who share the same DNA - have the same fingerprint.

Evaluate: (5 min)

- Students will be given worksheet 2 to solve.
- Attempt Q4(i-iv) on page 47 of student book.

Home Assignment:

Instructions:

- Create a family tree that shows the various members of your family.
- Include all of the family members from whom you will be gathering information.
- Males are represented by a triangle, while females are represented by a circle.
- You can observe the following traits: “earlobes," "eye colour," "hair (straight or curly)," and "thumb (straight or curved)."

Lesson Plan 2	Student Book pages	Time	Workbook pages
DNA	38	45 Minutes	19

Objective:

- describe the composition and structure of DNA
- design a model of DNA to demonstrate its structure, functions and various components.

Keywords

Deoxyribonucleic acid
Polynucleotide
Helix

Resources:

- Whiteboard and markers
- Visual aids (images of DNA structure)
- Craft materials (pipe cleaners, beads, colored paper)
- Scissors
- Glue
- Tape
- Computer with internet access)

Useful Link

https://youtu.be/6368Y-OfU9U

Engage:(5 min)

- Begin the lesson by asking, "What do you know about DNA?" Encourage students to share their thoughts and knowledge.
- Show a whiteboard or a screen image of the DNA double helix structure and ask students what they see. This will spark their interest.

Explain: (10 min)

- Give a brief overview of DNA, its full name (deoxyribonucleic acid), and its role in genetics and heredity.
- Explain the basics of DNA structure, such as nucleotides, base pairs (adenine-thymine and cytosine-guanine), and the double helix shape.
- Discuss how DNA transports genetic information and how it is passed down from generation to generation..

Explore: (15 min)

- Make small groups for the class.
- Provide craft supplies to each group (pipe cleaners, beads, coloured paper, scissors, glue, and tape).
- Instruct students to collaborate to design and build a 3D model of DNA. They should pay close attention to the double helix structure and base pair arrangement.
- Encourage your students' creativity and attention to detail.

Elaborate: (10 min)

- Ask each group to present their DNA models to the class, explaining the various components and how they represent the DNA structure.
- Facilitate a discussion about the accuracy of the models and the understanding gained from the activity after each presentation.
- Clarify any misunderstandings and stress the importance of accurate representation.

Evaluate: (5 min)

Ask students to attempt Q5(iii) on page 47 of student book.

Home Assignment:

- Assign students the task of researching and writing a brief essay about the discovery of the structure of DNA, highlighting key scientists such as Watson and Crick.
- Complete Q3 on page 19 of workbook.

Lesson Plan 3	Student Book pages	Time	Workbook pages
Physical Traits, Variation, and Adaptation	38-41	45 Minutes	-

Learning Objective:

- Describe variation and adaptation in living organisms.
- Explain and illustrate the differences between variation and adaptation.
- Identify sources of variation from environmental and genetic factors
- Explain how different adaptations affect the chances of survival of different species of organisms.

Keywords

Characteristics
Traits
Variation

Useful Link

https://youtu.be/SIdwzOJ23J8

Engage: (5 min)

- Inquire students whether they believe all members of the same species look the same. Then inquire as to why they believe there is variation within species.
- Inform students that in today's lesson, they will use scientific observation skills to observe a range of natural variations within a single species, and then consider what environmental factors may influence the survival of specific variations over others.

Explain: (10 min)

- Adaptation is a genetic trait that improves an organism's chances of survival and reproduction in its environment.
- One tortoise is born with a short stubby neck, while the other tortoise is born with a long neck. The short stubby-necked tortoise has difficulty reaching the tall cacti, but the long-necked tortoise can easily reach the food. The short-necked tortoise eventually dies from starvation, while the long-necked tortoise lives and reproduces.
- A variation is a minor difference in an inherited trait of individual species members. Variations in the colour of a tiger's coat or the colours of a snail's shell are examples of variation. These are the outcomes of mutation.
- When something adapts to its surroundings, it is adaptation, whereas variation means that something can adapt to different types of environments.

Explore: (15 mins)

1. Choose as many examples of the same species as there are students, and arrange them all in one area.
2. Explain that these are all members of the same species.
3. Allow all students to inspect all specimens. Request that they look for variations.
4. Allow each student to choose a specimen.
5. Distribute papers and instruct students to sketch their specimens. Encourage students to take measurements and make any descriptive notes that will assist them in identifying their specimen.
6. When they've finished their research papers, divide them into small groups (5 to 8 students) and have them mix up their specimens and try to find them again using their sketches.
7. Encourage students to consider which aspects of the sketch assisted them in identifying their specimen. Then allow them to add a few more details to their sketch.

Elaborate: (5 min)

Class Discussion:

- Encourage students to consider what they believe a good scientific research entry should include.
- Inquire, for example, what observations were particularly helpful in locating your or a classmate's specimen?
- What other details, words, or measurements could have aided in the identification of the correct specimen?
- How does sketching versus photographing help you notice the details of a specimen?

Evaluate: (5 min)

- Ask students to attempt Concept Check page 38 and 40 of student book.
- Ask students to attempt Discuss and Answer page 39-40 of student book.

Homework:

- Provide worksheet 1
- Do Q1,2, 4, and 5 on page 19-21 of student book

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
Cell Division	56-60	45 Minutes	-

Objective:

- describe cell division and its types – mitosis and meiosis and relate them to the passage of genetic information through reproduction
- explain the process of mitosis and meiosis and identify their key phases

Keywords

Mitosis
Meiosis
Daughter cells

Resources:

- Whiteboard or projector
- Markers or chalk
- Diagrams of mitosis and meiosis
- Sticky notes
- Access to online interactive simulations (optional)

Useful Link

https://youtu.be/f-ldPgEfAHI https://youtu.be/VzDMG7ke69g

Engage: (5 min)

- Begin with a thought-provoking question: "What happens to your cells when u get injured?"
- Allow students to talk in pairs or small groups about their initial thoughts and ideas.

Explain: (10 min)

- Introduce the concept of cell division and its significance in organism growth and reproduction.
- Discuss the two major types of cell division, mitosis and meiosis, with a focus on their roles in asexual and sexual reproduction, respectively.
- Use diagrams to explain the differences between mitosis and meiosis, as well as key terms such as chromosomes, diploid, and haploid.

Explore: (15 min)

- Divide the class into small groups and give each group a set of diagrams depicting the various stages of mitosis and meiosis.
- Ask each group match the diagrams to the appropriate phase (e.g., prophase, metaphase) and provide a brief explanation of what is happening in each phase.
- Allow groups to present their findings to the entire class.

Elaborate: (10 min)

1. Break the class up into small groups.
2. Give each group a set of different coloured beads or buttons that represent genes (for example, red for one gene variant and blue for another).
3. Assign a specific animal species to each group, such as a dog population.
4. Instruct the groups to use the beads/buttons to represent individual animals and their genetic traits in order to simulate the process of genetic variation within the population.
5. Have each group go through a series of "reproduction" rounds in which they randomly select genes from two parent "animals" to create offspring "animals."
6. Instruct groups to keep track of the genetic diversity within their animal population over several generations.
8. Assign each group the task of creating a chart or graph to represent the changing genetic makeup of their simulated animal population.
9. Ask groups to analyze and present their findings, explaining how genetic variation occurs in animal populations via reproduction.
10. Lead a discussion in class about the importance of genetic diversity in animal populations, adaptation, and natural selection.

This animal-themed simulation enables students to see how genetic diversity is achieved in animal populations through reproduction and how it relates to the lesson's goal of understanding genetic variation in animals.

Evaluate: (5 min)

- Encourage students to share their ideas and participate in a brief class discussion to reinforce their comprehension of the lesson's objectives.
- Provide worksheet 3

Home Assignment:

- Select an everyday object or organism (for example, a flower or a cell phone).
- Write a brief paragraph explaining how mitosis and meiosis may be relevant or applicable to that object or organism's growth, development, or reproduction.

Worksheet 1:

Identify the organism's name by its adaptation given in the table below.

Organism	Adaptation
	The organism has thick fur to keep it warm.
	Long roots that can penetrate deep into the ground to reach water below.
	Hump where fat and water can be stored when none are available in the environment.
	To protect themselves from predators, they are covered in tiny projections called needles.
	Claws and teeth are very strong.
	Toes that are specially shaped for walking in sand.
	Long lashes to shield the eyes from sandstorms.

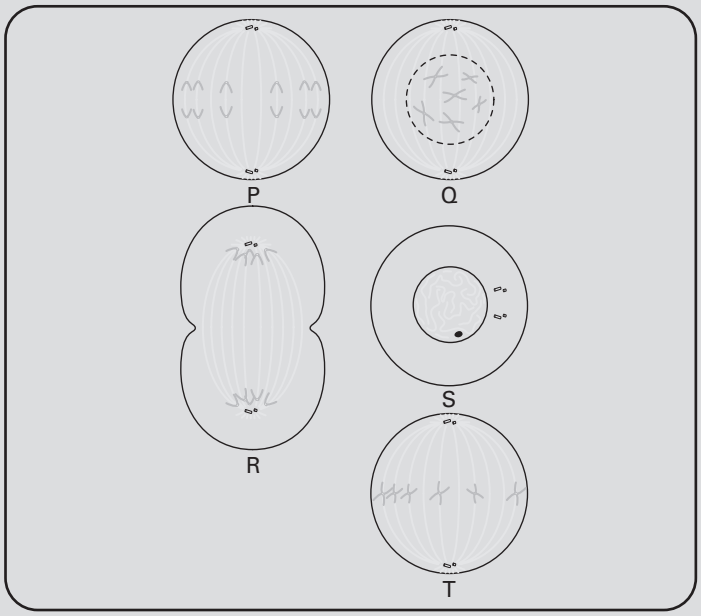
Worksheet 2:

Consider each trait and decide whether it is inherited or acquired.

Trait	Inherited/Acquired
The colour of your hair.	
Your height.	
Knowing how to ride a bicycle.	
The scar on your chin.	
Being able to play football	
The shape of your nose.	
Zebra'a stripes.	
Length of your hair.	

Worksheet 3:

1. The process taking place in the picture below is _____



2. Mitoses is divided into five phases: Name them:

3. The longest phase of cell cycle is _____.

(a) Interphase

(b) Metaphase

(c) Mitosis

(d) Cytokinesis

4. What is centrosome?

5. At what stage of meiosis do chromosomes start to condense?

(a) Prophase I

(b) Telophase I

(c) Metaphase I

(d) Cytokinesis I

Answers for Worksheet 1:

Identify the organism's name by its adaptation given in the table below.

Organism	Adaptation
Polar bear	The organism has thick fur to keep it warm.
Cactus	Long roots that can penetrate deep into the ground to reach water below.
Camel	Hump where fat and water can be stored when none are available in the environment.
Cactus	To protect themselves from predators, they are covered in tiny projections called needles.
Polar bear	Claws and teeth are very strong.
Camel	Toes that are specially shaped for walking in sand.
Camel	Long lashes to shield the eyes from sandstorms.

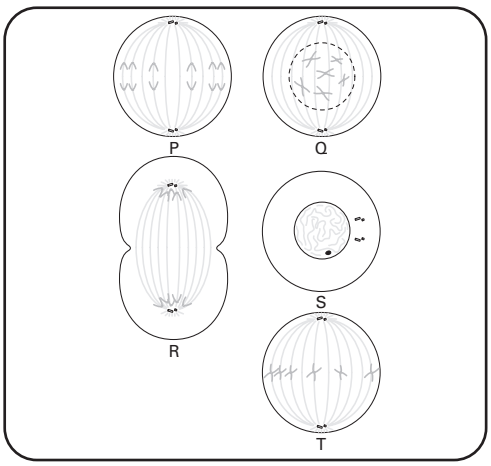
Answers for Worksheet 2:

Consider each trait and decide whether it is inherited or acquired.

Trait	Inherited/Acquired
The colour of your hair.	Inherited
Your height.	Inherited
Knowing how to ride a bicycle.	Acquired
The scar on your chin.	Acquired
Being able to play football	Acquired
The shape of your nose.	Inherited
Zebra'a stripes.	Inherited
Length of your hair.	Acquired

Answers for Worksheet 3:

6. The process taking place in the picture below is Telophase (Cytokinesis).



7. Mitoses is divided into five phases: Name them:

1. Interphase
2. Prophase
3. Metaphase
4. Anaphase
5. Telophase

8. The longest phase of cell cycle is interphase.

(e) Interphase
(f) Metaphase
(g) Mitosis
(h) Cytokinesis

9. What is centrosome?

A cell organelle near the nucleus that contains centrioles (in animal cells) and from which spindle fibres develop during cell division.

5. At what stage of meiosis do chromosomes start to condense?

(e) Prophase I
(f) Telophase I
(g) Metaphase I
(h) Cytokinesis I

Exercise Answers

1. Choose the correct answer:

- **i. b)** mitosis
- **ii. a)** in the reproductive organs
- **iii. a)** meiosis
- **iv. a)** 46
- **v. c)** DNA

2. Fill in the blanks:

- **i.** Cells
- **ii.** Variation
- **iii.** Nucleus
- **iv.** 46
- **v.** DNA.

4. Short answer questions:

- **i.** A gene is a segment of DNA that contains instructions for making a specific protein or determining a specific trait.
- **ii.** Genes tell our bodies to make proteins.
- **iii.** The thread-like structures found in the nucleus of a cell are called "chromosomes."
- **iv.** Chromosomes and genes are made of DNA and associated proteins.
- **v.** Humans have 46 chromosomes in each body cell.
- **v.** A species is a group of organisms that can interbreed and produce fertile offspring.
- **vi.** The name given to the differences in characteristics between organisms of the same species is "variation" or "genetic variation."
- **vii.** "Inherited" means that a trait or characteristic is passed from parents to offspring through genetic information.

5. Long answer questions:

- **i.** Certain characteristics in humans are determined primarily by genetics and are not significantly influenced by the environment. Here are four examples of such characteristics:
  1. Blood Type: Blood type (A, B, AB, or O) is primarily determined by genetics and is not influenced by environmental factors. It is determined by specific alleles inherited from parents.
  2. Eye Color: The color of a person's eyes is primarily determined by genetics. While factors like lighting can affect how eye color appears in different conditions, the underlying genetic makeup remains unchanged.
  3. Fingerprints: Each person's fingerprints are unique and are formed during fetal development. They are determined by genetic factors and remain constant throughout life, unaffected by the environment.
  4. Inherited Disorders: Certain genetic disorders, such as cystic fibrosis or sickle cell anemia, are inherited from parents and are not influenced by environmental factors. These conditions are determined by specific gene mutations.
- **ii.** Mitosis:

1. Prophase: Chromosomes condense, becoming visible. The nuclear envelope breaks down, and the mitotic spindle forms.
2. Metaphase: Chromosomes line up at the cell's center, ensuring equal distribution to daughter cells.
3. Anaphase: Sister chromatids separate and move to opposite ends of the cell.
4. Telophase: Chromatids reach cell poles, and new nuclear envelopes form around them.
5. Cytokinesis: The cell divides into two daughter cells, each with the same DNA as the parent cell. iii. DNA is important because it contains the genetic information necessary for the growth, development, and functioning of living organisms.

iii. Importance of DNA:

1. Genetic Blueprint: DNA carries the instructions (genes) that determine an organism's traits and characteristics, serving as the genetic blueprint for life.
2. Inheritance: DNA is passed from parents to offspring, allowing traits and genetic information to be inherited from one generation to the next.
3. Protein Production: DNA guides the production of proteins, which are essential for the structure and function of cells and the entire organism.
4. Genetic Diversity: DNA mutations and variations in DNA sequences contribute to genetic diversity within a species, which is vital for adaptation and evolution.
5. Medical and Scientific Advances: Understanding DNA has led to breakthroughs in medical research, genetic engineering, forensics, and species identification, benefiting both human health and scientific knowledge.

iv. Meiosis:

Interphase (Before Meiosis):

The cell undergoes normal growth and DNA replication in preparation for meiosis.

Each chromosome is duplicated, creating sister chromatids held together by a centromere.

Meiosis I (Reduction Division):

Prophase I: Chromosomes condense and become visible. Homologous chromosomes (chromosomes with the same genes but potentially different alleles) pair up through a process called synapsis. This pairing is called a tetrad.

Crossing Over: During synapsis, chromatids of homologous chromosomes can exchange genetic material in a process called crossing over. This introduces genetic variation.

Metaphase I: The tetrads align along the cell's equator.

Anaphase I: Homologous chromosomes are pulled apart and move to opposite poles of the cell. Each resulting cell now has half the chromosome number.

Telophase I: Two haploid daughter cells are formed, each with a unique combination of chromosomes due to crossing over.

Meiosis II (Equatorial Division):

Prophase II: The two haploid cells from Meiosis I enter a second meiotic division.

Metaphase II: Chromosomes align along the equator of each haploid cell.

Anaphase II: Sister chromatids are separated and pulled to opposite poles of the cells.

Telophase II: Four haploid daughter cells are produced, each with a unique combination of genetic material

v. Importance of Meiosis:

1. Creates Unique Offspring: Meiosis makes sure that children are not exactly like their parents. It mixes up the genetic information, making each child unique.
2. Forms Special Reproduction Cells: Meiosis creates special cells called sperm and egg cells. These are needed to make babies.
3. Keeps the Right Number of Genes: Meiosis makes sure that babies have the right number of genes. Too many genes would be a problem.
4. Makes Life Diverse: It's like a recipe for creating different types of living things. Without meiosis, everything would be the same.
5. Prevents Chromosome Overload: Meiosis stops us from having too many chromosomes. Too many chromosomes would be like having too many ingredients in a recipe, making it taste bad.

vi. Chromosomes:

- Store genetic information in the form of DNA.
- Organize and package DNA within the cell nucleus.
- Ensure the accurate transmission of genetic information during cell division.
- Each cell has a set of chromosomes, and they come in pairs.

Genes:

- Contain specific instructions for making proteins.
- Determine an organism's traits and characteristics.
- Are segments of DNA with unique sequences of nucleotide bases.
- Passed from parents to offspring, influencing inherited traits.
- Govern the synthesis of proteins, which are essential for the body's structure and function.

6. Think about it:

i. The study suggests that genetic factors play a significant role in height and weight, as the average differences in characteristics are smaller for identical twins brought up together compared to those brought up apart.

Question 1. What are the similarities and differences between mitosis and meiosis in the following Venn diagram:

Similarities:

1. Cell Division: Both mitosis and meiosis are processes of cell division.
2. DNA Replication:Before both processes begin, the DNA in the cell is duplicated.
3. Chromosome Involvement: Both processes involve the cell's chromosomes.
4. Cytokinesis: In both mitosis and meiosis, cytokinesis occurs after the division of the nucleus to create two new daughter cells.

Differences:

1. Purpose:
   - Mitosis: The main purpose of mitosis is to create two identical daughter cells for growth, repair, and tissue maintenance.
   - Meiosis: The main purpose of meiosis is to produce four non-identical daughter cells (gametes) with half the chromosome number for sexual reproduction.
2. Number of Divisions:
   - Mitosis: It involves one division of the cell, resulting in two daughter cells.
   - Meiosis: It involves two consecutive divisions (meiosis I and meiosis II), resulting in four daughter cells.

3. Genetic Variation:
   - Mitosis: Genetic variation between the parent and daughter cells is minimal because the daughter cells are genetically identical to each other and to the parent cell.
   - Meiosis: Genetic variation is high due to processes like crossing over and random chromosome assortment, leading to genetically diverse daughter cells.
4. Chromosome Number:
   - Mitosis: The daughter cells have the same chromosome number (diploid) as the parent cell.
   - Meiosis: The daughter cells have half the chromosome number (haploid) of the parent cell.
5. Occurrence:
   - Mitosis: Occurs in somatic (body) cells for growth and tissue repair.
   - Meiosis: Occurs in germ cells (sperm and egg) for sexual reproduction.
6. End Result:
   - Mitosis: Results in the production of genetically identical daughter cells.
   - Meiosis: Results in the production of genetically diverse daughter cells, each with a unique combination of genetic traits.

Question 2.

Environmental factors affecting plant growth can include light, temperature, water, soil quality, nutrients, and the presence of pests or diseases.

Question 3. Complete the following table:

TYPE OF CELL DIVISION	MITOSIS	MEIOSIS
Number of cell produced	2 identical daughter cells	4 non-identical daughter cells
Characteristics	Growth, repair, asexual reproduction	Formation of gametes (sperm and egg cells), genetic diversity
Number of chromosomes in new cell	Growth, repair, asexual reproduction	Haploid (half the number of the parent cell)

CHAPTER 04

Biotechnology

Student Book Pages 49-59

Learning outcomes

- define biotechnology as the use of living cells and organisms in products and processes that can improve the quality of life
- illustrate how biotechnology is a discipline/ field that has the potential to transform how we live
- Discuss the applications of biotechnology in the Pakistani context and their effects on the people and the environment of Pakistan over time. Illustrative examples: bread-making, making of yoghurt and cheese, vaccines for immunization, insulin production, dyes, etc.
- relate the use of biotechnology in food sciences in producing foods with higher nutritional value and improved taste and quality [How fermentation has been improved by genetically modified organisms or the introduction of certain genes to raise iron content in rice, can be taken as examples]

Overview of the Unit

Biotechnology is the application of biology to solve problems and create useful products.
Around 6,000 years ago, humans began to use microorganisms' biological processes to make bread, alcoholic beverages, and cheese, as well as to preserve dairy products. However, such processes are not what is meant by biotechnology today, a concept that was first widely applied to the molecular and cellular technologies that emerged in the 1960s and 1970s.
Biotechnology has a wide range of applications, most notably in medicine and agriculture. Examples include using biotechnology to merge biological information with computer technology (bioinformatics), investigating the use of microscopic devices that can enter the human body (nanotechnology).

Keywords

biotechnology, genetic modification, nucleic acid, Deoxyribonucleic Acid (DNA), traits, characteristics, genes, genetic information

Lesson Plan 1	Student Book pages	Time	Workbook pages
Biotechnology	49-51	45 Minutes	-

Objective:

- define biotechnology as the use of living cells and organisms in products and processes that can improve the quality of life
- illustrate how biotechnology is a discipline/ field that has the potential to transform how we live

Keywords

Biotechnology
Fermentation
Agriculture

Engage (5 min):

- Tell students that according to the United Nations, the world population will have risen to 9.7 billion people by 2050—more than 2 billion more than today!
- Then ask them how the world's population will be fed by 2050 if we continue to have the same resources and food growth rate.

Useful Link

https://youtu.be/xFqecEtdGZ0

- Explain to them that we will need a lot more food to feed everyone, which makes agricultural

technology critical. Agriculture technology is the application of science, engineering, and technology to improve agriculture (farming). This can include preventing plant diseases, gathering data to optimize crop yield (the amount of food you can grow on a piece of land), more effectively using resources like water, or even creating more nutritious versions of vegetables.

Explain: (10 min)

- Biotechnology has been used in food production and processing for a long time. Fermentation, a type of biotechnology, has been used to make bread for ten thousand years. For centuries, animals such as horses and dogs have been selectively bred. Selective breeding of essential foods like rice, corn, and wheat has resulted in thousands of local varieties with higher yields than their wild ancestors.
- Scientists today use techniques such as recombinant DNA through newer biotechnology and genetic engineering (rDNA). Using rDNA, scientists can transfer one gene, the inherited instruction for specific traits, from one organism to another while removing the undesirable traits. This allows food producers to improve animals and crops in a much more accurate, controlled, and predictable way.

Explore: (15 min)

- All living things contain DNA. DNA, which stands for deoxyribonucleic acid, is the blueprint for almost everything that happens inside the body and instructs the organism on how to develop and function. DNA is so important that it can be found in nearly every cell of a living organism. Tell students that they will be making their own DNA extraction kit out of household chemicals and using it to extract DNA from strawberries in today's activity.
- What do we need:
- Vinegar
- Strawberries (3)
- Salt
- Water
- Dishwashing liquid
- Measuring cup
- Measuring spoons
- Small bowl
- Funnel
- Tall drinking glass
- Cheesecloth
- Re-sealable plastic bag
- Small glass jar
- Bamboo skewer

Procedure:

1. In a glass or small bowl, combine 1/3 cup (C) water, 12 teaspoon salt, and 1 tablespoon (tbsp) dishwashing liquid. Set the mixture aside for the time being. This is the extraction liquid that will be used to extract (or remove) the DNA from the strawberries.
2. Line the funnel completely with cheesecloth. Fill a tall drinking glass halfway with the funnel's tube (not the glass with the extraction liquid in it). Set this arrangement aside for the time being.
3. Remove and discard the green tops from the strawberries. Place the strawberries in a resealable plastic sandwich bag and squeeze out any excess air. Close the bag tightly.

4. Squeeze and smash the strawberries for two minutes with your fingers.
5. 3 tbsp of the extraction liquid you prepared should be added to the strawberries in the bag. Remove any excess air and reseal the bag.
6. For one minute, squeeze the strawberry mixture with your fingers.
7. Fill the funnel halfway with the strawberry mixture from the bag. Allow it to drip through the cheesecloth and into the tall glass until very little liquid remains in the funnel (only wet pulp remains).
8. Fill the small glass jar 1/4 with the filtered strawberry liquid from the tall glass.
9. Pour the cold vinegar down the side of the jar while tilting it. Pour until the vinegar has formed a one-inch thick layer on top of the strawberry liquid.
10. Examine the mixture in the jar. Strawberry DNA will appear as clear/white stringy stuff.
11. Pull up the skewer after dipping it into the jar where the strawberry liquid and vinegar layers meet.

Elaborate: (5 min)

- Discuss the activity with students. Let them ask questions about the experiment and then explain to them that the detergent helped to pop open the strawberry cells when you mixed salt and detergent (i.e., dishwashing liquid) with the smashed strawberries. This caused the cells to release their DNA into the bag's liquid. At the same time, the salt helped to create an environment in which the different strands of DNA could clump together, making them easier to see. (When you added the salt and detergent mixture, you most likely saw more bubbles form in the bag as a result of the detergent.) When you added the filtered strawberry liquid to the cold vinegar, the vinegar should have caused the DNA to bind together and separate from the rest of the liquid.
- The white/clear DNA strands should have been visible in the vinegar layer as well as between the two layers. A single strand of DNA is extremely small, too small to see with the naked eye, but because the DNA clumped together in this activity, you were able to see how much DNA three strawberries have when all of their octoploid cells were combined. ("Octoploid" refers to the fact that they have eight genomes or sets of genes.)

Evaluate: (5 min)

Worksheet 1 will be distributed among the students.

Homework:

Investigate the applications of biotechnology in food and agriculture and make a list of its agricultural benefits.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Using Genetic material of bacteria and Genetic Engineering	51-52	45 Minutes	-

Objective:

Relate the use of biotechnology in food sciences in producing foods with higher nutritional value and improved taste and quality [How fermentation has been improved by genetically modified organisms or the introduction of certain genes to raise iron content in rice, can be taken as examples]

Keywords

Genes
Genetic material
Genetic engineering

Resources:

- Whiteboard and markers
- Projector and screen
- Printed articles and diagrams related to biotechnology in food production
- Samples of genetically modified foods (if available)
- Laboratory equipment for STEM activities

Useful Link

https://youtu.be/o-0kk9csAbk

Engage: (5 min)

Begin by having a discussion with the students about their favourite foods and the factors that influence their choices. Then, ask whether they are familiar with genetically modified foods or biotechnology in food production. To grab their interest, share a few news stories about biotechnology's role in food production.

Explain: (10 min)

- Give an overview of biotechnology in food sciences, focusing on how it has transformed the industry.
- Discuss gene introduction as tools for improving nutritional value and taste.
- Showcase genetically modified yeast for improved fermentation and genetically modified rice for increased iron content.
- Use diagrams and visuals to help you understand the science behind these examples.

Explore: (15 min)

Create small groups of students for hands-on STEM activities:

Fermentation Improvement Activity:

Materials: Sugar, yeast, water, and balloons

- Instruct students to create two setups using the materials provided.
- One with regular yeast and one with (if available) genetically modified yeast.
- Over a specified time period, measure and compare the rate of CO_2 production, which can be monitored by the balloon's inflation.
- Discuss the consequences of this experiment for food production.

Iron Content in Rice Activity:

- Materials: Rice, genetically modified rice (if available), magnets, and water
- Show how magnets can be used to separate genetically modified rice with increased iron content.
- Discuss the potential benefits for iron-deficiency regions.

Elaborate: (10 min)

- Have a class discussion about the outcomes of the STEM activities.
- Encourage students to relate their findings to biotechnology and its applications in food production.
- Discuss the ethical and environmental implications of genetically modified organisms in food production.

Evaluate: (5 min)

- Worksheet 2 will be given to solve.
- Discuss and Answer on page 52 of student book.

Home Assignment:

Q1 and 4 of workbook.

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
Applications of Biotechnology in Pakistan	52-55	45 Minutes	26-27

Objective:

Discuss the applications of biotechnology in Pakistan. Illustrative examples: bread-making, making of yoghurt and cheese, vaccines for immunization, insulin production, dyes, etc.

Keywords

Genetic modification
Genome
Selective breeding

Resources:

- Whiteboard and markers
- Projector and screen
- Printed articles and diagrams related to biotechnology applications in Pakistan
- Samples of biotech products (if available)
- Laboratory equipment for STEM activities
- Handout for home assignment

Engage: (5 min)

- You can start with questions like, "Have you ever thought about how your food is made, how vaccines are created, or how insulin is produced?"
- To grab their interest, share some basic facts about biotechnology in Pakistan.

Explain: (10 min)

- Give an overview of biotechnology and its role in Pakistan.
- Introduce biotechnology applications in the country, such as bread-making, yoghurt and cheese production, vaccines, insulin production, and dyes.
- Explain the science behind each of these applications, aided by diagrams and visuals.
- Share real-life success stories and examples of how these apps have benefited Pakistan.

Explore: (15 min)

arrange students into small groups for hands-on STEM activities:

Bread-Making Activity:

- Flour, yeast, water, sugar, and mixing bowls are required.
- Instruct students to make two batches of bread dough, one traditional and one biotechnological (e.g., improved yeast strains).
- Discuss how biotechnology has improved bread production by comparing factors such as rising time, taste, and texture.
- Yoghurt Manufacturing Activity:
- Milk, yoghurt starter culture, and incubation containers are required.

- Guide students through the yogurt-making process. Discuss the role of specific bacterial cultures in yoghurt production and how biotechnology has improved it.

Elaborate: (10 min)

Encourage students to relate their findings to biotechnology concepts and applications in Pakistan. Discuss the impact of these applications on people's daily lives and the economy.

Evaluate: (5 min)

- Discuss and Answer page 53 of student book.
- Concept Check on page 54 of student book.

Home Assignment:

- Complete Concept Check page 55-56 of student book.
- Complete Q5 and 6 on page 26-27 of workbook.

Lesson Plan 4	Student Book pages	Time	Workbook pages
Effects of Biotechnology on the People and Environment of Pakistan	52-55	45 Minutes	-

Objective:

- Discuss the effects of Biotechnology on the people and the environment of Pakistan over time.

Keywords

Biological detergents
Enzymes
Insulin

Engage:(5 min)

- Make flashcards with one benefit of biotechnology written on each card.
- Show the students each card and ask them what they think. Is Pakistan reaping the benefits of biotechnology in this field?

Useful Link

https://youtu.be/IKoqns7TVHA

Explain: (10 min)

- Biotechnology has an impact on the environment and the lives of Pakistanis in a variety of ways, including reducing pollution, saving lives, increasing food production, and so on. Let's take a look at some of the most important ones.
- With the help of biotechnology, the nutritional content of our foods has improved. Food biotechnology has also improved scientists' speed and precision, which can improve the food production process.
- Making healthier foods can help to reduce health problems caused by a lack of nutrients while also increasing food availability.
- With the help of biotechnology, numerous medical advancements have been made, such as the understanding of cancer and the development of treatments, vaccines, artificial tissue growth, etc. These advancements in the medical field allow us to increase the average human lifespan and help those with illnesses live longer lives.
- Environmental biotechnology is replacing non-eco-friendly materials and chemical processes with more sustainable biological and eco-friendly alternatives.
- For example, the production of biofuels from crops is gradually becoming a feasible option, and several companies are also employing biotechnology to break down agricultural waste to produce fuels.

Explore: (15 min)

Divide the class into five groups.

Ask each group to prepare a presentation on the role of biotechnology in Pakistan in the following areas:

1. Medicine.
2. Environment.
3. Agriculture.
4. Food Products.
5. Industry.

Elaborate: (5 min)

Discuss with your class what else needs to be done in Pakistan for the people to benefit from biotechnology.

Evaluate: (5 min)

Worksheet 3 will be given to the students.

Homework:

Complete Q10 on page 30 of workbook.

Worksheet 1:

Complete the sentences.

1. It is impossible to make cheese without _____.
2. As the bacteria grow in milk, sugar lactose is converted into _____.
3. Bacteria is a single-celled _____.
4. Give two examples of products made through the fermentation process:

5. **Explain how biotechnology is beneficial to food and agriculture.**

Worksheet 2:

Describe genetic engineering.

Why do scientists use genetic material of bacteria?

How is insulin extracted from bacteria?

Write about some treatments created by biotechnology.

Worksheet 3:

Make a list of the benefits and risks of biotechnology for Pakistan's environment

Potential Benefits	Potential Risks

Answers for Worksheet 1:

Complete the sentences.

1. It is impossible to make cheese without rennet.
2. As the bacteria grow in milk, sugar lactose is converted into lactic acid.
3. Bacteria is a single-celled microbe.

4. **Give two examples of products made through the fermentation process:**
   - **(i)** Bread
   - **(ii)** Yogurt

5. **Explain how biotechnology is beneficial to food and agriculture.**
   1. Biotechnology helps to grow more food.
   2. Increase the nutritional value
   3. It aids in disease control and increases crop tolerance to drought and flooding.

Answers for Worksheet 2:

Describe genetic engineering.

Genetic engineering is the process of altering an organism's genetic structure by removing or inserting DNA, or modifying existing genetic material.

Why do scientists use genetic material of bacteria?

Bacterial cells are relatively simple, making it easier for scientists to modify their genes to perform specific tasks.

How is insulin extracted from bacteria?

Because bacteria do not naturally produce or use insulin, the human insulin gene is inserted into the genes of a normal E-coli bacterium.

Write about some treatments created by biotechnology.

- Transplantation of bone marrow.
- Cancer treatment.
- Reduce the risk of rejection following organ transplantation.
- Biotechnology is attempting to solve the chronic shortage of donors for various organs and tissues through xenotransplantation. Here, various species, including monkeys, are used to supply the donor organs

Answers for Worksheet 3:

Make a list of the benefits and risks of biotechnology for Pakistan's environment.

Potential Benefits	Potential Risks
Increases the growth of food.	The unintentional release of genetically modified organisms (GMOs) into the environment, which could harm our ecosystems and human health.
Contributes to the fight against diseases and offers innovative medical treatments.	There is a danger that modern science will ignore the needs of the poor.
Helps in solving the climate change problem.	The risk of food allergens in genetically modified food.
Create new energy sources.	
Improves the overall quality of life.	

Exercise Answers

1. Choose the correct answer:

i. **d.** anaerobic respiration

ii. **b.** fungus

iii. **c**. jam

iv. **c.** 15-25 oC

v. **d.** I only

2. Fill in the blanks:

i. Biotechnology

ii. Fermentation

iii. Alexander Fleming

iv. Double helix

v. Insulin

i powders i. Biological washing contain protease enzymes, which can help remove blood from clothes by breaking down the protein molecules in the bloodstains. Protease enzymes break down proteins into smaller, soluble fragments, making it easier to wash away the bloodstains.

ii. Enzymes obtained from bacteria living in hot springs at high temperatures (up to 80°C) are useful in washing powders because they are thermostable. This means they can function at high temperatures without losing their activity. Hot water can enhance the cleaning process, and these enzymes can remain effective in breaking down stains even in hot water, making them more efficient in removing dirt and stains.

iii. The early biological washing powders could harm people's hands and skin because they contained protease enzymes, which, if not properly rinsed from clothes, could cause skin irritation or allergic reactions in some individuals.

4. Short answer questions:

i. Biotechnology refers to the use of living organisms, their systems, or their derivatives to develop or create products and technologies for specific applications.

ii. Genes make proteins in human cells.

iii. The substance found in both chromosomes and genes is DNA (Deoxyribonucleic Acid).

iv. Four materials that could be put in a digester to produce methane are organic waste, manure, sewage, and food scraps.

v. The shape that best describes a DNA molecule is a double helix.

vi. Yeast is a type of fungus.

vii. The four kinds of bases in the 'rungs' of the DNA molecule are adenine (A), thymine (T), cytosine (C), and guanine (G).

viii. Fermentation is a metabolic process that converts sugars into alcohol or organic acids using microorganisms, typically yeast or bacteria. Two products made during fermentation are ethanol (alcohol) and carbon dioxide.

ix. Diabetes is a chronic medical condition characterized by high blood sugar levels, resulting from either insufficient insulin production or the body's inability to use insulin effectively.

x. Diabetes is caused by various factors, including genetic predisposition, lifestyle choices, obesity, and other environmental factors. Type 1 diabetes is primarily due to an autoimmune response, while Type 2 diabetes is often related to lifestyle and genetics.

xi. One 'old' source of insulin used to be extracted from the pancreases of animals, such as pigs and cows, before synthetic insulin production became more common.

5. Long answer questions:

i. DNA replication is a complex process in which a molecule of DNA makes an exact copy of itself. This occurs during the cell cycle, particularly in the S (synthesis) phase. The process involves several steps:

- The DNA molecule unwinds, and the hydrogen bonds between the base pairs break, separating the two strands.
- Enzymes called DNA polymerases start building complementary strands by adding nucleotides according to the base-pairing rules (A with T, and C with G).
- The end result is two identical DNA molecules, each containing one original strand and one newly synthesized complementary strand.

ii. Microbes are used in genetic engineering for several reasons:

- They can be easily manipulated and engineered to carry specific genes.
- They have a fast growth rate, allowing for the rapid production of genetically modified organisms.
- Microbes are relatively simple to culture and work with in a laboratory.
- They can be used to produce valuable proteins, enzymes, and other products through recombinant DNA technology.

iii. To produce sheep with finer wool through selective breeding, the farmer can follow these steps:

- Identify sheep with the finest wool quality within the existing flock.
- Mate these superior sheep to produce offspring with desirable wool traits.
- Continue selecting and breeding successive generations from the offspring that exhibit the desired wool characteristics.
- Over time, the genetic traits for finer wool will become more prevalent in the sheep population.

iv. Advantages of cloning:

- Reproduction of genetically identical organisms.
- Preservation of valuable or endangered species.
- Potential for organ transplantation and medical research.

Disadvantages of cloning:

- Reduced genetic diversity, which can make the population more susceptible to diseases.
- Ethical and moral concerns.
- High failure rate in cloning attempts.

v. Advantages of genetic engineering:

- Development of crops with increased yield and resistance to pests and diseases.
- Production of valuable pharmaceuticals and enzymes through genetically modified organisms.
- Potential for gene therapy to treat genetic disorders.

- Increased understanding of genetics and the ability to manipulate genes for various applications.

vi. Genetically engineered insulin is better than old kinds of insulin because it is produced using bacteria or yeast that have been modified to produce human insulin. This eliminates the need to extract insulin from animal sources, reducing the risk of allergic reactions in patients and ensuring a consistent and purer product.

vii. A digester is a bioreactor that breaks down organic materials, such as food waste, manure, or sewage, in an anaerobic (absence of oxygen) environment. It works by providing the right conditions for anaerobic bacteria to decompose organic matter, producing biogas (mainly methane) as a byproduct. This biogas can be used as a renewable energy source.

viii. A vaccine is a biological preparation that contains weakened or inactivated forms of pathogens (such as viruses or bacteria) or their components. When administered to a person, it stimulates the immune system to produce a protective immune response. One disease that can be prevented by a vaccine is polio.

CHAPTER 05

Periodic Table

Student Book Pages 65-76

Learning outcomes

- recognize a periodic table as a way of classifying the elements in groups and periods
- Identify the names and location of the first 18 elements only
- Identify the properties of metals and non-metals
- Relate the properties to the uses of metals

Keywords

biotechnology, genetic modification, nucleic acid, Deoxyribonucleic Acid (DNA), traits, characteristics, genes, genetic information

Overview of the Unit

Biotechnology is the application of biology to solve problems and create useful products.
Around 6,000 years ago, humans began to use microorganisms' biological processes to make bread, alcoholic beverages, and cheese, as well as to preserve dairy products. However, such processes are not what is meant by biotechnology today, a concept that was first widely applied to the molecular and cellular technologies that emerged in the 1960s and 1970s.
Biotechnology has a wide range of applications, most notably in medicine and agriculture. Examples include using biotechnology to merge biological information with computer technology (bioinformatics), investigating the use of microscopic devices that can enter the human body (nanotechnology).

Lesson Plan 1	Student Book pages	Time	Workbook pages
Periodic Table	86-88	45 Minutes	-

Objective:

- recognize a periodic table as a way of classifying the elements in groups and periods
- Identify the names and location of the first 18 elements only

Keywords

Periods
Groups
Element key

Engage (5 min):

- Paste different maps on the board and explain them to students.
- When you travel to a new location, you use a map to show you the best route to take.

Useful Link

https://www.youtube.com/watch?v=nsbXp64YPRQ

- Maps come in a variety of styles; some are colourful and show small pictures, while others have ways to show different altitudes.
- Some only display state or national boundaries.
- In either case, just as a point on a map can tell you where you are, an element's position on the periodic table can tell you about its properties.

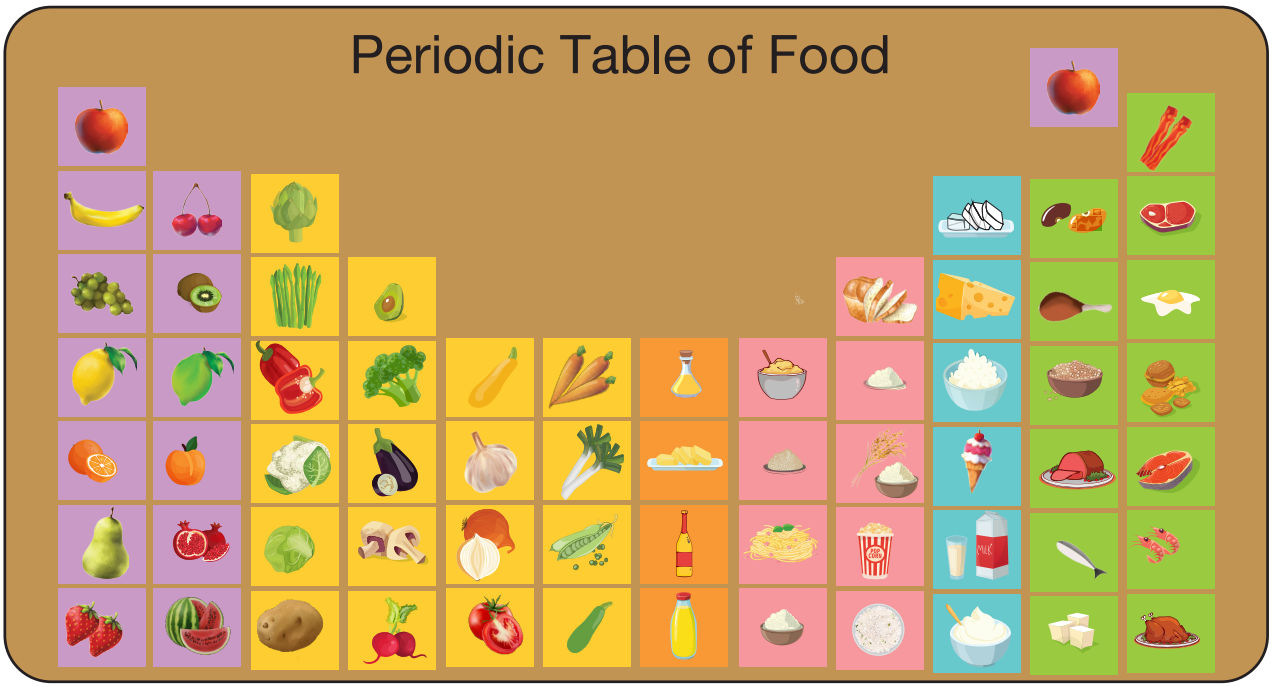
Explain: (10 min)

- Periods: The periodic table of the elements includes all of the chemical elements discovered or created; they are arranged in seven horizontal periods in the order of their atomic numbers, with the lanthanoids (lanthanum, 57, to lutetium, 71) and actinoids (actinium, 89, to lawrencium, 103) indicated separately below. The lengths of the periods vary.

- The hydrogen period begins with the two elements hydrogen, 1, and helium, 2. Then there are two short periods of eight elements each: the first from lithium, 3, to neon, 10; and the second from sodium, 11, to argon, 18. There are two long periods of 18 elements each: the first from potassium 19 to krypton 36, and the second from rubidium 37 to xenon 54.
- The omission of the lanthanoids (which are indicated separately below) condenses the first very long period of 32 elements, from cesium, 55, to radon, 86, into 18 columns, allowing the remaining 18 elements, which are closely similar in properties to corresponding elements of the first and second long periods, to be placed directly underneath these elements. The omission of the actinoids condenses the second very long period, from francium, 87, to oganesson, 118, into 18 columns.
- Groups: The six noble gases (helium, neon, argon, krypton, xenon, and radon) occur at the ends of the six completed periods and form the periodic system's Group 18 (0) group. Horizontal series of elements in the table are referred to as periods, and vertical series are referred to as groups. The seven elements lithium to fluorine and the seven elements sodium to chlorine are classified as 1 (Ia), 2 (IIa), 13 (IIIa), 14 (IVa), 15 (Va), 16 (VIa), and 17 (VIIa). The 17 elements of the fourth period, ranging from potassium (19) to bromine (35) have distinct properties and are classified as Groups 1-17 (Ia-VIIa) of the periodic system.

Explore: (15 min)

- Students will create their own Periodic Table.



- Students select a theme that includes at least 20 'things' that can be arranged in two different ways to form a periodic pattern. They can compile the items into a Periodic Table. They can, for example, create a Periodic Table of Musical Instruments. Each family in this table represents a different type of instrument (woodwinds, horns, strings, percussion), and the periodicity is determined by the instrument's range, with the largest range at the top of the family and the narrowest range at the bottom.
- The themes can cover anything from drama characters to different cereals, sneakers to surfboards, various locations or cities, etc.

Elaborate: (5 min)

You can hold a competition among the students, and the student who creates the best periodic table will be awarded a small prize and his table will be displayed on the classroom wall.

Evaluate: (5 min)

- Students will be given worksheet 1 to complete.
- Complete Think About It on page 76 of student book.

Homework:

Complete Q8-10 of workbook.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Properties of Metals and Non-Metals	67-68	45 Minutes	-

Objective:

Identify the properties of metals and non-metals

Keywords

Luminosity
Malleable
Ductile
Density

Engage:(5 min)

Instruct students to draw the table below in their notebooks. Under the appropriate heading, write each of the following properties. Write the entire property, not just the first letter.

Useful Link

https://youtu.be/LqLEKWTYUas

METALS	NON-METALS	METALLOIDS

Properties:

1. good heat conductor
2. poor heat conductor (insulator)
3. good heat conductor
4. gleaming, high lustre
5. solids are dull
6. malleable
7. brittle
8. ductile
9. good electrical conductor
10. poor electrical conductor

Explain: (10 min)

- The periodic table is a chart that arranges all known elements in atomic number order. Metals and nonmetals are the two main sections of the table. Metals are positioned on the left side of the table, while nonmetals are positioned on the right.
- Metals are typically lustrous and good conductors of heat and electricity. They are typically hard and brittle, but they can be melted and reshaped.

- Non-metals are typically dull, brittle, and poor heat and electricity conductors. They are softer than metals in general.
- There are a few exceptions to these general rules: carbon is a nonmetal, but it can be converted into steel, which is a metal. Furthermore, some elements, such as mercury, can have properties that are shared by metals and nonmetals.

Explore: (15 min)

What do we need:

- Prepare sealed test tubes containing any five of the following elements for the observation test:
- copper, silicon, magnesium, carbon, nickel, aluminium, zinc, sulphur, oxygen, lead, bismuth, silver, nitrogen, antimony, and hydrogen.
- For the malleability test, have one piece of each element per group, as well as paper towels and hammers.
- For the reactivity test, have one piece of each element per group, 9 test tubes, a test tube rack, and 1 M HCl.

What to do:

1. Create a table in your lab notebook to record your observations.
2. Examine how each of the elements appears. Keep track of the physical state, colour, lustre, and other detectable characteristics.
3. Place a single piece of the element on a paper towel and gently tap it with a hammer to determine which elements are malleable. If an element shatters when struck, it is brittle. If an element flattens when tapped, it is malleable.
4. Label 9 test tubes with the symbols for each element to test the reactivity with 1 M HCl. Fill each tube with 5 mL of acid. Then, add a small sample of each element (about 0.1 gramme) to the labelled tubes. The formation of hydrogen bubbles indicates the presence of a reaction. (You might want to demonstrate the reactivity using 1 M HCl.)

Elaborate: (5 min)

- Provide the students with a blank periodic table. They label it with the elements tested. Based on their observations, they will determine whether each element is a metal, a nonmetal, or a metalloid.
- The groups of metals, non-metals, and metalloids can also be coloured differently.

Evaluate: (5 min)

Complete Q4 on page 75 of student book.

Homework:

Give worksheet 2 to solve at home.

Lesson Plan 3 Uses of Metals	**Student Book pages** 68	**Time** 45 Minutes	**Workbook pages** -

Objective:

Relate the properties to the uses of metals

Keywords

Copper
Aluminium
Iron
Lead
Gold

Resources:

- Whiteboard and markers
- Projector and screen
- Samples of common metals (e.g., copper, iron, aluminum)
- Everyday metal objects (e.g., aluminum foil, copper wire, iron nail)
- Safety goggles and gloves
- Laboratory equipment for STEM activity

Useful Link

https://www.youtube.com/watch?v=MqyteEWzHqM

Engage: (5 min)

- Ask questions like, "What are some common metals you see around your home or school?"
- Share interesting facts or stories about the discovery and application of metals.

Explain: (10 min)

- Give an overview of metal properties like conductivity, malleability, ductility, and lustre.
- Explain how these properties enable metals to be used in a variety of applications.
- Discuss common metals and their applications, such as copper in electrical wiring nn nkjji ualuminium in packaging, and iron in construction.

Explore: (15 min)

Make small groups of students for hands-on STEM activities:

Conductivity Experiment:

- Materials: Battery, wires, bulb, copper, and aluminum strips.
- Instruct students to use the materials provided to build a simple circuit.
- Compare the conductivity of copper and aluminium and discuss the role of metals as electrical conductors.

Malleability and Ductility Experiment:

Materials: Copper sheet, iron nail, and hammer.

- Allow students to observe the malleability of copper by shaping it into various shapes.
- Compare the ability of copper and iron to be drawn into thin wires in a ductility experiment.

Elaborate: (10 min)

- Encourage students to relate their findings to metal properties and applications.
- Discuss the significance of these properties in different industries.

Evaluate: (5 min)

- Conduct a "Metal Match-Up" activity in which you provide one side with a list of properties (e.g., high conductivity, malleability, corrosion resistance) and the other side with a list of common metals (e.g., copper, aluminium, iron).

- Students should match the properties to the appropriate metals.
- As a class, go over the answers and discuss them.

Home Assignment:

Each student should select a common metal (such as copper, aluminium, or iron) and create a visual presentation or poster highlighting its properties, applications, and significance in our daily lives. Images, diagrams, and a brief explanation of how the metal's properties make it suitable for various uses can be included.

Lesson Plan 4	Student Book pages	Time	Workbook pages
Group I, II, VII and 0	69-72	45 Minutes	-

Objective:

Recognise Periodic Table as a way of classifying the elements in groups and periods.

Keywords

Alkali metals
Alkaline earth metals
Halogens
Noble gases

Engage: (5 min)

Show students the videos related to each group and ask them to write down the points they have learnt from the videos.

Explain: (10 min)

- Ask students to read pages 69-72.
- Explain them the properties of different elements.
- Explain the meanings of their names.

Useful Link

https://www.youtube.com/watch?v=CmiitvJiCPc
https://www.youtube.com/watch?v=8qh5myTmcRs
https://www.youtube.com/watch?v=yW_C10cEzMk
https://www.youtube.com/watch?v=qNaBMvJXdJ4

Explore: (15 min)

Ask students to search more about the groups and find out as much as they can through different books or internet.

Elaborate: (10 min)

Let students present their findings in front of the class.

Evaluate: (5 min)

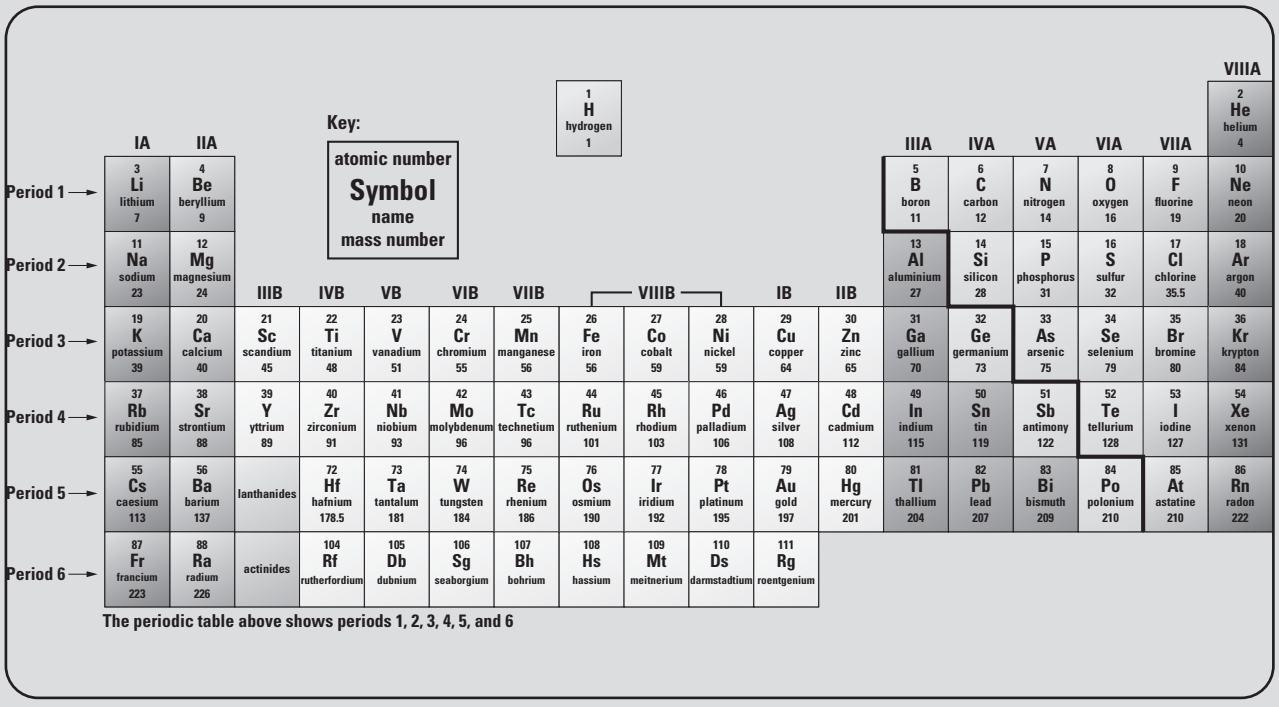
Students will complete Concept Check and Discuss and Answer on pages 69-72.

Home Assignment:

Workbook questions.

Worksheet 1:

Look at the periodic table below and answer the questions:



The periodic table above shows periods 1, 2, 3, 4, 5, and 6

Which element is in group 3A and period 4?

Which element is in group 6A and period 3?

Which group and period is Iodine in?

Which group and period is Manganese in?

Which element is in group 4B and period 5?

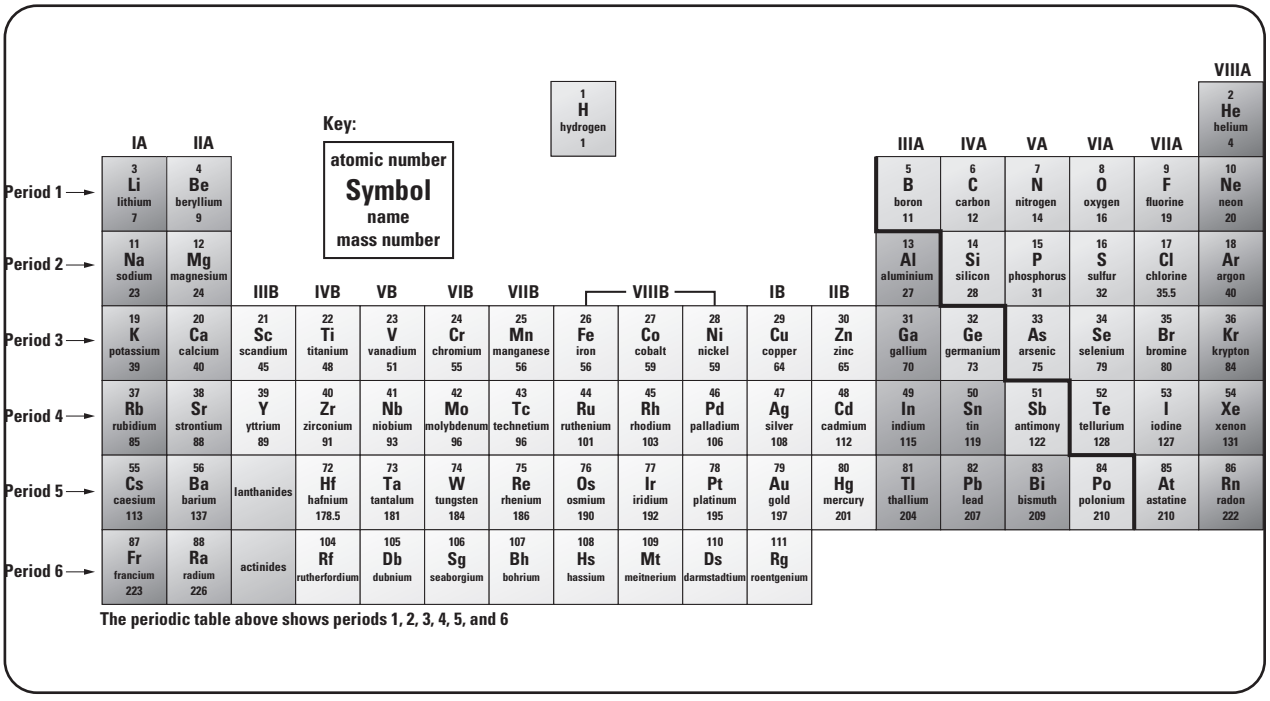
Worksheet 2:

Identify the following element as metals, non-metals or metalloids.

Calcium			
Copper			
Oxygen			
Boron			
Silicon			
Helium			
Potassium			
Silver			

Answers for Worksheet 1:

Look at the periodic table below and answer the questions:



The periodic table above shows periods 1, 2, 3, 4, 5, and 6

Which element is in group 3A and period 4?

Gallium(Ga)

Which element is in group 6A and period 3?

Sulfur (S)

Which group and period is Iodine in?

Group:7A

Period: 5

Which group and period is Manganese in?

Group:7B

Period: 4

Which element is in group 4B and period 5?

Zirconium (Zr)

Answers for Worksheet 2:

Identify the following element as metals, non-metals or metalloids.

Elements	Metals	Non-Metals	Metalloids
Calcium	✓		
Copper	✓		
Oxygen		✓	
Boron			✓
Silicon			
Helium		✓	
Potassium	✓		
Silver	✓		

Exercise Answers

1. Choose the correct answer:

- **i.** **d.** classifying the elements
- **ii.** **b.** electrons
- **iii**. **c.** six elements
- **iv.** **c.** sodium fluoride
- **v.** **a.** 2

2. Fill in the blanks:

- **i.** Aluminum
- **ii.** Aluminum
- **iii.** 18
- **iv.** Period
- **v.** Periodicity

3. **i.** The name of the group is the Alkali Metals group.

- **ii.** The reason for the answer in question i is that the elements listed (Lithium, Sodium, Potassium, Rubidium, Cesium, and Francium) share similar chemical properties and characteristics. They all belong to the same group in the periodic table.
- **iii.** The Period number of sodium is 3.
- **iv.** Potassium and sodium have different period numbers but the same group number because they have different numbers of electron shells (energy levels). Sodium is in Period 3 because it has electrons in three energy levels, while potassium is in Period 4 because it has electrons in four energy levels. However, they both belong to Group 1 because they have one valence electron, which is the defining characteristic of elements in Group 1. The group number is based on the number of valence electrons and their similar chemical properties.

4. Based on the given atomic structure of the element:

- **i.** As the total number of protons(Atomic Number)is equal to the number of electrons in a neutral cell. In this case, there are 2 electrons in the first orbit, 8 electrons in the second orbit, and 1 electron in the third orbit, making a total of 11 electrons. So, the atomic number is 11.
- **ii.** The group number can be determined by looking at the number of valence electrons (electrons in the outermost shell). In this case, there is 1 valence electron, which places the element in Group 1.
- **iii.** The period number is determined by the highest energy level (orbit) with electrons. In this case, there are electrons in the first, second, and third orbits. So, the period number is 3.
- **iv.** The Mass Number is 23
- **v.** Using the atomic number (11), you can find the name and symbol of the element. The element with atomic number 11 is sodium (Na).

5. Write the uses of the following elements:

Beryllium: Used in the aerospace industry for lightweight and high-strength components.

Fluorine: Used in dental products to prevent dental cavities.

Chlorine: Used for disinfection of water in swimming pools.

Calcium: Used as a dietary supplement for maintaining strong bones and teeth.

Bromine: Used as a flame retardant in textiles.

Helium: Used to inflate balloons and airships.

Neon: Used in neon signs and lighting.

Magnesium: Used in the aerospace industry for lightweight alloys.

Xenon: Used in high-intensity discharge lamps for vehicle headlights.

6. Short answer questions:

i. Alkali metals are the elements in Group 1 of the periodic table, including lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), and francium (Fr). They are highly reactive metals.

ii. The Group II elements are known as the alkaline earth metals and include beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra).

iii. There are 18 groups and 7 periods in the periodic table.

iv. Noble gases are a group of elements in Group 18 of the periodic table, which includes helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe), and radon (Rn). They are inert, colorless gases with low reactivity.

v. Metalloids are elements that exhibit properties of both metals and non-metals. Examples include boron (B), silicon (Si), germanium (Ge), arsenic (As), antimony (Sb), and tellurium (Te).

vi. There are approximately 11 elements that are gases at room temperature and standard pressure.

vii. About 75% of the elements in the periodic table are classified as metals.

7. Long answer questions:

i. Elements in the periodic table are arranged based on their atomic number, which represents the number of protons in the nucleus. Elements with similar chemical properties are grouped together in columns (groups), and elements with the same number of electron shells are arranged in rows (periods).

ii. Periodicity is the repeating pattern of properties of elements in the periodic table. It is caused by the regular variation of atomic structure as you move across periods and down groups, leading to similarities in chemical behavior.

iii. Elements have different group and period numbers because they are classified based on their electronic configuration. Elements in the same group have the same number of valence electrons, leading to similar chemical properties. Elements in the same period have the same number of electron shells. The differences in these numbers result from variations in atomic structure.

iv. Hydrogen is not classified in any specific group in the periodic table because its properties are unique. It is a non-metal, but it also exhibits similarities with alkali metals. Due to this, hydrogen is placed at the top of Group 1 and is sometimes called a "non-metal" as well.

v. Non-metals are found on the right side of the periodic table, especially in Groups 14, 15, 16, and 17. They include elements like carbon, oxygen, nitrogen, and chlorine.

vi. Differences between metals and non-metals:

- Metals are generally solid at room temperature, while non-metals can be solid, liquid, or gas.
- Metals are good conductors of heat and electricity, while non-metals are poor conductors.
- Metals are typically shiny and have a lustrous appearance, whereas non-metals may lack this shine.

- Metals tend to be malleable and ductile, meaning they can be easily shaped, whereas non-metals are often brittle.
- Metals tend to have a higher density, while non-metals are less dense.
- Metals usually have a metallic luster, while non-metals may have a variety of appearances, including dull, shiny, or glassy.
- Metals tend to lose electrons to form positive ions (cations), while non-metals tend to gain electrons to form negative ions (anions).

Think about it:

Element	Symbol	Atomic Number	Mass Number	Group	Period
Carbon	C	6	12.01	14	2
Oxygen	O	8	16.00	16	2

Complete the table:

Halogen	Symbol	Atomic Number	Mass Number	Uses
Fluorine	F	9	19	Used in dental products to prevent dental cavities.
Chlorine	Cl	17	35.5	Used for disinfection of water in swimming pools.
Bromine	Br	35	79.9	Used to destroy bacteria around cuts and as a flame retardant in textiles.

CHAPTER 06

Chemical Reactions

Student Book Pages 77-95

Learning outcomes

- identify chemical reactions and give examples
- define the law of conservation of mass and demonstrate the law with an experiment
- write and balance chemical equations
- distinguish between different types of reactions (combination, displacement, double displacement, combustion)
- distinguish between endothermic and exothermic reactions
- recognize the importance of exothermic and endothermic reactions in daily life
- design a car that is powered solely by a chemical reaction and can travel (STEAM)
- discuss the formation of ionic bonds as a result of electrostatic forces between atoms (e.g. NaCl)
- recognize the importance of exothermic and endothermic reactions in daily life
- discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e.g. H2, O2, N2)
- name certain ionic and covalent compounds
- draw cross and dot structures showing formation of ionic compounds and covalent compounds

Overview of the Unit

A chemical reaction occurs when the bonds between reactant molecules are broken and new bonds are formed between product molecules to form a new substance.

Chemical reactions can be found all around us, from the metabolism of food in our bodies to the light we receive from the sun.

Compounds that interact to form new compounds are referred to as reactants, while the newly formed compounds are referred to as products.

Chemical reactions are important in many industries, customs, and even in our daily lives. They are constantly occurring in our surroundings, such as iron rusting.

A chemical change must occur in a chemical reaction, which is commonly observed with physical changes such as precipitation, heat production, colour change, and so on.

A reaction can occur between two atoms, ions, or molecules in which they form a new bond without destroying or creating an atom, but a new product is formed from reactants.

The rate of reaction is affected by factors such as pressure, temperature, and the concentration of reactants.

Keywords

chemical reactions, synthesis /combination reaction, decomposition reaction, single displacement or replacement reaction, neutralisation reaction, neutral compound, chemical equation, reactants, products, balanced equation , conservation of mass, exothermic reaction, endothermic reaction

Lesson Plan 1	Student Book pages	Time	Workbook pages
Chemical Reactions, Law of Conservation of Mass	77-78	45 Minutes	-

Objective:

- identify chemical reactions and give examples
- define the law of conservation of mass and demonstrate the law with an experiment

Keywords

Reaction
Conservation
Mass

Engage:(5 min)

- Put five biscuits on the table.
- Call a student and instruct him or her to smash them.
- Now, after smashing the biscuits, ask the class if the weight of the biscuits increased, decreased, or remained the same.

Useful Link

https://youtu.be/2S6e11NBwiw

- After receiving the students' responses, inform them that, according to the law of conservation of mass: In an isolated system, mass cannot be created or destroyed, but it can be transformed from one form to another.

Explain: (10 min)

- According to the law of conservation of mass,
  "The mass in an isolated system can neither be created nor be destroyed but can be transformed from one form to another".
- Energy cannot be created or destroyed, according to the law of conservation of energy. When a toy vehicle rolls down a ramp and collides with a wall, for example, kinetic energy is converted to potential energy.
- An isolated system is one that does not interact with its surroundings. As a result, no matter what changes or chemical reactions occur in that isolated system, the mass will remain constant; even if the final state differs from the initial state, no more or less mass can exist than before the change or reaction.
- The understanding that substances, contrary to appearances, do not actually disappear as a result of a reaction, but rather change into another material of equal mass, was made possible by the law of conservation of mass, which was essential to the development of chemistry.

Example:

Water Formation

The combination of Hydrogen and Oxygen produces water. When hydrogen and oxygen combine in a 2:1 ratio to produce two moles of the molecule, a water molecule is formed. That is, one molecule of water has a molecular weight of 10 and has the chemical formula H_2O. This is made up of the elements hydrogen with a molecular weight of 2 and oxygen with a molecular weight of 8. As a result, the mass is conserved.

Explore: (15 min)

What do we need:

- balloons
- baking soda
- vinegar
- triple beam balance
- 16-ounce water bottle
- 16-ounce water
- bottle

What to do:

1. On the triple beam balance, have students weigh the empty measuring cup. Make them weigh the balloon and their bottle as well.
2. Students will create a data table and record their findings.

Mass of water bottle (grams)	Mass of Baking Soda (grams) (Cup + Baking Soda-Cup	Mass of Vinegar(grams) (Cup + Vinegar-cup)	Mass of balloon	Mass of bottle, balloon after the experiment

3. After that, students should use the measuring cup to add half a cup of baking soda and place it back on the triple beam balance. The difference in mass between the cup and the cup plus baking soda will give them the actual mass of the baking soda.
4. Using a funnel, add the baking soda to the bottle.
5. For a half-cup of vinegar, follow the same procedure.
6. Students should quickly pour vinegar into the bottle and wrap the balloon around the opening. As one student prepares to pour in the vinegar, another expands the opening of the balloon and prepares to snap it over the top of the bottom as soon as the vinegar is poured into the bottle.
7. The balloon will fill up with gas and inflate as the reaction between the vinegar and baking soda occurs.
8. Once the reaction is complete, have students weigh the entire bottle and balloon filled with gas. They can keep track of the mass in their data table.
9. Students should compare the weight of their final apparatus to the weight of all of its parts.

Elaborate: (5 min)

- Class Discussion:

  Discuss whether the law of conservation of mass is true or false as a class. Talk about how the matter in the vinegar and baking soda was converted into gas in the balloon. The presence of the gas contributes to proving the law of conservation of matter.

Evaluate: (5 min)

Worksheet 1 will be given to students.

Homework:

Complete Q6(i and ii) on page 94 of student book.

Lesson Plan 2	Student Book pages	Time	Workbook pages
Representation of Chemical Reactions by Equations, Balancing Chemical Equations	79-81	45 Minutes	-

Objective:

Write and balance chemical equations.

Engage:(5 min)

The class will do a Think-Pair-Share at the start of the lesson to discuss what they know about balancing a chemical equation.

Keywords

Word equation
Symbol equation
Reactant
Product

Explain: (10 min)

Useful Link

https://youtu.be/ApJvQQLL2iY

- A chemical equation represents the chemical formulas of reacting and producing substances. The number of atoms in the reactants and products should be equal.
- The addition of stoichiometric coefficients to products and reactants is required to balance the chemical equations. This is required because any chemical equation must follow the laws of constant proportions and conservation of mass, which require that the same number of atoms of each element exist on the product and reactant sides of the equation
- Follow these four simple steps to balance a chemical equation:
  1. Write the imbalanced equation to show the reactants and products.
  2. Determine how many atoms of each element are on each side of the reaction arrow.
  3. Multiply coefficients to equalize the number of atoms of each element on both sides of the equation (the numbers in front of the formulas). The oxygen and hydrogen atoms are convenient to balance last.
  4. In order to check your work, indicate the state of matter of the reactants and products.

Explore: (15 min)

What do we need:

- Different coloured candies.
- Paper
- Marker

What to do:

- Write any two chemical equations on the white board. For Example:
  1. $H_2 + O_2 \rightarrow H_2O$
  2. $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$
- Allow each student to choose a different coloured piece of candy to represent a different element.
- Draw an arrow in the middle of the page.
- Tell the students to look at the equation on #1 and model what the equation shows using the candies.
- Determine whether both sides of the arrow have the same number of candies of each colour.
- Students should repeat for #2.
- Students should be divided into small groups to discuss which formula had the same number of coloured candies, what the arrows stand for, and whether a chemical reaction could occur if the equation was out of balance.

Elaborate: (5 min)

- You will need to place unbalanced chemical equations at various points on the classroom wall to form a complete circle for this activity.
- Students should work in pairs or groups. Pairs are ideal; however, each pair or group will require one equation on the wall. If this is not possible, larger groups can be used.
- To begin, students are assigned to one of the equations on the wall at random.
- They must examine the equation, attempt to balance it in their heads or on rough paper, and then add or change any number in the equation. They could, for example, place a four next to water or change a 2 next to nitrogen into a 4.

Evaluate:

Complete Concept Check page 81 of student book.

Homework:

Complete Q5 on page 94 of student book.

Lesson Plan 3	Student Book pages	Time	Workbook pages
Types of Reactions	81-85	45 Minutes	-

Objective:

distinguish between different types of reactions (combination, displacement, double displacement, combustion)

Keywords

Addition
Decomposition
Displacement
Oxidation
Neutralization

Useful Link

https://youtu.be/TX6BYceUSL

Engage:(5 min)

Show the class pictures of various chemical reactions from everyday life. Ask them if they are aware that chemical reactions are occurring in these pictures. Then inform them that there are various types of chemical reactions occurring in our surroundings that they will learn about today.

Explain: (10 min)

The basis for various types of reactions includes the product created changes that take place, reactants involved, etc. There are various types of reactions.

1. Combustion Reaction

A combustion reaction occurs when a combustible material reacts with an oxidizer to produce an oxidised product. An oxidizer is a chemical that a fuel needs to burn, typically oxygen. Consider the case of magnesium metal combustion.

In this reaction, two magnesium atoms react with an oxygen molecule, producing two molecules of the compound magnesium oxide and releasing some heat in the process.

2. Decomposition Reaction

A decomposition reaction occurs when a single component degrades into multiple products. Certain changes in energy in the environment, such as heat, light, or electricity, must be made to break the bonds of the compound. Consider the decomposition of calcium carbonate, which produces CaO (Quick Lime), a major component of cement.

When heated, the compound calcium carbonate decomposes into calcium oxide and carbon dioxide.

3. Neutralization Reaction

A neutralization reaction is mainly the reaction of an acid and a base that produces salt and water as byproducts. The water molecule is formed by combining OH^- ions and H^+ ions. When a strong acid and a strong base are neutralized, the overall pH of the products is 7.

Consider the neutralization reaction of hydrochloric acid and sodium hydroxide, which produces sodium chloride (common salt) and water.

4. A single-displacement reaction:

A single-displacement reaction is a chemical reaction that exchanges one ion of one reactant for one ion of another reactant. A single-replacement reaction is another name for it.

An example of a single-displacement reaction is the reaction between zinc metal and hydrochloric acid, which results in zinc chloride and hydrogen gas.

5. Double-Displacement Reaction:

It is a type of displacement reaction in which two compounds react and their anions and cations switch places, resulting in the formation of two new products. Consider the reaction between silver nitrate and sodium chloride as an example. After the double-displacement reaction, the products will be silver chloride and sodium nitrate.

A double displacement reaction occurs between silver nitrate and sodium chloride. In which Silver replaces Sodium in Sodium Chloride and Sodium joins with Nitrate to form Sodium Nitrate, with Silver Chloride as the product.

Explore: (15 min)

What do we need:

- Cards with substances (the ingredients and means by which a chemical reaction will take place)
  For example adding baking soda to vinegar.
- Cards for Reaction (pictures or descriptions of a chemical reaction taking place)
  For example fizzing, expanding substance.
- You can also create cards for different types of reactions that relate to a specific reaction card. Combination, decomposition, displacement, combustion, and other types of reactions are examples.

What to do:

- Students will play in groups of 2-4 to match substances to their corresponding reactions.
- Who goes first is decided by the players. The game will resume with the player to the left of player one.
- Player one will shuffle the set of cards and deal five cards to each player. The remaining cards will be stacked upside down.
- Player one will examine his or her hand to see if any cards match. If there is a match, he or she will place those cards face up. If there is no match, he or she will ask one of the other players for a specific card.
- If a player has the requested card, he or she must hand it over to player one.
- The player will say "Go React" if he or she does not have the requested card. Player one must draw a card from the pile.
- In this manner, players will continue to take turns.
- The player with the most matches wins when all of the cards have been matched.

Elaborate: (5 min)

Students will create posters showing various types of chemical reactions. The same groups of students who participated in the game may be used to create posters.

Evaluate: (5 min)

- Tell the class about the characteristic of the reaction and ask them to guess the chemical reaction.
- For example:
- Combination Reaction: When two or more reactants combine to form a single product.
- Decomposition Reaction: The inverse of a combination reaction or in which a complex molecule is broken down into simpler ones.

- Precipitation Reaction: When two soluble salt solutions are combined, an insoluble solid is formed.
- Neutralization Reaction: An acid and a base react with each other and generally, the product of this reaction is salt and water.
- Complete Q3-4 on page 93-94 of student book.

Homework:

- Give worksheet 2 to solve at home.
- Complete Q 1,2,6, and 12 on page 39 and 45 in workbook.

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
Types of Reactions	81-85	45 Minutes	45

Objective:

- discuss the formation of ionic bonds as a result of electrostatic forces between atoms (e.g. NaCl)
- discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e.g. H_2, O_2, N_2)
- name certain ionic and covalent compounds
- draw cross and dot structures showing formation of ionic compounds and covalent compounds

Keywords

Ionic
Covalent
Cation
Anion

Resources:

- Whiteboard and markers
- Projector and screen
- Models or molecular kits (if available)
- Handouts with chemical symbols and information
- Blank paper and colored pencils for drawing structures
- Laboratory equipment for STEM activities

Useful Link

https://youtu.be/KDVahhH8mcU

Engage: (5 min)

Engage students with a discussion on the fundamental concepts of chemical bonding. Ask questions like,

- What holds atoms together in a compound?
- Can you name some common chemical compounds you encounter in everyday life?

Explain: (10 min)

- Give an overview of ionic and covalent bonds, focusing on electrostatic forces in ionic bonds and electron sharing in covalent bonds.
- Introduce specific examples for ionic bonds, such as NaCl, and covalent bonds, such as H_2, O_2, and N_2.
- Explain why ionic bonds form between metals and nonmetals and covalent bonds form between nonmetals.
- Talk about the naming rules for covalent and ionic compounds.

Explore: (15 min)

Divide students into small groups for hands-on STEM activities:

Ionic Compound Formation:

Materials: Small metal and non-metal balls (representing atoms), magnets

- Instruct students to simulate the formation of NaCl (sodium chloride) by combining metal and nonmetal balls and representing the ionic bond with magnets.
- Discuss electron transfer and the electrostatic forces that keep them together.

Covalent Compound Formation:

Materials: Model kits or balls representing electrons and nuclei

- To demonstrate the sharing of electrons in covalent bonds, have students build models of H_2 (hydrogen), O_2 (oxygen), and N_2 (nitrogen) molecules.
- Talk about the concept of electron sharing.

Elaborate: (10 min)

- Students should research and identify real-world examples of ionic and covalent compounds in pairs or small groups.
- They can make brief presentations or posters highlighting these examples and explaining the importance of these compounds in everyday life.
- Encourage class discussion following the presentations and ask students to evaluate each other's findings.

Evaluate: (5 min)

Complete Q10 on page 45 in workbook

Home Assignment:

Complete Q11 on page 45 in workbook

Lesson Plan 5	**Student Book pages**	**Time**	**Workbook pages**
Energy Changes in Chemical Reactions	90-91	45 Minutes	45

Objective:

- distinguish between endothermic and exothermic reactions
- recognize the importance of exothermic and endothermic reactions in daily life

Keywords

Endothermic
Exothermic
Heat energy

Resources:

- Whiteboard and markers
- Projector and screen
- Samples of common endothermic and exothermic reactions (e.g., hand warmers, cold packs, chemical reactions)
- Safety goggles and gloves
- Laboratory equipment for STEM activities

Engage: (5 min)

- Have a class discussion on temperature changes in various scenarios.
- Ask questions like, "Have you ever touched something that felt hot or cold? What caused these temperature changes?"

Explain: (10 min)

- Explain how endothermic and exothermic reactions absorb and release heat from their surroundings.
- Show examples of both types of reactions, such as the dissolution of ammonium nitrate (endothermic) and the combustion of methane (exothermic).
- Discuss the significance of these reactions in daily life, such as cooking, hand warmers, and chemical reactions.

Explore: (15 min)

- Divide students into small groups for hands-on STEM activities:

Endothermic Reaction Activity - Instant Cold Pack:

Materials: Instant cold packs, water

- Students can activate an instant cold pack by breaking the inner pouch, causing an endothermic reaction that cools the pack. Discuss how such reactions can be used in first aid and sports.

Exothermic Reaction Activity - Baking Soda and Vinegar:

Materials: Baking soda, vinegar, and a sealed plastic bag

- Instruct students to create a foaming exothermic reaction by combining baking soda and vinegar in a sealed plastic bag.
- Discuss the importance of this reaction in cleaning and cooking.

Elaborate: (10 min)

- Encourage students to relate their hands-on experiences to endothermic and exothermic reactions.
- Discuss how these reactions are important in a variety of everyday situations.

Evaluate: (5 min)

Complete Q7(vii) on page 94 of student book.

Home Assignment:

Complete Q14 on page 45 of workbook.

Worksheet 1:

1. The law of conservation of mass states:

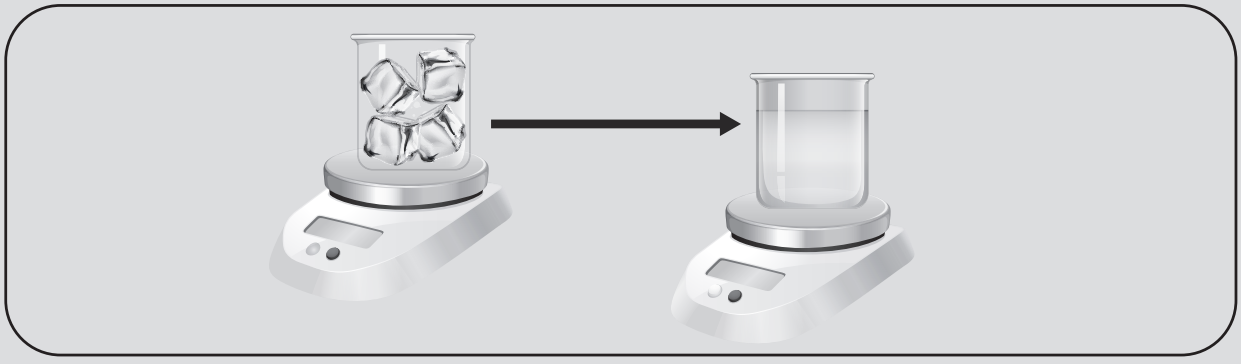
The matter cannot be _____.

You cannot _____ the matter

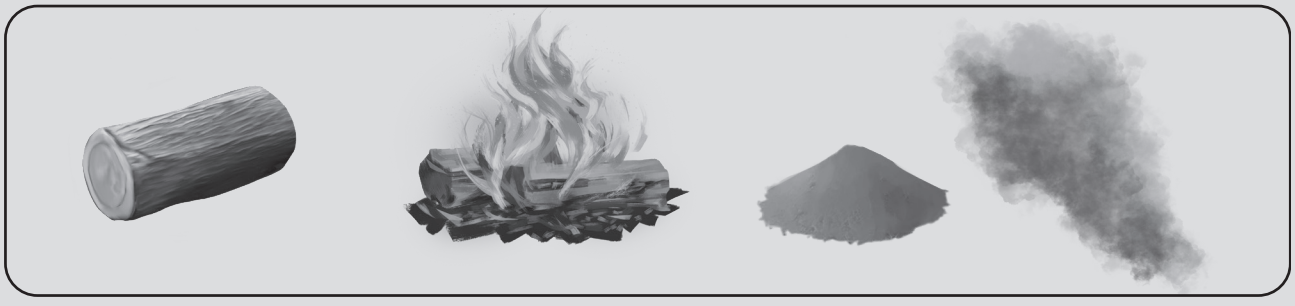
The matter can only be _____ into a new form.

In comparison to the old form, the new form will have the _____ amount of mass.

2. Write down the mass of water, whether it will change or stay the same as that of ice, and then justify your decision.



3. Determine the mass of smoke that would result from the following reaction



Worksheet 2:

Identify the type of reaction and write down its name with an example:

A + B → AB

AB → A + B

A + BC → AC + B

AB + CD → AD + CB

Answers for Worksheet 1:

The law of conservation of mass states:

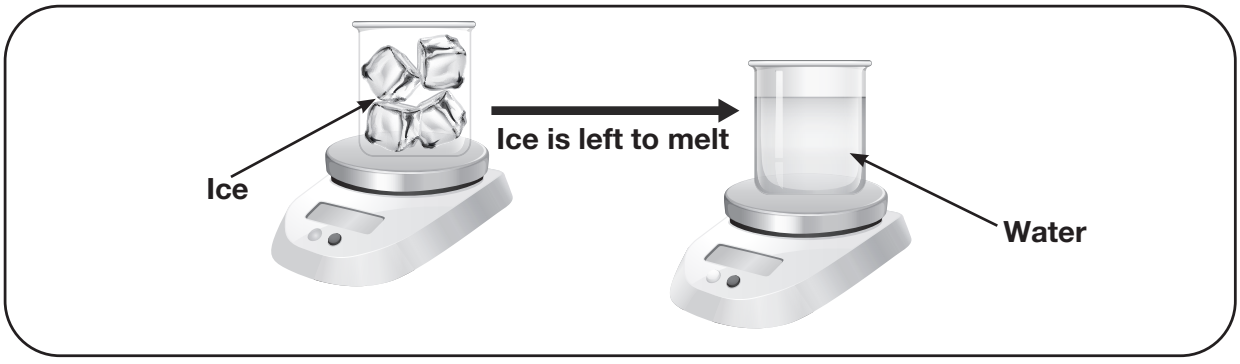
The matter cannot be destroyed.

You cannot create the matter.

The matter can only be transformed into a new form.

In comparison to the old form, the new form will have the same amount of mass.

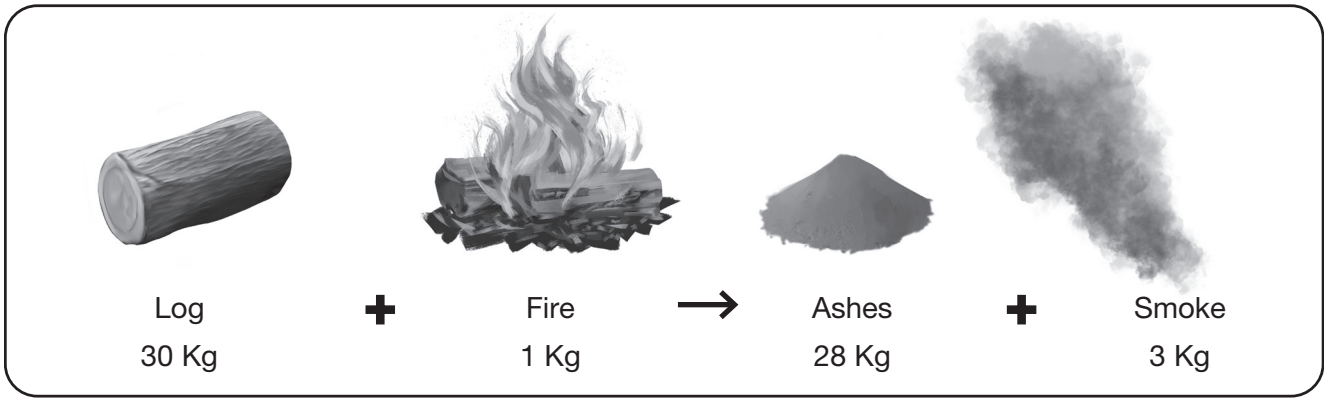
2. Write down the mass of water, whether it will change or stay the same as that of ice, and then justify your decision.



Mass of water: 180g

When substances change state there is no change in mass so if 180 g of ice is melted 180g of water is formed.

3. Determine the mass of smoke that would result from the following reaction



Answers for Worksheet 2:

Identify the type of reaction and write down its name with an example:

A + B → AB

Addition Reaction
Example: $2Mg + O_2 \longrightarrow 2MgO$

AB → A + B

Decomposition Reaction
Example: $CUCO_3 \longrightarrow CuO + CO_2$

A + BC → AC + B

Single Displacement Reaction
Example: $Na + 2H_2O + \longrightarrow 2NaOH + H_2$

AB + CD → AD + CB

Double Displacement Reaction
Example: $AgNO_3 + NaCl \longrightarrow NaNO_3 + AgCl$

Exercise Answers

1. Choose the correct answer:
- **i.** **a.** magnesium oxide
- **ii.** **d.** displacement reaction
- **iii.** **b.** sodium nitrate and silver chloride
- **iv.** **b.** exothermic reactions
- **v.** **b.** Hydrogen gas combines with chlorine gas to form hydrochloric acid

2. Fill in the blanks:
- **i.** Reactants
- **ii.** acid
- **iii.** Heat
- **iv.** Magnesium and oxygen
- **v.** Endothermic

3. Complete word equations for the following reactions:
- **i.** magnesium + oxygen→magnesium oxide
- **ii.** sodium hydroxide + hydrochloric acid → sodium chloride + water
- **iii.** silver nitrate + sodium chloride →sodium nitrate + silver chloride
- **iv.** calcium oxide + water → calcium hydroxide
- **v.** methane + oxygen → carbon dioxide + water

4. Complete the following balanced equations:
- **i.** $N_2 + O_2 \rightarrow 2N_2O$
- **ii.** $Mg + HCl \rightarrow MgCl_2 + H_2$
- **iii.** $H_2 + O_2 \rightarrow 2H_2O$
- **iv.** $Mg + FeSO_4 \rightarrow MgSO_4 + Fe$
- **v.** $Mg + O_2 \rightarrow 2MgO$

5. Balance the following equations:
- **i.** $H_2 + Cl_2 \rightarrow 2HCl$
- **ii.** $Na + Cl_2 \rightarrow 2NaCl$
- **iii.** $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- **iv.** $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$
- **v.** $2KClO_3 \rightarrow 2KCl + 3O_2$

6. Short answer questions:
- **i.** A chemical reaction is a process in which one or more substances (reactants) are transformed into one or more different substances (products) with new properties.
- **ii.** The law of conservation of mass states that the total mass of substances involved in a chemical reaction remains constant; mass is neither created nor destroyed. For example, in the reaction: 2H2 + O2 → 2H2O, the total mass of hydrogen and oxygen before the reaction is equal to the total mass of water formed after the reaction.
- **iii.** Energy changes in chemical reactions can be exothermic (heat is released) or endothermic (heat is absorbed).
- **iv.** Another name for combustion is "burning."

v. Combustion requires fuel, oxygen, and heat.

vi. Examples of chemical reactions that are not useful include rusting of iron, decomposition of organic matter in landfills, and some types of pollution reactions.

vii. Covalent bond.

viii. Ionic compounds are compounds formed by the transfer of electrons between atoms, resulting in the formation of positively and negatively charged ions (cations and anions) that are attracted to each other.

7. Long answer questions:

i. You can tell whether a chemical reaction has taken place through various signs and observations. Some common indicators of a chemical reaction include:

- Formation of a new substance with different properties.
- Color change in the reactants or products.
- Production of gas (e.g., bubbling or effervescence).
- Release or absorption of heat or light.
- Irreversibility of the change (the reaction is not easily undone).
- Changes in odor or taste.
- Precipitate formation (formation of solid particles in a liquid).

ii. When an element burns in oxygen, it produces an oxide of that element. For example, when carbon (C) burns in oxygen (O_2), it produces carbon dioxide (CO_2). The general reaction is $C + O_2 \rightarrow CO_2$.

iii. Types of chemical reactions with examples:

- Synthesis (Combination) Reaction: In a synthesis reaction, two or more substances combine to form a single compound. Example: $2H_2 + O_2 \rightarrow 2H_2O$ (formation of water).
- Decomposition Reaction: In a decomposition reaction, a single compound breaks down into two or more simpler substances. Example: $2H_2O \rightarrow 2H_2 + O_2$ (water decomposition).
- Single Replacement (Displacement) Reaction: In a single replacement reaction, one element replaces another element in a compound. Example: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ (zinc replaces hydrogen in hydrochloric acid).
- Double Replacement (Displacement) Reaction: In a double replacement reaction, ions in two compounds exchange places to form new compounds.
- Example: $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ (exchange of ions between silver nitrate and sodium chloride).

iv. When a fuel like methane (CH4) burns in air, it produces carbon dioxide (CO_2) and water (H2O). The reaction is $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

v. In a chemical reaction, a subscript in a chemical formula indicates the number of atoms of an element in a molecule. For example, H_2O shows two hydrogen (H) atoms and one oxygen (O) atom in a water molecule. A coefficient represents the number of molecules or moles involved in the reaction. For example, $2H_2O$ means two molecules of water.

vi. Types of reactions with examples were explained in response to question iii.

vii. Exothermic reactions release heat or energy to the surroundings, causing a temperature increase. Examples include combustion reactions like burning wood, where heat and light are emitted. Endothermic reactions absorb heat from the surroundings, resulting in a temperature decrease. An example is photosynthesis in plants, which absorbs energy from the sun to convert carbon dioxide and water into glucose.

viii. The bond in a nitrogen molecule (N2) is called a triple bond because it involves the sharing of three pairs of electrons between the two nitrogen atoms. This results in a strong and stable covalent bond.

ix. Covalent bonds hold the bonded atoms together. These bonds involve the sharing of electrons between atoms.

x. Types of covalent compounds include:

- Simple Covalent Compounds: These are compounds composed of molecules formed by the sharing of electrons. For example, water (H2O) and methane (CH4) are simple covalent compounds.
- Coordinate Covalent Compounds: In these compounds, one atom provides both of the shared elctrons in a covalent bond. For example, in the ammonium ion (NH4+), the nitrogen atom shares its electrons with the four hydrogen atoms, forming a coordinate covalent bond.

CHAPTER 07

Acids, Bases, and Salts

Student Book Pages 96-109

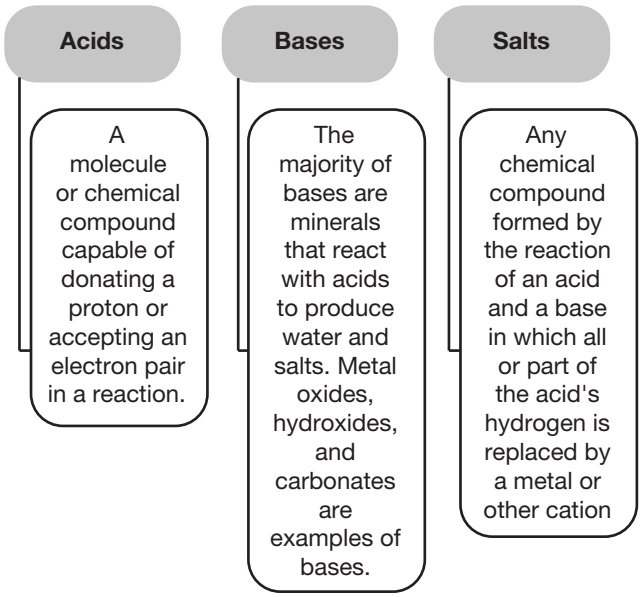
Learning outcomes

- classify acids, alkalis, and salts and give examples of each
- identify the physical and chemical properties of acids, alkalis and salts
- define pH and its ranges with reference to indicators
- interpret the pH scale and identify acids, alkalis and salts
- describe neutralisation reactions with real life examples
- observe and write the uses of acid, alkalis and salts in daily life

Keywords

Methyl blue, Phenolphthalein, Litmus, neutralisation, pH, indicator, carbonates, carbon dioxide, metals, dilute, concentrated, hydrogen, soapy, sour, bitter, conductor, corrosive, titration, phenolphthalein, acidic, alkaline

Overview of the Unit



Lesson Plan 1	Student Book pages	Time	Workbook pages
Acids, Alkalis, and Salts	96-99	45 + 45 Minutes	-

Objective:

- classify acids, alkalis, and salts and give examples of each
- identify the physical and chemical properties of acids, alkalis and salts
- observe and write the uses of acid, alkalis and salts in daily life

Useful Link

https://youtu.be/vt8fB3MFzLk

Engage:

- Display an acid and a base in a liquid form (e.g. vinegar & liquid soap). Ask students to differentiate the two liquids. Remind the students to think about the five senses. Ask them to tell you the similarities and differences between the two liquids.
- You can ask them brainstorming questions like:

  What are the colours of the two liquids?

  How do they smell?

  How would they feel if you touched them?

Is there any similarity between the two liquids?

Explain: (10 min)

Acids and bases can frequently be distinguished by some of their easily observed chemical and physical properties. Some of these properties are described below:

Properice of Acids	Properties of Bases
• Acids have sour (vinegar) taste • Frequently causes nose burns, if smells. • Sticky to touch. • H_2 is frequently Fpormed when reacting with metals.	• Bitter (baking soda) • Except for NH_3, there is usually no odour. • Slippery to touch. • Reacts with a wide range of oils and fats

Explore:

- Gather different acids and bases on a table.
- Ask students to make a chart on a piece of chart paper and fill it up with your findings.

Items	Taste	Smell	Reactivity	Conductivity	Acid/Base
Soap					
Lemon					
Ammonia					
Water					
Baking Soda					

Elaborate:

- Discuss the findings of your students with them. You can choose the student randomly or ask them turn wise to share their findings with their class mates.
- Later elaborate the properties of these items as an acid or base to the students.

Evaluate:

- Complete Concept Check page 98.
- Complete Q4 and 7 on page 47 and 48 of workbook.

Home Assignment:

- Your task is to observe and document how you use acids, alkalis, and salts in your daily life. Keep a journal for one day, noting any encounters with these substances or their applications.

Examples of what to look for include:

- Lemon juice (acid) is used in cooking and cleaning.
- Baking soda (alkali) content in recipes or cleaning agents.
- The application of table salt (common salt) to food.
- Any other instances in which you have observed the use of these substances.
- Briefly describe the context and the role of the acid, alkali, or salt for each observation. Explain how it helps the process or product in which it is used.
- Complete Discuss and Answer page 99 of student book.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Neutralization Reactions	96-99	45 Minutes	48

Objective:

- describe neutralization reactions with real life examples

Keywords

Neutralize
Salt
Antacid

Engage:

- Arrange a role play in which one student tries to portray Mr. X, a patient who is suffering from heartburn caused by stomach acid.
- Then ask students to advise him on what he should do to relieve
- his heartburn. Discuss with them the various home remedies for
- such problems that people use.
- Then inquire as to why we use those products.
- What ingredient is in these products that help to reduce stomach acid?
- What happens in the stomach when we intake such products?

Useful Link

https://youtu.be/RmnT9jwX4gQ

Explain:

A neutralization reaction is a chemical reaction that takes place between an acid and a base and results in a more neutral solution (closer to a pH of 7). The final pH is determined by the acid and base concentrations in the reaction. There are no excess hydrogen or hydroxide ions at the end of a neutralization reaction in water. Some of the examples of neutralization reactions in real life are:

1. Wasp Sting Treatment
2. Shampoo and conditioner
3. Waste Treatment in Industry
4. Teeth Brushing
5. Table salt production

Explore:

Resources:

- Three test tubes
- Test tube stand beaker
- Vinegar
- Baking Soda (Sodium bicarbonate)
- Sugar

- Universal indicator
- Paper
- Pen
- Sticking tape
- Scissors

Procedure:

- Students will have a STEM activity to resolve that patient's problem.
- Students will try to neutralize the pH of vinegar (Stomach acid) by adding substances that can be available at home.
- This activity will be done in groups.
- Students will collect the vinegar mixed with universal indicator and put approximately 5ml of the mixture in each test tube and 10 ml in the beaker.
- Students will draw Mr.X character with the help of paper, pencil and scissors and stick in front of the beaker with the sticking tape.
- The students will then try each household substance by mixing it with the solution.
- When they will discover the substance that can successfully neutralize the vinegar or acid, they will add it to the beaker as well to solve the problem of Mr.X with the stomach problem and to make him happy.

Elaborate:

After the activity discuss the experiment with the students. Explain to them that how they add different substances to the vinegar and only Sodium Bicarbonate reacts with the mixture to neutralize it. The chemical equation for the reaction is

$$\mathbf{NaHCO_3 + CH_3COOH \rightarrow NaCH_3COO + H_2O + CO_2}$$

The chemical reaction occurs in two stages. First, acetic acid in vinegar reacts with sodium bicarbonate to form sodium acetate and carbonic acid via a double displacement reaction:

$NaHCO_3 + HC_2H_3O_2 \rightarrow NaCH_3COO + H_2CO_3$

Carbonic acid is an unstable substance that after a decomposition reaction produce carbon dioxide gas:

$H_2CO_3 \rightarrow H_2O + CO_2$

Evaluate:

- Ask students to write about an incident where they themselves neutralized an acidic substance or have seen that happening somewhere.
- Provide worksheet 1
- Complete Q2 on page 46 of workbook.

Home Assignment:

- Your task is to search for and document a real-world example of a neutralisation reaction that you encounter on a daily basis. In most neutralisation reactions, an acid and a base react to form a salt and water.
- For example, you may notice stomach acid (hydrochloric acid) neutralization with an antacid tablet (base), resulting in indigestion relief. Alternatively, you could look for examples of

household cleaning products that use neutralisation reactions to balance pH.

- Complete Q6 on page 48 of workbook.

Lesson Plan 3 Indicators	Student Book pages 103-104	Time 45 Minutes	Workbook pages 46

Objective:

- define pH and its ranges with reference to indicators
- interpret the pH scale and identify acids, alkalis and salts

Keywords

pH
Litmus
neutral

Engage:

Ask students questions about the previous lecture to recall the physical and chemical properties of acids and bases. Ask them the following questions to gain their interest.

- How can we identify whether a substance is acidic or basic?
- There are some acids/ bases that are weak and some of them are strong. Can we find the strength of acids or bases?

Explain:

- The pH scale measures how acidic or basic a substance is, and we can get that measurement by combining it with a universal indicator.
- A universal indicator is a substance that changes colour to indicate whether a substance is acidic or basic. It is constantly used in laboratories by scientists who need to know which substances are acids and which are bases.
- A pH of 1 indicates a strong acid, while a pH of 14 indicates a strong base. A substance with a pH of 7 is said to be neutral (not acidic or basic).
- The extent to which an acid or base ionizes when dissolved in water is defined as its relative strength. If the ionization reaction is nearly complete, the acid or base is said to be strong; if very little ionization occurs, the acid or base is said to be weak.

Explore:

Allow students to investigate the use of the pH scale through the following activity, in which students will first hypothesize the strength of the acid or base, then test the hypothesis to see if it is correct.

Resources:

- Orange juice
- Tomato
- Water
- Ammonia solution
- Soapy water
- Bleach
- pH strips
- Colour pencils

Procedure:

- Students will draw a large, color-coded version of the pH scale on a sheet of drawing paper. Acids, bases, and neutral indicators should all be labelled clearly.

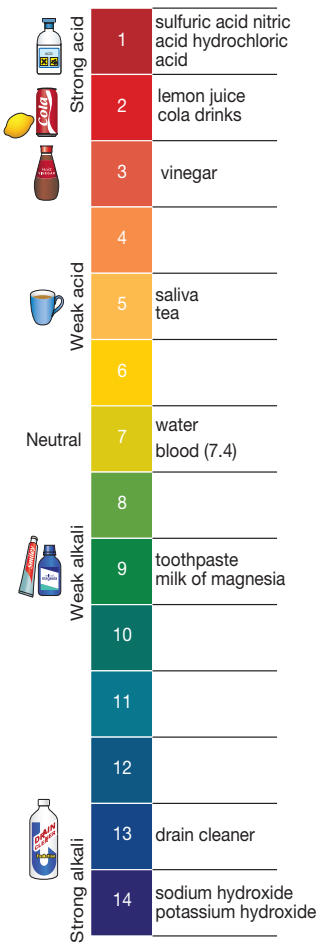
- Students will hypothesise the order in which the provided substances will fall on the pH scale.
- On the left side of their drawing, students will write their predictions.
- The students will then team up to test each of the substances using pH strips.
- Data will be recorded on the pH scale's right side.

pH Scale

Predicted Values	Actual Readings

pH Values of

- Orange juice
- Tomato
- Water
- Ammonia solution
- Soapy water
- Bleach



Elaborate:

Discuss the results that the students drew after the activity. Examine their findings and ask them to draw conclusions about acids and bases based on their data, which will be written in the form of a reflection paragraph at the end of the paper.

Evaluate:

To test the understanding of students, ask them

- What is the pH for neutral substance?
- Why does orange juice have a pH of 3?
- What does it mean that bleach has a pH of 13?

Provide worksheet 7.2

Complete Q1 and 3 on page 46 of workbook.

Home Assignment:

- Your task is to search your home for at least three household items or substances. Determine whether an item is acidic, neutral, basic (alkaline), or salt. If litmus paper or pH test strips are available, use them, otherwise make an educated guess based on your knowledge of the pH scale.
- Once you've identified these substances, make a list and explain your reasoning for categorising them. Lemon juice (acidic), tap water (neutral), baking soda solution (basic), and table salt (salt) are some examples.
- Complete Q3 on page 106 of student book.

Worksheet 1:

Complete the following equations:

Acid + Metal	**Salt +**

Acid + Base	**Salt+**

Acid + Carbonate	**Salt+**

(a) A substance that produces hydroxide ions in solution is _____.
(a) Acid **(b)** Base

(b) A substance that produces hydrogen ions in solution is _____.
(a) Acid **(b)** Base

(c) A hydrogen ion is indicated by _____.
(a) H^+ **(b)** OH^-

(d) The acidity of a solution is indicated by its _____.
(a) pH **(b)** Saturation

(e) An organic compound that changes colour in acid or base is _____.
(a) Water **(b)** indicator

(f) If the pH of a solution is 12, it is _____.
(a) Acidic **(b)** Basic

(g) An acid that ionizes almost completely in a solution is _____.
(a) Weak **(b)** Strong

Worksheet 2:

1. **Identify the following as acid, base, or both.**
   - **i.** Sour _____
   - **ii.** Bite _____
   - **iii.** Turns pH paper red _____
   - **iv.** Turns pH paper blue _____
   - **v.** Produces hydrogen gas when reacts with water. _____
   - **vi.** Electricity conductor _____
2. **Write down the formulas of the following acids**:
   - **i.** Hydrochloric acid _____
   - **ii.** Sulphuric Acid _____
   - **iii.** Citric Acid _____
3. **Write down the formulas of the following Bases:**
   - **i.** Sodium Hydroxide _____
   - **ii.** Calcium Hydroxide _____
   - **iii.** Ammonium Hydroxide _____

Answers for Worksheet 1:

Complete the following equations:

Acid + Metal	**Salt + Hydrogen**

Acid + Base	**Salt+ Water**

Acid + Carbonate	**Salt+ Carbon dioxde + water**

(a) A substance that produces hydroxide ions in solution is _____.
(a) Acid **(b) Base**

(b) A substance that produces hydrogen ions in solution is _____.
(a) Acid **(b)** Base

(c) A hydrogen ion is indicated by _____.
(a) H+ **(b)** OH-

(d) The acidity of a solution is indicated by its _____.
(a) pH **(b)** Saturation

(e) An organic compound that changes colour in acid or base is _____.
(a) Water **(b) indicator**

(f) If the pH of a solution is 12, it is _____.
(a) Acidic **(b) Basic**

(g) An acid that ionizes almost completely in a solution is _____.
(a) Weak **(b) Strong**

Answers for Worksheet 2:

1. Identify the following as acid, base, or both.

i.	Sour	Acid
ii.	Biter	Base
iii.	Turns pH paper red	Acid
iv.	Turns pH paper blue	Base
v.	Produces hydrogen gas when reacts with water.	Acid
vi.	Electricity conductor	Base

2. Write down the formulas of the following acids:

i.	Hydrochloric acid	HCl
ii.	Sulphuric Acid	H_2SO_4
iii.	Citric Acid	$C_6H_8O_7$

3. Write down the formulas of the following Bases:

i.	Sodium Hydroxide	NaOH
ii.	Calcium Hydroxide	$Ca(OH)_2$
iii.	Ammonium Hydroxide	NH_4OH

Exercise Answers

1. Choose the correct answer:
- **i. b.** salt plus water
- **ii. d.** sulphuric acid
- **iii. c**. 7
- **iv. b.** calcium carbonate
- **v. d.** calcium oxide

2. Fill in the blanks:
- **i.** lower than 7
- **ii.** red
- **iii.** lime
- **iv.** salt and water
- **v.** carbon dioxide

3.
- **i.** The soap with the strongest acid content is Easyclean (pH 5.8).
- **ii.** The soap with the weakest alkaline content is Lifeguar (pH 6.9).
- **iii.** The best description of the soap called Lifeguard is weakly alkaline.
- **iv.** The soap Easyclean will turn Universal Indicator red.
- **v.** The soap Healthy Clean will turn Universal Indicator blue.

4. When an acid reacts with an alkali, a chemical reaction occurs:
- **a)** The neutral substance made in this reaction is water.
- **b)** The word equation for when an acid reacts with a metal is

sodium hydroxide + sulphuric acid $\longrightarrow$ sodium sulfate + water.
- **c)** The kind of salt always formed in reactions with sulphuric acid is sulfate.
- **d)** The name of the reaction between an acid and an alkali is neutralization.

5. Short answer questions:
- **i.** Acids are substances that release hydrogen ions (H^+) when dissolved in water, resulting in a sour taste, the ability to turn blue litmus paper red, and a pH less than 7.
- **ii.** Two strong acids are hydrochloric acid (HCl) and sulfuric acid (H_2SO_4), while two weak acids are acetic acid (found in vinegar) and citric acid (found in citrus fruits).
- **iii.** Examples of neutralization include the reaction between hydrochloric acid and sodium hydroxide to produce salt and water and the reaction between acetic acid and sodium bicarbonate to produce carbon dioxide, salt, and water.
- **iv.** When an acid is added to a base or alkali, salt and water are produced.
- **v.** A salt is a chemical compound formed by the reaction between an acid and a base (alkali) where the hydrogen ions of the acid are replaced by metal ions.
- **vi.** Two strong acids are hydrochloric acid (HCl) and sulfuric acid (H_2SO_4), and two weak acids are acetic acid (found in vinegar) and citric acid (found in citrus fruits).
- **vii.** The pH of pure water is 7, making it neutral.
- **viii.** Neutralization is a chemical reaction between an acid and a base (alkali) that results in the formation of salt and water, with a change in the pH of the solution towards neutrality.
- **ix.** When an acid is added to a base or alkali, salt and water are produced.

x. Four properties of alkalis are: they have a bitter taste, they turn red litmus paper blue, they feel slippery, and they have a pH greater than 7.

xi. A salt is a chemical compound formed by the reaction between an acid and a base (alkali) where the hydrogen ions of the acid are replaced by metal ions.

6. Long answer questions:

i. The difference between a concentrated acid and a weak one lies in their concentration of hydrogen ions (H^+). Concentrated acids have a high concentration of H^+ ions, making them more corrosive and potentially dangerous. In contrast, weak acids have a lower concentration of H^+ ions and are generally less corrosive and less dangerous.

ii. The difference between an acid and an alkali is primarily related to their properties and the pH level. Acids have a pH less than 7, taste sour, turn blue litmus paper red, and release hydrogen ions (H^+) when dissolved in water. Alkalis have a pH greater than 7, taste bitter, turn red litmus paper blue, and release hydroxide ions (OH^-) when dissolved in water.

iii. Neutralization is a chemical reaction between an acid and a base (alkali) that results in the formation of salt and water, with a change in the pH of the solution towards neutrality (pH 7). It involves the combination of H^+ ions from the acid and OH^- ions from the base to form water, while the remaining ions form a salt.

iv. The difference between a strong acid and a weak acid is related to their ionization in water. Strong acids ionize completely in water, releasing a high concentration of hydrogen ions (H^+), resulting in a low pH. Weak acids ionize only partially in water, releasing a lower concentration of H^+ ions, resulting in a less acidic solution with a higher pH.

v. The difference between an acid and a base is primarily related to their properties and pH. Acids have a pH less than 7, taste sour, and release hydrogen ions (H^+). Bases have a pH greater than 7, taste bitter, and release hydroxide ions (OH^-).

vi. Some uses of acids include:

vii. Two examples of neutralization:

- Hydrochloric acid + sodium hydroxide→ sodium chloride + water
- Sulfuric acid + calcium hydroxide →calcium sulfate + water

viii. Litmus is used as an indicator to test the acidity or alkalinity (pH) of a solution. Red litmus paper turns blue in an alkaline solution, while blue litmus paper turns red in an acidic solution.

7. Think About it:

i. a)

Field A: Weakly acidic (pH below 7) based on the green color.

Field B: Weakly acidic (pH below 7) based on the yellow color.

Field C: Weakly alkaline (pH above 7) based on the blue color.

b) Depending on the type of crops and their preferred pH levels:

- Field A: Suitable for potatoes (pH 5.5).
- Field B: Suitable for wheat (pH 7.0).
- Field C: Suitable for cabbages (pH 8.0).

ii. Neutralization reactions:

a) hydrochloric acid + sodium hydroxide → sodium chloride + water

b) nitric acid + calcium hydroxide → calcium nitrate + water

c) calcium + hydrochloric acid → calcium chloride + hydrogen gas

d) Zinc + sulfuric acid→zinc sulfate + hydrogen gas

8. Complete the table:

Chemical	Uses
Ammonium chloride	Used in cold packs and as a nitrogen source in fertilizers.
Citric acid	Used as an acidulant in food and beverages and for descaling kettles.
Calcium hydroxide	Used in the production of lime, in wastewater treatment, and as a food additive.
Nitric acid	Used in the production of explosives, fertilizers, and rocket propellants.
Sodium hydroxide	Used in soap and detergent production, drain cleaning, and paper manufacturing.
Calcium chloride	Used as a de-icer, in food preservation, and as a drying agent.

CHAPTER 08

Forces and Pressure

Student Book Pages 115-125

Learning outcomes

- recognize that several forces may act on an object and that they may or may not balance each other
- the effect of an unbalanced force on an object
- differentiate between floating and sinking objects in terms of density
- define 'pressure' with examples and its unit
- relate pressure with force and area
- investigate effects related to pressure (e.g. water pressure increasing with depth, a balloon expanding when inflated etc.)
- examine the effect of force in the presence of air pressure
- Make a hydraulic elevator. (STEAM)
- Build a two stage rocket model. (STEAM)

Keywords

pressure, density, pressure, balanced, unbalanced, weight, Newton, pascals, mass, weight.

Overview of the Unit

- A push or pull of an object is referred to as force in science. Force is created when two objects interact. The magnitude and direction of force are both present. The magnitude of a force is used to express its strength. A change in the direction or state of motion of a body is caused by force.
- Body forces include gravitational forces, electric fields, and magnetic fields. Body forces differ from contact or surface forces, which are applied to an object's surface. Normal forces and shear forces between objects are surface forces because they act on an object's surface.
- The net force is the sum of all the forces acting on a body.
- The gravitational force is proportional to the masses of the objects and diminishes as the distance between them grows. Both objects have the same attractive force on each other: a falling object attracts the Earth with the same force that the Earth attracts it.
- When a force of 'F' Newton is applied perpendicularly to a surface area 'A,' the force's pressure on the surface equals the ratio of F to A. The pressure (P) formula is as follows:
- P = F / A (P=Pressure, F=Force, A= Area)
- Pressure can be expressed in a variety of units, some of which will be discussed further in this article.
- The pascal is the SI unit of pressure (Pa).
- A pascal is defined as a force of one newton applied over a one-meter square surface area.
- The hydraulic system uses a pressurized fluid to perform and function multiple tasks. In other words, a pressurized fluid is used to make things work, and this process is known as a hydraulic system.

Lesson Plan 1	Student Book pages	Time	Workbook pages
Balanced and Unbalanced Forces	115	45 Minutes	-

Objective:

- recognize that several forces may act on an object and that they may or may not balance each other
- the effect of an unbalanced force on an object

Keywords

Stationary
Balanced
Unbalanced
Accelerate

Engage: (5 min)

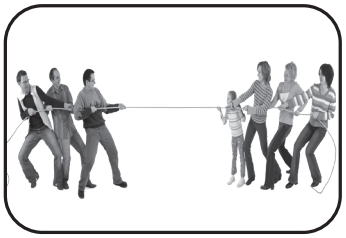
- Make five-student teams and play 'tug of war' with them.
- For this activity, take students to a field.
- 'What happens when you pull a rope?' ask the students.
- Then ask them, 'Why is the rope moving to the right or left?'

Useful Link

https://youtu.be/8Q1tw_QWy-8

- Inquire of your students: Why do the ropes stop moving at times?
- After they have answered the questions, explain to them that when the force is more to the right, the rope moves to the right, and when the force is more to the left, the rope moves to the left. Tell them that when the forces on both sides are equal or balanced, the rope does not move.

Explain: (10 min)



- Balanced forces are forces acting on an object that do not cause it to change its state of rest or uniform motion.
- Unbalanced force: The result of two opposing forces acting on an object and propelling it forward. These opposing forces are referred to as unbalanced forces.
- When an object is in equilibrium, or is not moving at all, the net force acting on it is balanced.

For example, when an apple hangs from a tree, the force exerted by the branch on the apple balances its weight.

- When an object moves at a varying speed, the net force acting on it is unbalanced.

For example, when an apple falls from a tree, it experiences an unbalanced force equal to its weight.

Difference between balanced and unbalanced forces:

- The magnitudes of the balanced forces are equal while the magnitudes of the unbalanced forces are unequal.
- A balanced force has no effect on the object's state of motion but an unbalanced force causes the object's state of motion to change.

Explore: (15 min)

- Display a toy car on a table to the students.
- Ask a student to push the car to the right with one hand. Ask the students,' What direction does the car move in'?
- Ask the same student: Now, with your other hand, push the car to the left. 'In which direction is the car now moving'?
- Now request that the car be pushed to the right with one hand while being pushed to the left with the other. What will the car's motion be?
- Draw the conclusion that if two forces acting on a body result in no motion, the forces are said to be balanced. The forces are said to be unbalanced if they cause motion in the body.
- When two forces are equal and moving in opposing directions, they balance one another.

Elaborate: (5 min)

- Hang a wooden block with thread and ask the students how many forces are acting on the block.
- What is the force acting downward on a block?
- What forces are acting upwards on the block?
- Draw a diagram of the block, thread, and hand on the board, with two arrows representing the two forces, and ask: Why is the block at rest?
- Ask a student to cut the thread and ask him what happens to the block now?
- Draw a diagram of the block and thread on the board after the thread has been cut, with an arrow representing one force, and ask how many forces are acting on the block after the thread has been cut.

- Then inquire. The force is balanced or unbalanced.

Evaluate: (5 min)

Provide worksheet 1 to solve at home.

Home Assignment:

- Assume there's a book on a table. What forces are affecting the book? Draw a diagram in your notebook that depicts the forces acting on the book using arrows.
- Draw the arrows in the same manner by using various examples from everyday life, such as a bicycle or a table lamp. A chair when you're sitting in it, and a computer.
- Do Q6 on page 53 of workbook.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Float or Sink	116-117	45 Minutes	53 and 55

Objective:

Differentiate between floating and sinking objects in terms of density

Keywords

Float
Sink
Density

Resources:

- Various objects of different shapes and materials (e.g., wooden blocks, plastic toys, metal objects)
- Water tanks or containers large enough to immerse objects
- Graduated cylinders or measuring cups
- Access to water and sinks
- Small weights (e.g., washers)
- Safety goggles and gloves
- Handout for home assignment

Useful Link

https://youtu.be/2dyCe1GPagE

Engage: (5 min)

- Start by having students debate why some objects float while others sink. Ask questions such as, "Have you ever wondered why ships and boats float on water, while some objects like rocks sink?"

Explain: (10 min)

- Explain what density is and how it is used to determine how much mass is contained in a given volume. Discuss the importance of density in determining whether an object floats or sinks.
- Introduce Archimedes' principle, which states that the buoyant force exerted by an object equals the weight of the fluid displaced by the object.
- Explain that an object will float if its density is less than the density of the fluid in which it is immersed (for example, water), and sink if its density is greater.

Explore: (15 min)

Density Experiment:

- Materials: Graduated cylinders, water, various objects
- Instruct students to calculate the mass and volume of various objects. Calculate the density of each object using the mass and volume measurements.
- Discuss the density values and make predictions about whether each object will float or sink.

Buoyancy Experiment:

Materials: Water tanks or containers, various objects, small weights

- Place the objects in water tanks to put the predictions to the test. If necessary, add small weights (washers) to objects to adjust their density.
- Examine the results to see which objects float and which sink.

Elaborate: (10 min)

Have a class discussion about the outcomes of the STEM activities. Encourage students to make connections between their findings and the concepts of density and buoyancy.

Evaluate: (5 min)

- Conduct a "Density Challenge" activity in which you present a variety of objects to students and ask them to predict whether each object will float or sink in a container of water. The objects may consist of rubber balls, plastic toys, wooden blocks, and other items.
- Students will take turns making density-based predictions and explaining their reasoning. They can test the object's actual behaviour after each prediction by placing it in a container of water. As a class, discuss their predictions and observations to help them understand how density and buoyancy work in practice.
- Ask students to complete Concept Check on page 117 of student book.

Home Assignment:

- Ask each student to find an image or video on the internet that depicts a real-world scenario in which density and buoyancy play an important role in whether an object floats or sinks. They might come across images or videos about ship design, hot air balloons, or even everyday objects like submarines.
- Complete Q7 and 11 on page 53 and 55 of workbbook.

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
Force and Pressure	117-119	45 Minutes	-

Objective:

- define ‘pressure’ with examples and its unit
- relate pressure with force and area
- investigate effects related to pressure (e.g. water pressure increasing with depth, a balloon expanding when inflated etc.)

Keywords

Pressure
Upthrust
Newton

Engage: (5 min)

- Show students a knife and a nail and ask them: Have you ever wondered why our knives have to be so sharp, or why the nails we use have such a sharp point?
- Allow the students to express their responses. Then tell them, ‘All of these questions are answered by the concept of pressure’.

Useful Link

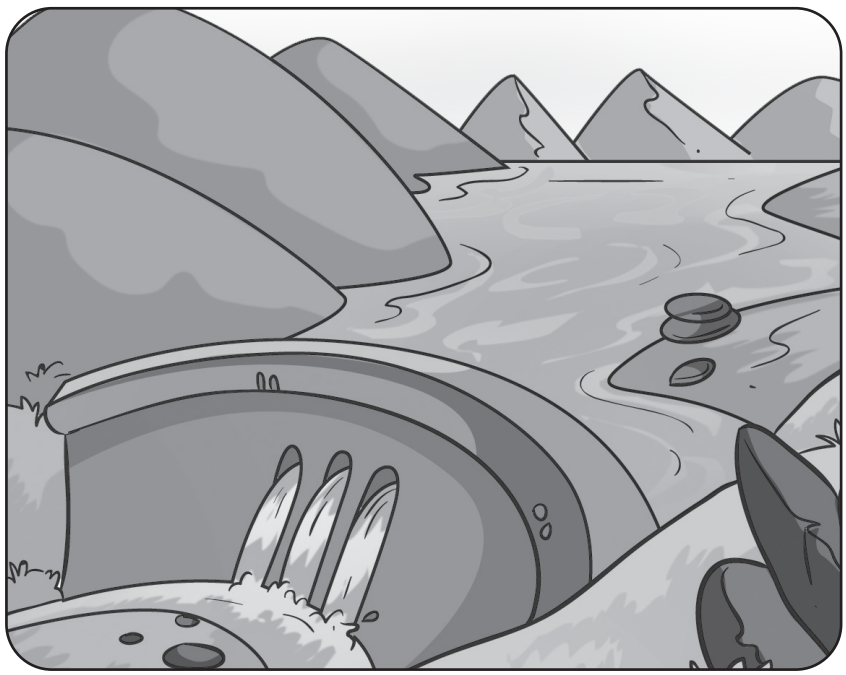
https://youtu.be/0P3b8bWqAkc
https://youtu.be/9Gw0rlXn6ec

Explain: (10 min)

- The force exerted perpendicular to an object's surface per unit area over which that force is distributed. P = F / A is the pressure (P) formula.
- As pressure is proportional to the area over which the force acts, it can be increased and decreased without affecting the force. If the force applied remains constant, the pressure

increases as the surface shrinks, and vice versa.

- A brick, for example, exerts a force equal to its weight on the object it is resting on. We now know that the sides of a rectangular brick have a wide surface and a thin surface. We are effectively changing the orientation of the brick resting on a surface by changing its orientation.
- The pressure in a liquid varies depending on its depth. As the depth increases, so does the pressure. The weight of the column of water above causes pressure in a liquid. Because the particles in a liquid are so closely packed, pressure acts in all directions.



- The pressure acting on a dam at the bottom of a reservoir, for example, is greater than the pressure acting near the top. As a result, dam walls are typically wedge-shaped.

Explore: (10 min)

What do we need:

- Wooden board.
- Balloon.
- Sharp pins.

What to do:

I. Arrange a matrix of sharp pins in rows and columns on a wooden board.

II. Take a large inflated balloon.

III. Gently place it over the pins.

IV. Place a small book on the balloon's top.

V. What happens next?

VI. Will the balloon deflate? Will the pins poke a hole in the balloon?

VII. Students will infer and draw conclusions.

Inference: The balloon is not going to burst. The balloon will burst if you prick it with a single pin. Despite the fact that many more pins were pricking the balloon, this did not occur.

A single pin exerts a large amount of pressure over a small area. When a large number of pins prick a body, the applied force is distributed over a large surface of the body, so each pin exerts very little

pressure on the balloon. As a result, the balloon will not burst.

Conclusion: It is concluded that the impact of a force depends on the magnitude of the force and the area over which it acts.

Elaborate: (10 min)

What do we need:

- Bottle made of plastic
- Water

What to do:

(i) Take a plastic bottle.

(ii) Make three holes in the same direction but at different heights on its sides.

(iii) Pour some water into it and allow it to run through the holes.

(iv) Examine the water flow.

(v) Students will observe and draw conclusion.

Observation:

(i) Water comes out of each hole with a different force and falls on the table at different distances from the bottle.

(ii) Water from the lowest hole emerges with the greatest force and falls at the greatest distance from the bottle.

(iii) Water flows from the topmost hole with the least amount of force and falls at the closest point to the bottle.

Conclusion: This demonstrates that the pressure in a liquid varies with the depth of the point of observation on it.

Evaluate: (5 min)

- Solve the worksheet 2
- Ask students to complete Concept Check on page 119

Home Assignment:

Find out:

- Why are dams built to be stronger and wider at the bottom than at the top?
- Why do scuba divers wear special suits when diving to great depths?

Do Q3-4 on page 51-52 of workbook.

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
Hydraulic Systems	119-121	45 Minutes	-

Objective:

Make a hydraulic elevator. (STEAM)

Engage: (5 min)

- Ask students that when someone steps on the brake in the car, the car stops. How can a 2000-pound car be stopped with just his foot on the pedal?
- After giving the students time to consider the situation, tell them that it is the hydraulic brake system. It transferred energy from the foot to the cylinders and pistons of the brake system, and then to the brake pads and rotors via the brake fluid. Then ask students So, how does hydraulics work?

- Explain them, hydraulic systems employ Pascal's Law, which states that a change in pressure on an incompressible fluid can be transmitted throughout the fluid. A user can exert force on one part of the hydraulic system, which applies pressure to the liquid and sends the energy to another part of the system, where it is converted to work.

Explain: (10 min)

- The study of how fluids behave when they are in motion is known as hydraulics. This is true for liquid flow in pipes, rivers, and channels. It also applies to fluids stored in tanks or other containers. Cities can keep water supplies and sewer lines flowing by understanding hydraulics. It has also contributed to the creation of powerful machines to assist with various types of work.
- Ancient people discovered how to do work with flowing water. Water was used to power water mills and to irrigate farmland. After scientists discovered that all liquids follow certain rules, people were able to do even more with them. They discovered that pressure in a liquid is equally transmitted in all directions. That is, if one presses down on the liquid in a tube, the liquid will push against whatever it comes into contact with, even if it is larger than the original tube. As a result, a small amount of force can be used to generate a larger force elsewhere.
- In the 19th century, scientists were able to use what they knew about liquids to develop systems to power factory equipment. Others have since learned to harness the power of liquids in a variety of other machines. Hydraulics, for example, is used in modern aircraft and automobiles to power brakes and steering mechanisms. Hydraulics is also used in factory robots and large earth-moving equipment on construction sites. The fluid is almost always some kind of oil. Thin oil is preferable to water because it does not freeze or rust and keeps moving parts lubricated.

Explore: (15 min)

Ask students to build hydraulic elevator by following the steps on page 121 of student book.

Elaborate: (5 min)

Show pictures of various places and machines and have a discussion with the class about where and how they use hydraulic machines.

- Gasoline pumps. They use hydraulics to transport fuel from the storage tank to the vehicle.
- Cars. A hydraulic brake circuit controls the brakes on all four wheels of a vehicle.
- Vehicle repair and maintenance. A hydraulic system is what allows a very heavy car to be raised and lowered while being serviced.
- Dishwashers. Hydraulics are used to increase water pressure for better cleaning. Hydraulic-powered dishwashers are also generally quieter.
- Machines for construction. Hydraulics is used to lift and lower objects by cranes, forklifts, jacks, pumps, and fall arrest safety harnesses.
- Airplanes. Their control panels are operated by hydraulic mechanisms.
- Elevators. Some elevators use a hydraulic mechanism to power the elevator car's movement and stop it when necessary.
- Bakeries. They use hydraulics to mass produce breads and pastries by lifting, flipping, and moving them along conveyor belts for packaging.

Evaluate: (5 min)

Complete Discuss and Answer on page 121 of student book.

Home Assignment:

Complete Concept Check on page 122 of student book.

Lesson Plan 5	Student Book pages	Time	Workbook pages
Gas Pressure and Atmospheric Pressure	122-123	45 Minutes	-

Objective:

examine the effect of force in the presence of air pressure

Keywords

Pascal
Atmospheric pressure

Resources:

- Whiteboard and markers
- Projector and screen
- Small plastic or rubber balloons
- Empty plastic bottles
- Rubber bands
- Small wooden blocks
- String
- Access to water and sinks

Useful Link

https://youtu.be/KndNN28OcEI

Engage: (5 min)

Ask questions like,

- "Have you ever noticed how a balloon inflates when you blow air into it?" or
- "Why does it get harder to breathe as you go higher in the mountains?"

Share real-world examples to grab their interest.

Explain: (10 min)

- Explain what air pressure is and how it is the force exerted by air molecules in all directions.
- Discuss how air pressure changes affect objects and forces. Low air pressure at higher altitudes, for example, can affect the boiling point of water.
- Explain atmospheric pressure, which is the pressure exerted by the weight of the Earth's atmosphere.

Explore: (15 min)

Balloon in a Bottle Experiment:

Materials: Small plastic bottles, balloons

- Students should be instructed to place an uninflated balloon inside a plastic bottle.
- They will then attempt to inflate the balloon inside the bottle using only their breath. Examine the forces and air pressure at work in this experiment.

Block and String Experiment:

Materials: Small wooden blocks, string

- Students should tie a string to a wooden block and place it in a container of water. They'll notice the block looks lighter underwater.
- Discuss how buoyancy and air pressure play a role in this phenomenon.

Elaborate: (10 min)

Encourage students to relate their hands-on experiences to concepts such as air pressure and forces. Discuss how these principles apply to their lives.

Evaluate: (5 min)

Conduct a "Pressure Quiz" activity in which you ask students multiple-choice or true/false questions about air pressure and its effects on forces. As an example:

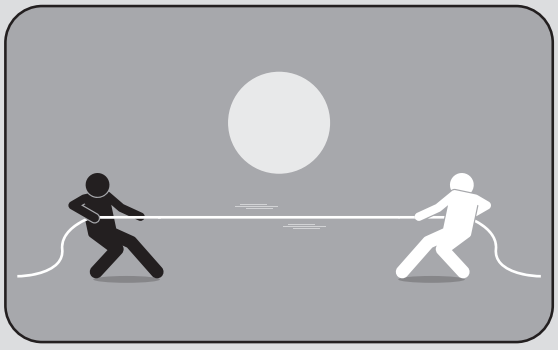
- True or False: Air pressure decreases with increasing altitude.
- Which statement is correct? A) High air pressure leads to more buoyant forces. B) Low air pressure leads to less buoyant forces.
- Multiple-choice: When you blow up a balloon inside a bottle, what forces are at play? A) Gravity only. B) Air pressure only. C) Both gravity and air pressure.

Home Assignment:

- Take a small, empty plastic bottle and carefully attach a balloon to the neck of the bottle, making sure it's securely sealed. Over the next 24 hours, have them observe and document any changes in the balloon's size and appearance.
- Students should explain their observations and relate them to the concepts of air pressure and forces discussed in the lesson in a brief report. Encourage them to think about how changes in external conditions, such as temperature, may have affected the balloon's behaviour.

Worksheet 1:

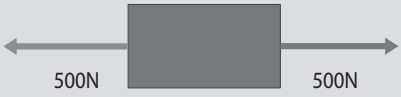
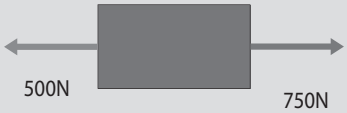
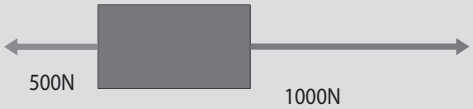
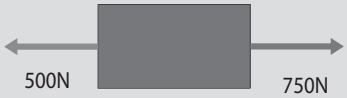
A force is either balanced or unbalanced. People are exerting force in one of these ways in the image below



- Is the above image an example of pushing or pulling? _____
- If one boy exerts 240 N of force and the other boy exerts 240 N of force.

  Who will triumph? _____
- What is the total force on the rope? _____
- Is this a balanced or an unbalanced force? _____

Complete the following table:

Forces Acting on an Object	Resultant Force	Direction of the Resultant Force
		
		
		
		

Worksheet 2:

Give the equation for the relationship between pressure, force, and area.

In each of the following cases, explain what happens to the pressure.

1. A woman changes her stiletto heels for a flipflop.

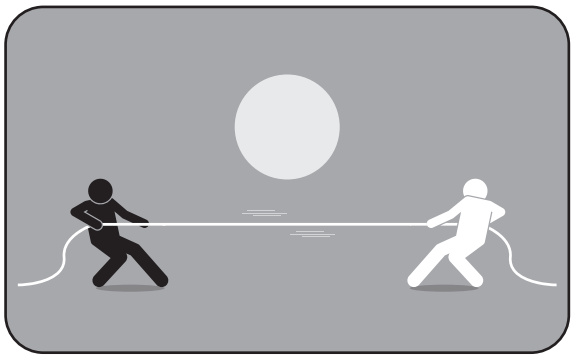
2. A dull knife has been sharpened

3. Describe why it is easy for camels to walk on the sand but difficult for us.

4. An elephant's average weight is 4000 N. Its foot sole has a surface area of 0.1m2. Determine the pressure exerted by one elephant foot.

Answers for Worksheet 2:

A force is either balanced or unbalanced. People are exerting force in one of these ways in the image below



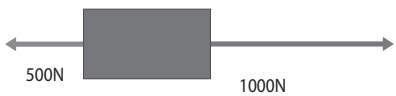
- Is the above image an example of pushing or pulling? Pulling
- If one boy exerts 240 N of force and the other boy exerts 240 N of force.

  Who will triumph? No one.
- What is the total force on the rope?

Correct answer is zero.
When equal forces in opposite directions are added, the net force is zero.

- Is this a balanced or an unbalanced force? Balanced

Complete the following table:

Forces Acting on an Object	Resultant Force	Direction of the Resultant Force
	zero	Does not move
	250 N	Moves towards right.
	500 N	Moves towards right.
	200 N	Moves towards left.

Answers for Worksheet 2:

Give the equation for the relationship between pressure, force, and area.

Pressure =Force + Area

In each of the following cases, explain what happens to the pressure.

1. A woman changes her stiletto heels for a flipflop.

The downward pressure exerted by the woman's shoe is reduced once she switches to a flip flop, as the area in contact with the ground increases.

2. A dull knife has been sharpened

As the surface area in contact with the cutting surface decreases after sharpening, the downward pressure from the knife increases.

Describe why it is easy for camels to walk on the sand but difficult for us.

Walking on sand is extremely difficult for us. Camels, on the other hand, can easily walk on it because they have large padded feet that increase the area of contact with the sandy ground. This relieves pressure and allows them to walk more easily on the sand.

An elephant's average weight is 4000 N. Its foot sole has a surface area of 0.1m2. Determine the pressure exerted by one elephant foot.

Average weight of the elephant = 4000 N

Weight of one leg = Force exerted by one leg
= 4000/4 = 1000 N

Area of the sole of one foot = 0.1 m2

Exercise Answers

1. Choose the correct answer:

i. **a.** Are balanced

ii. **b.** Fluid

iii. **d.** the pull of gravity

iv. **b.** the pressure is high

v. **d.** 20 N /m2

vi B

2. Fill in the blanks:

i. interaction

ii. Hydraulic system

iii. kilograms per cubic meter (kg/m3

iv. balancer

v. buoyancy

3. **a)** Calculate the volume of the wooden block:

Volume = Length x Width x Height

Volume = 6m x 2m x 2m = 24 cubic meters

b) Calculate the density of the wooden block:

Density = Mass / Volume

Mass = 200g = 0.2 kg

Density = 0.2 kg / 24 m3 = 0.0083 kg/m3

4. Short answer questions:

i. Force is a push or pull on an object that can cause it to accelerate or deform.

ii. Pressure is the force applied per unit area.

iii. The pressure is 20 N/m^2 (P = F/A, P = 500 N / 25 m^2).

iv. Camel's feet do not sink into the sand because the large, soft, and padded surface area of their feet distributes the weight over a larger area, reducing the pressure on the sand.

v. The second law of Newton states that the acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass. It can be written as F = ma, where F is the force, m is the mass, and a is the acceleration.

vi. Uses of hydraulic systems include car brakes, elevators, construction equipment, and more.

vii. The relationship between area and pressure is inversely proportional. As the area over which a force is spread increases, the pressure decreases, and vice versa.

viii. A barometer is used to measure atmospheric pressure.

5. Long answer questions:

i. The floating or sinking of objects in a fluid, like water, is determined by the principle of buoyancy. When an object is immersed in a fluid, it experiences an upthrust or buoyant force, which opposes its weight. If the object's weight is less than or equal to the upthrust, it will float. If the weight is greater, the object will sink. This depends on the relative densities of the object and the fluid. For example, objects with a density less than that of water will float.

ii. Pressure is measured using instruments called pressure gauges. There are various types of pressure gauges, including manometers, barometers, and pressure sensors. Manometers typically use a liquid column to gauge pressure by measuring the height difference between two columns of liquid in a U-shaped tube. The height difference is directly proportional to the pressure difference.

iii. Pressure in liquids is determined by the depth below the liquid's surface. It increases with depth according to Pascal's principle. The pressure in a liquid is the same in all directions at a given depth and is transmitted undiminished in all directions. Therefore, the deeper you go into a liquid, the greater the pressure due to the weight of the liquid above.

iv. To reduce the pressure of the feet of a chair on the carpet, a furniture maker could use broader, flatter feet or attach some form of padding to distribute the chair's weight over a larger area.

v. A needle used for sewing has a sharp point to easily penetrate fabrics without causing excessive damage. The sharp point minimizes friction and makes it easier to pierce through materials.

vi. Dams are built with thicker walls at the bottom and thinner walls at the top to withstand the enormous pressure of the water reservoir. The thickness of the dam's walls is designed to support the weight of the water and resist the lateral force it exerts.

vii. The effect of depth on pressure is that pressure increases with depth in a fluid. This is due to the weight of the fluid above a certain depth, creating greater pressure at greater depths.

viii. A hydraulic system is a mechanism that utilizes a liquid to transmit force. It operates on Pascal's principle, which states that when pressure is applied to a confined fluid, the pressure is transmitted undiminished throughout the fluid. Hydraulic systems are commonly used in various applications, such as car brakes and heavy machinery.

6. Think about it:

a) A butcher sharpens knives to maintain their cutting efficiency and precision.

b) Stiletto heels can damage wooden floors due to their small point of contact with the floor, creating high pressure, and increasing the risk of damage.

CHAPTER 09

Reflection and Refraction of Light

Student Book Pages 126-138

Learning outcomes

- identify basic properties of light (i.e. speed, transmission through different media, absorption, reflection and dispersion)
- Describe and show how an image is formed by the plane mirror.
- state the Laws of Reflection
- describe different optical instruments which use curved mirror
- relate the apparent colour of objects to reflected or absorbed light
- explain that light is refracted at the boundary between air and any transparent material
- distinguish between reflection and refraction of light with daily life examples
- Investigate that light is made up of many colours. Relate the apparent color of objects to reflected or absorbed light
- identify spherical mirrors. describe the characteristics of an image(s) formed by concave and convex mirror
- describe use of different optical instruments with planes in which spherical mirrors are used.

Keywords

refraction, reflection, transparent,, medium,, mirror image, rare-view mirror, optical instruments, diminished, magnified, refraction, refracted ray, emergent ray, object, image, dispersion, rainbow spectrum

Overview of the Unit

All of our daily activities, such as running, walking, holding, lifting, and so on, involve the application of force.

Force: In simpler words, force is defined as a push or a pull. Force is a vector quantity, which means it has a direction as well as a magnitude. The SI Unit of Force is Newton N.

Pressure: Thrust is the surface's net effective force or the component of the force acting normal to the surface.The SI unit of thrust is Newton N.

Force is the result of two objects interacting and attempting to change the state of the object. The pressure is the force acting on an object perpendicular to its surface, resulting in force spreading over a specific area. This could be analogous to the distinction between stress and pressure. As a result, when force is applied over a large area, pressure is said to be low, whereas when the same force is applied to a small area, pressure is said to be high.

Lesson Plan 1	Student Book pages	Time	Workbook pages
Reflection of Light	126-128	45 Minutes	-

Objective:

- identify basic properties of light (i.e. speed, transmission through different media, absorption, reflection and dispersion)
- Describe and show how an image is formed by the plane mirror.
- state the Laws of Reflection

Keywords

Ray
Angle of incidence
Angle of reflection
Regular reflection
Diffused reflection

Engage: (5 min)

- Without offering any corrections, have students share what they already know about light reflection on the board or poster paper.
- Ask questions like, 'What is required to create a reflection?' and 'Which materials are capable of reflecting light?' to guide the discussion.

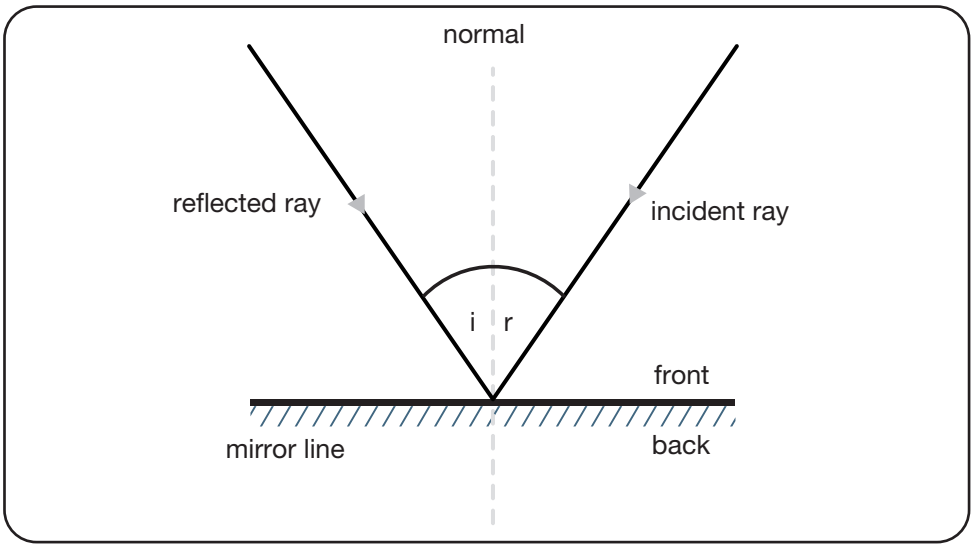
- Inform the students that in today's lesson, they will learn more about reflection.

Explain: (10 min)

Useful Link

https://youtu.be/EwBK_cXUTZI

- The reflection of light occurs when a light ray approaches a smooth polished surface and bounces back. The incident light rays that hit the surface are reflected back. The reflected ray is the ray that bounces back. Normal is the name given to a perpendicular drawn on a reflecting surface. The reflection of an incident beam on a plane mirror is depicted in the figure below.



- The laws of reflection govern how incident light rays are reflected on reflecting surfaces such as mirrors, smooth metal surfaces, and clear water. Consider the plane mirror depicted in the figure above. According to the law of reflection,

1. The incident ray, reflected ray, and normal all share the same plane.
2. The angle of incidence = Angle of reflection

Explore: (10 min)

The properties of light waves as they bounce off smooth surfaces are described by the law of reflection. The activity will allow students to learn how light waves reflect off a surface at an angle equal to the angle at which the light strikes the surface.

What do we need:

- mirrors
- paper
- flashlights
- glass jar filled with water
- ball of aluminum foil
- box wrapped in aluminum foil

What to do:

- Make materials available to students.
- Students will practice shining flashlights on each of the materials.
- Students will use drawings, labels, or words to record their observations.
- Students will reach conclusions about other surfaces that are excellent light reflectors.

Elaborate: (10 min)

What do we need:

- mirror
- protractor
- flashlight

What to do:

- On a white sheet of paper, students will place a protractor.
- Students will hold a mirror at a 90-degree angle to the protractor's zero-degree line.
- Students will place the flashlight next to the protractor on the paper. Students will shine the flashlight at the 15-degree, 30-degree, 60-degree, and 90-degree angles to see how much light reflects off the mirror at each of those angles.
- Students will draw a reflection pattern from each angle.
- Students will explain how their drawings demonstrate the Law of Reflection.

Evaluate: (5 min)

Ask students to complete Q5 on page 60 of workbook.

Homework:

- Observe the reflection of light using the different surfaces that you can fine at your home.
- Complete Q6-7 of on page 60 workbook.

Lesson Plan 2	Student Book pages	Time	Workbook pages
Reflection of Light	128-129	45 Minutes	62

Objective:

- explain that light is refracted at the boundary between air and any transparent material
- distinguish between reflection and refraction of light with daily life examples

Keywords

Apparent depth
Real depth
Bends

Engage: (5 min)

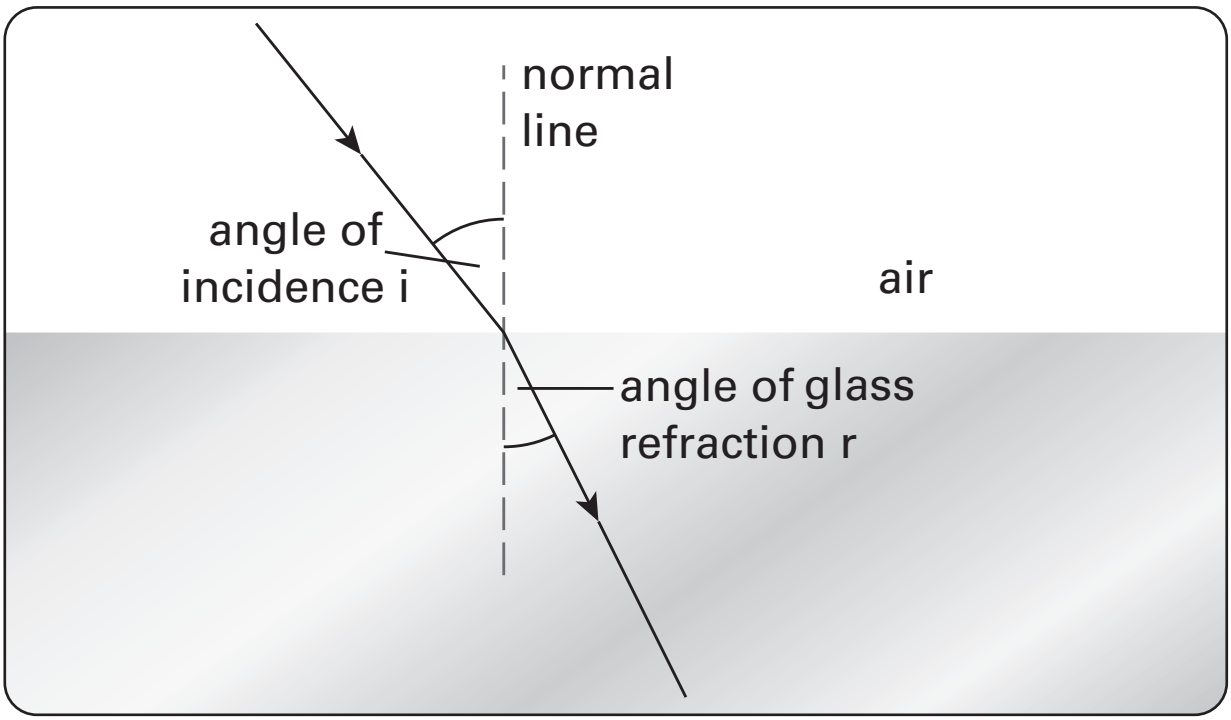
- Begin the lesson by projecting a rainbow onto the board. Inquire if students understand how a rainbow forms. What are the scientific principles at work here?
- Allow students to share their ideas with their classmates.
- After students have shared their thoughts, tell the students that a rainbow forms in the exact opposite direction of the sun. The simple procedure involved is light refraction, which causes a ray to split into seven different colours.

Useful Link

https://youtu.be/UUc44Vg5pCI

Explain: (10 min)

The bending of a wave as it travels from one medium to another is known as refraction. The bending is caused by density differences between the two substances. Light refraction is one of the most commonly observed phenomena, but other waves, such as sound waves and water waves, also exhibit refraction. Refraction allows us to have optical instruments like magnifying glasses, lenses, and prisms. It is also due to light refraction that we are able to focus light on our retina.



Explore: (15 min)

What do we need:

- Pen
- water
- Card or paper
- Glass

What to do:

- Fill the glass nearly to the edge.
- Make arrows on a single piece of card or paper. Place the paper behind the glass and observe how the arrow changes direction.
- Try to come up with a word that still makes sense when you put it behind the glass.
- 'BUD' or 'NOW' are two options.
- Examine what happens when the words are placed behind the glass.

Elaborate: (10 min)

- Students can try this experiment with glasses of various sizes and styles. They can also draw different images and place them behind the glass to see what happens.

Class Discussion:

- Discuss with the students what they believe caused the change in direction, and then explain that the light from the arrow that reaches your eye is refracted by the glass of water.In fact, the glass of water functions as a convex lens (like you might have in a magnifying glass). Convex lenses bend light to focus on a specific point. This is the point where the light from an object intersects.
- As far as your eye is concerned, the light at the tip of the arrow is now on the right side, and the light on the right side is now on the left (assuming you are further away from the glass than the focal point).

- The direction of the arrow will be as you expect it to be if you move the image closer to the glass than the focal point.

Evaluate: (5 min)

- Worksheet 1 will be given.
- Discuss and Answer page 129 of student book.

Homework:

Complete Q10 on page 62 of workbook

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
Spherical Mirrors	130-131	45 Minutes	58 and 63

Objective:

- identify spherical mirrors. describe the characteristics of an image(s) formed by concave and convex mirror
- describe use of different optical instruments with planes in which spherical mirrors are used.

Keywords

Centre of curvature
Principal axis
Principal focus
Concave
Convex

Engage: (5 min)

- One day before, ask students to bring a spoon.
- Each student will bring a stainless steel spoon then ask them to look into the spoon with the outside edge up to your face.
- Ask them to look into the spoon with the outside edge up to your face. Now ask the students:
  - Do they recognize themselves in it?
  - Is this image different than what you see in a plane mirror?
  - Is this a vertical image?
  - Is the image the same size, smaller, or larger?

Useful Link

https://youtu.be/b_R6t-q4ALc

Explanation: Observe your image with the spoon's inner side. Your image may be more upright and larger this time. You may notice that your image is inverted if you move the spoon away from your face. You can compare the image of your pen or pencil instead of your face.

Explain: (10 min)

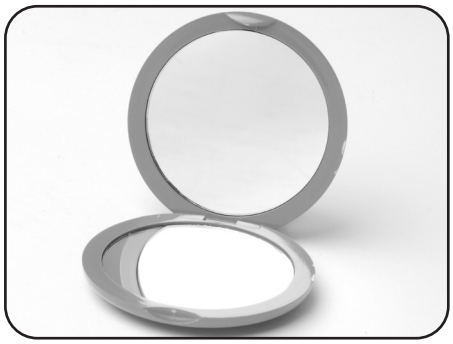
A spherical mirror is a mirror with the shape of a spherical surface cut out of it.

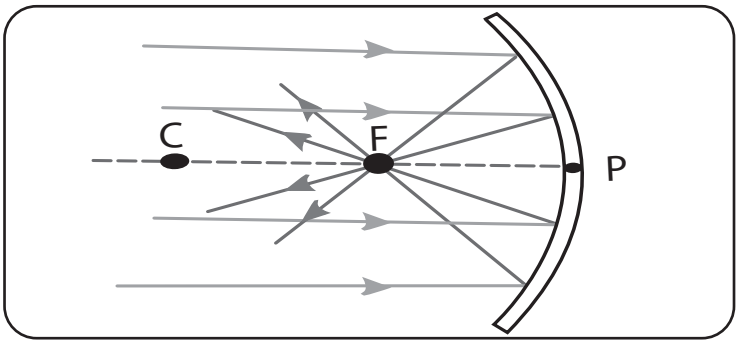
Spherical mirrors are divided into two types, which are as follows:

1. Concave Mirror
2. Convex Mirror

Concave Mirror:

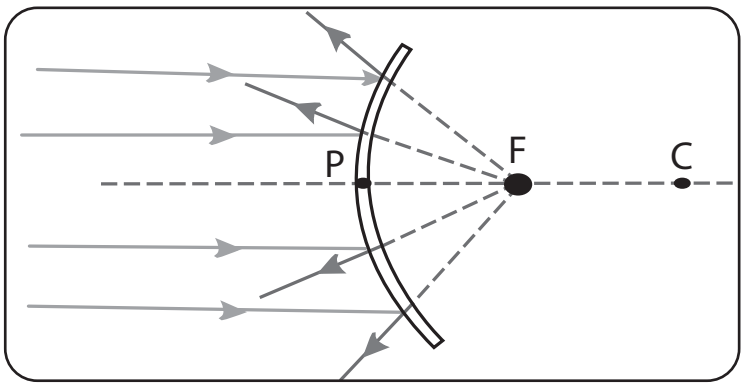
We know that a spherical mirror is a cut-out of a reflective sphere. A concave mirror has a reflective surface that is curved inwards on one side. Concave mirrors are common in shaving mirrors, dentists, and even telescopes. Although the reflected image is magnified, the field of view is restricted. Concave mirrors are also referred to as converging mirrors.





Convex Mirror:

Similarly, a convex mirror has a reflective surface that curves outwards. Convex mirrors are widely used in automobile mirrors. The reflected image shrinks as the focal length increases, but the field of view expands. This is very useful for drivers because it reduces blind spots significantly. Convex mirrors are also known as fish eye mirrors or diverging mirrors. These mirrors are easily identified because the outward bulge is quite visible most of the time.



Explore: (15 min)

What do we need:

- Concave mirror
- Convex mirror
- Chart Paper
- Marker

What to do:

1. Perform this activity in groups.
2. Provide convex and concave mirrors to each group.
3. The image formation will be observed by students using concave and then convex mirrors.
4. The properties of the image formed by both mirrors will then be written down by the students.
5. Students will create a T-chart to record the properties of an image formed by a concave mirror and the properties of an image formed by a convex mirror.

Elaborate: (5 min)

- Each group will present their T-chart to the class.
- Following that, all groups will compare their findings, reach a consensus, and write the properties of images formed by convex and concave mirrors on the board.

Evaluate: (5 min)

Worksheet 2 will be given.

Homework:

Complete Q3 and 11 on page 58 and 63 of workbook.

Lesson Plan 4	Student Book pages	Time	Workbook pages
Prisms and Refraction	131-133	45 Minutes	-

Objective:

- Investigate that light is made up of many colours.
- Relate the apparent color of objects to reflected or absorbed light

Keywords

Refraction
Prism
Disperse

Resources:

- Prism or diffraction grating (or a glass of water and a flashlight)
- White light source (e.g., flashlight)
- Various colored objects (e.g., colored paper, fabrics, toys)
- Reflective objects (e.g., mirrors)
- Whiteboard and markers

Useful Link

https://youtu.be/9Vsl0Iom3S0

Engage: (5 min)

Begin the lesson by talking about light and colour.

- "What happens when you shine a torch through a prism or a glass of water?"
- "Why does a red shirt appear red to our eyes?"

Explain: (10 min)

- Explain how white light is made up of different colours by providing an overview of the visible light spectrum.
- Introduce the concept of refraction and how it divides light into its constituent colours, using a prism or a glass of water as an example.
- Discuss how the colour of an object is related to the amount of light it reflects or absorbs. Explain that objects appear coloured because certain colours of light are reflected while others are absorbed.

Explore: (15 min)

Rainbow Reflection with CD:

Materials: Compact disc (CD), white light source (flashlight), and a dark room

- Instruct students to enter a darkened room and shine a white light source (such as a torch) on the surface of a compact disc (CD).
- They should look at the colourful patterns that have been created on the wall or ceiling.
- Ask them to describe the colours and patterns they see and why they do so.
- Discuss the phenomenon of light diffraction and its relationship to the colour dispersion in a rainbow.
- Encourage students to investigate how different angles of tilting the CD affect the appearance of the rainbow pattern. Students can see firsthand how light is made up of different colours and how they can be separated using a simple object like a CD in this activity.

Elaborate: (10 min)

- Encourage students to relate their hands-on experiences to the visible light spectrum and the relationship between object colour and reflected light.

Evaluate: (5 min)

- Ask students to explain how the visible light spectrum and light reflection or absorption relate to the apparent colour of objects.
- Complete Concept Check page 133 of student book.
- Complete Q4 on page 59 of workbook.

Home Assignment:

- Give students a list of objects or scenarios to consider.
- Instruct them to determine whether these objects would change colour when illuminated by different coloured lights.
- They might consider how a red apple would appear under a green light, for example. Students should justify their decisions.
- Complete Q2 on page 136 of student book.

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
Optical Instruments	133-135	45 Minutes	-

Objective:

- Describe different optical instruments which use curved mirrors.
- Describe use of different optical instruments with plane in which spherical mirrors are used.

Keywords

Microscope
Binoculars
Telescopes

Resources:

Engage: (5 min)

- Begin the lesson by talking about planets.
- "How are we able to know about planets even though we can’t see them?"

Explain: (10 min)

- Explain how the spherical mirrors in different instruments so that we are able to see far.
- Explain and show them different optical instruments.

Explore: (15 min)

- Bring binoculars and microscope in class and let students use them.
- If possible, open them and show students the lenses and mirrors and their placement

Elaborate: (10 min)

Draw ray diagram and explain them the working of the optical instruments.

Evaluate: (5 min)

Ask students to attempt Discuss and Answer page 133-134 of student book.

Home Assignment:

Complete Concept Check page 135 of student book.

Worksheet 1:

Define Reflection:

Define Refraction:

Identify and write the correct option in the relevant box





Reflection	Refraction

Worksheet 2:

1. What are the two types of spherical mirrors?

Name		
Definition:		
Drawing:		

2. Write down the properties of an image:

(i) When the object is very close to the concave mirror.

(ii) When the object moved a long away from the concave mirror

(iii) The image formed by a convex mirror.

Answers for Worksheet 1:

Define Reflection:

Light reflection is the simple phenomenon of light bouncing back after striking an object.

Define Refraction:

Light refraction is the change in direction of light as it travels from one medium to another.

Identify and write the correct option in the relevant box

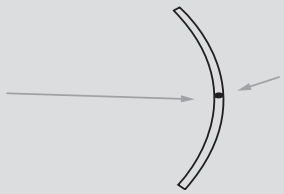
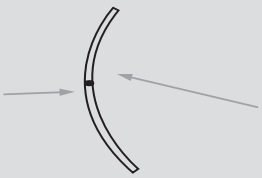




Reflection	Refraction
Mirror	Glass of water
Water and mountains	Eye glasses
Silver Spoon	

Answers for Worksheet 2:

What are the two types of spherical mirrors?

Name	Concave Mirror	Convex Mirror
Definition:	A concave mirror is a spherical mirror with a dented inward reflecting surface.	The reflective surface of a convex mirror bulges out toward the light source.
Drawing:	Concave mirror 	Convex mirror 

2. Write down the properties of an image:

(i) When the object is very close to the concave mirror.

1. Virtual
2. Upright
3. Larger than the object.

(ii) When the object moved a long away from the concave mirror

1. Real
2. Inverted
3. Smaller than the object

(iii) The image formed by a convex mirror.

1. Virtual
2. Upright
3. Smaller than the object

Exercise Answers

1. **i.** **d)** glass jar

ii. **a)** regular reflection

iii. **d)** they are laterally inverted

iv. **c)** virtual, upright, smaller than the object

v. **d)** a torch

vi. **b)** Light is a form of energy.

3. Short answer questions:

i. **a)** Opaque objects do not allow light to pass through them and cast shadows.

Example: a wooden door.

b) Transparent objects allow light to pass through clearly. Example: clear glass.

c) Translucent objects allow some light to pass through, but it scatters the light. Example: frosted glass.

d) Luminous objects emit their own light. Example: the Sun.

ii. Opaque objects: a brick wall, a wooden desk.

Transparent objects: a clear glass window, a plastic bottle.

Translucent objects: frosted glass, wax paper.

iii. We can see non-luminous objects because they reflect or scatter light from luminous objects or other sources.

iv. In a plane mirror, the angles of the incident and reflected rays are equal.

vi. The distance of the image in a plane mirror is the same as the distance of the object in front of the mirror.

vii. The laws of reflection are:

1. The incident ray, the reflected ray, and the normal (a line perpendicular to the mirror's surface) all lie in the same plane.

2. The angle of incidence is equal to the angle of reflection.

Light travels slower in water than in air. This is because the speed of light decreases as it passes from air into a denser medium like water.

Three effects of refraction are:

1. Bending of light when it passes from one medium to another with a different optical density.

2. Dispersion of light into its component colors when passing through a prism.

3. Lenses, such as eyeglasses or camera lenses, use refraction to focus light and form images.

The colors in the spectrum of white light are, in order: red, orange, yellow, green, blue, indigo, and violet.

4. Long answer questions:

i. Plane mirrors are flat mirrors with a reflective surface, such as the typical mirrors we use every day. These mirrors produce virtual, upright, and laterally inverted images of objects. They reflect light according to the law of reflection, with the angle of incidence equal to the angle of reflection. Plane mirrors are commonly used for personal grooming, home decor, and various practical applications, including in cars and dressing rooms.

ii. Characteristics of an image formed by a plane mirror:

- The image is virtual, meaning it cannot be projected onto a screen.
- The image is upright, which means it has the same orientation as the object.
- The image is the same size as the object.
- The image is laterally inverted, meaning left and right are swapped.

iii. The image formed by a concave mirror is different from that formed by a convex mirror in the following ways:

- A concave mirror can produce both real and virtual images, whereas a convex mirror always produces virtual images.
- The image formed by a concave mirror can be magnified or reduced in size, while a convex mirror typically produces smaller, upright images.
- The focal point of a concave mirror can be either in front of the mirror (real image) or behind the mirror (virtual image), depending on the object's position. In contrast, a convex mirror has a virtual focus.

iv. Evidence that light travels in straight lines:

- Shadows are formed in a straight line when an object blocks light.
- Light does not bend around corners; it travels in a straight path until it encounters a surface or medium where it can change direction.

v. If the image formed by a concave mirror is virtual, upright, and larger than the object, it tells us that the object is positioned between the focal point and the mirror's surface.

vi. The image formed by a convex mirror is virtual, upright, and smaller than the object. It is also diminished, meaning it appears to be farther away than the object's actual distance.

vii. Reflection occurs when light rays bounce off a surface, while refraction happens when light changes direction as it passes from one medium to another with a different optical density.

viii. Three uses of refraction are:

- Corrective lenses (eyeglasses) to aid vision.
- Magnifying glasses and telescopes use lenses to magnify objects.
- Cameras and projectors use lenses to form and focus images.

5. Think about it:

i. Diamonds sparkle from many directions and in various colors due to their high refractive index. The cut of the diamond reflects and refracts light, causing dispersion into different colors.

ii. A concave mirror cannot be used as a rear-view mirror in a car because it forms real, inverted images, making objects appear closer and potentially creating safety issues.

iii. Uses for plane, concave, and convex mirrors:

- Plane mirrors: Used in everyday mirrors, dressing mirrors, and home decor.
- Concave mirrors: Used in makeup mirrors, telescopes, and car headlights.
- Convex mirrors: Used in rear-view mirrors for vehicles, security mirrors, and surveillance systems.

iv. Yes, a ray of light bends differently when it travels from air to water and from water to air. When it travels from air to water, it bends toward the normal line because water is denser than air. When it goes from water to air, it bends away from the normal line.

v. The fish appears to be at a different position than its actual location due to the bending of light at the air-water interface. The man should aim the spear where the fish appears to be rather than its actual position.

CHAPTER 10

Electricity and Magnetism

Student Book Pages 139-149

Learning outcomes

- define voltage and current, state their SI unit
- define resistance and its SI unit
- formulate that resistance is the ratio of voltage to current
- define electric power and state its unit
- recognize the electric power of various electrical appliances
- estimate the cost of using electrical appliances (electricity bill) in daily life
- recognize the terms earth wire, fuse, circuit breaker
- analyse the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers
- list precautionary measures to ensure the safe use of electricity
- investigate the factors that affect the strength of an electromagnet.
- describe the properties that are unique to electromagnets (i.e. the strength varies with current, number of coils and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch
- describe briefly the working principles of electromagnetic devices such as speaker and doorbell

Overview of the Unit

Electricity is frequently described as static or dynamic. The difference between the two is simply whether the electrons are at rest (static) or in motion (dynamic). Static electricity is the accumulation of an electrical charge on the surface of an object. It is considered "static" because there is no current flowing.

Physics introduces the concept of magnetism to help you comprehend one of the most basic interactions in nature: the interaction between moving charges. The magnetic force, like gravitational and electrostatic forces, is a distant interaction.

Electricity and magnetism:

- Magnetism is only felt when there are moving charges as a result of electricity.
- In other words, electricity can exist in the absence of magnetism, but magnetism cannot exist in the absence of electricity.

Keywords

earth wire, fuse, circuit breaker, switch, wire, rheostat, ampere, electric power, battery, static electricity, attraction, repulsion, electric charge, coulomb-metre, positive electric charge, negative electric charge, neutral, friction, conductors, insulators, circuit, circuit symbols, circuit diagrams, closed and open circuit, electric current, ammeter, ampere (symbol A) series circuit, parallel circuit, voltage, resistance, volts, voltmeter, resistor, variable resistor, positive, negative terminals, electromagnets

Lesson Plan 1	Student Book pages	Time	Workbook pages
Voltage, Current, and Resistance	139-140	45 Minutes	-

Objective:

- define voltage and current, state their SI unit
- define resistance and its SI unit
- formulate that resistance is the ratio of voltage to current

Keywords

Electrical charges
Ampere
Ammeter
Potential energy
Volts

Engage: (5 min)

- Use a brief activity to capture the student's attention.
- Excite students by saying 'Let's do a quick activity before we start our lesson today'.
- Form three groups from the class. Tell them that you will provide each group with a bulb, two connecting wires, and a battery, and they will construct a simple circuit. To recognize the winner, the student who finished first must clap his hands.
- already know about light reflection on the board or poster paper.

Useful Link

https://youtu.be/NntY-D6ySZ0

Explain: (10 min)

- The property of materials that allows the flow of electric current is referred to as resistance. The flow of current is certainly opposed by resistance.
- The resistance unit is ohms, which is represented by the Greek uppercase letter omega.
- The resistance is affected by the voltage across a resistor as well as the current flowing through it.
- An object's electrical resistance is the measure of its resistance to the flow of electric current. The electrical conductance is the inverse quantity.
- Electrical conductance refers to the ease with which an electrical current can be passed.
- Resistors are electrical circuit components.
- To some extent, all of the materials resist current flow.

Explore: (15 min)

- The activity will be demonstrated by the teacher.
- To begin, have a basic circuit consists of one bulb, two batteries, and an ammeter. Ask student ' Who wants to read the ammeter's reading?'
- A student will volunteer to read the ammeter measurement and write it on the board.
- The ammeter will be replaced with a voltmeter.
- Another student will read the measurement and write it on the board.
- Now ask them
  - o ‘I'm going to add another bulb who wants to read the ammeter's measurement’.

  Another student will read the measurement and write it on the board.
  - o Have you noticed any changes in the brightness of the bulb?
- Yes, the lighting has dimmed.
- Finally, add another bulb and ask the students
  - o Who wants to read the measurement?

    (Another student will read the measurement and write it on the board.)
  - o Is there a difference in the brightness of the bulb now that we have three bulbs in our circuit?

    (When compared to the circuit with only one bulb, the brightness of the bulb has now dimmed)

Elaborate: (5 min)

Analyze the experiment with students.

- What happens to the voltage as the number of bulbs increases? What happens to the ammeter reading as the number of bulbs increases?

- (Nothing has changed; everything remains the same.)

Evaluate: (5 min)

- Provide worksheet 1 to solve.
- Complete Concept Check page 141 of student book.

Home Assignment:

Attempt Q4 (i-ii) on page 148 of student book.

Lesson Plan 2	Student Book pages	Time	Workbook pages
Electric Power	141-142	45 Minutes	-

Objective:

- define electric power and state its unit
- recognize the electric power of various electrical appliances
- estimate the cost of using electrical appliances (electricity bill) in daily life

Keywords

Rate
Watt
Power

Resources:

- Sample electrical appliances (e.g., toaster, light bulb, microwave, TV)
- Electricity meter or wattmeter (if available)
- Electricity bill sample
- Whiteboard and markers
- Projector and screen

Useful Link

https://youtu.be/CIv6vu9d73c

Engage: (5 min)

Start the lesson by sharing a few interesting facts about electric power. Ask questions like,

- "What are some common electrical appliances you use daily?"
- "Do you know how much electricity these appliances consume?"

Explain: (10 min)

- Give an overview of electric power, defining it as the rate at which electrical energy is consumed or produced.
- Discuss the unit of electric power, which is the watt (W).
- Present examples of electrical appliances and their power ratings, emphasizing how different appliances consume varying amounts of power.
- Explain the relationship between electric power and energy consumption, discussing the formula $P = IV$ (Power = Current × Voltage).

Explore: (15 min)

- Appliance Power Calculation:
- Materials: Sample electrical appliances, electricity meter (if available)
- Provide a sample of electrical appliances.
- Students can directly measure the power consumption of each appliance if an electricity metre is available.
- If a metre is not available, students can estimate their power consumption by researching or referring to typical power ratings.

- They must compute the energy consumption per hour (kWh) for each appliance.

Elaborate: (10 min)

- Distribute mock electricity bills to students, each with a list of various appliances and their estimated usage.
- Based on the power ratings of the appliances and the provided electricity rate, students will calculate the total energy consumption and cost.

Evaluate: (5 min)

- Students will compare the energy consumption and cost of two different electrical appliances.
- Provide them with the power ratings and typical usage times for a microwave and a toaster.
- Ask students to calculate and compare the monthly energy consumption and cost for both appliances, assuming 30 days of use.
- This exercise assesses their ability to apply their knowledge of electric power and cost estimation.

Home Assignment:

Students should conduct a "appliance audit" in their own homes for the home assignment. Instruct them to identify and list all of the electrical appliances they use on a daily basis, as well as to record their power ratings (in watts). Then, ask them to estimate the monthly energy consumption and cost for each appliance based on their typical daily usage. This practical assignment allows students to apply what they've learned to a real-life scenario and gain insights into their electricity consumption patterns.

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
Earth Wire, Fuse, Circuit Breaker	142-143	45 Minutes	-

Objective:

- recognize the terms earth wire, fuse, circuit breaker
- analyse the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers
- list precautionary measures to ensure the safe use of electricity

Keywords

Earth wire
Fuse
Overloading
Circuit breaker

Engage: (5 min)

Write the words:

- Earth Wire
- Fuse
- Circuit Breaker

Discuss with the students what they know about these words.

Useful Link

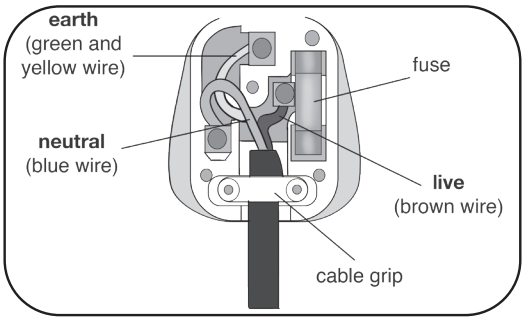
https://youtu.be/S8lB2kxT1n0

Explain: (10 min)

- A metallic body of high-power-rated electrical equipment is earthed by ground wire, shielding us from electric shocks.
- It also prevents live wire overloading and any leakage of electric charge through the body of metallic appliances, which could easily be transmitted to the ground. That is why earthing metallic equipment.
- Grounding wires provide an alternate path for electricity to return to the source rather than

through anyone who comes into contact with a potentially hazardous device or electrical box.

- Some electrical devices, such as vacuum cleaners and drills, do not even have an earth wire.



Explore: (15 min)

- Provide each student with a plug.
- Ask them to open the plug and identify the earth wire and fuse.

Elaborate: (5 min)

Students will make a poster on the importance of Earth wire, fuse and circuit breaker.

Evaluate: (5 min)

Do Q3-4 on page 148 of student book.

Home Assignment:

Attempt Q5-6 on page 68 of workbook.

Lesson Plan 4	Student Book pages	Time	Workbook pages
Electromagnets	144-146	45 Minutes	-

Objective:

- investigate the factors that affect the strength of an electromagnet.
- describe the properties that are unique to electromagnets (i.e. the strength varies with current, number of coils and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch
- describe briefly the working principles of electromagnetic devices such as speaker and doorbell

Keywords

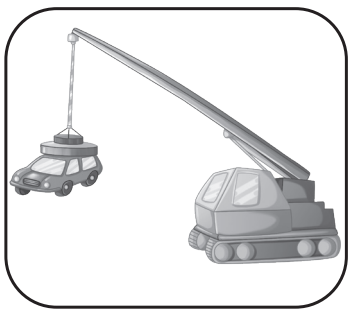
Electromagnet
Coiled
Strength
Flow

Useful Link

https://youtu.be/79_SF5AZtzo

Engage: (5 min)

- Show some images of electromagnets being used in daily life.
- Ask students what they think of these images. What is happening in the pictures?
- How are these machines working?



Explain: (10 min)

- Electromagnetism is the process of creating a magnetic field by passing current through a conductor. When a conductor is electrically charged, magnetic lines are produced. For example, if current, or positive charges, move in a wire, the magnetic field along the wire is produced, and the direction of magnetic lines and force can be determined using the Right-hand Rule.
- Electric and magnetic waves that oscillate at right angles to each other propagate electromagnetic waves.
- They have interference and diffraction properties.
- In a vacuum, they travel at a speed of 3 108m/s.
- Transverse waves are what they are.
- The following is the relationship between an electromagnetic wave's wavelength (λ) and frequency (c): $c = v \lambda$

Application in daily life:

- Many home appliances in household applications use electromagnetism as a fundamental operating principle.
- Maglev trains, also known as high-speed trains, operate on the electromagnetism principle.
- In a communication system, electromagnets are used to transfer data from the source to the receiver.
- Electromagnetism is used at some point in the manufacturing process in industries ranging from small instruments to large power equipment.

Explore: (15 min)

What do we need:

- A thin wire
- Nail
- AA battery
- Electrical Tape
- Metal paper clips or safety pins
- Sandpaper

What to do:

- Remove 1/2 inch of insulation from the ends of a foot-long piece of wire.
- Wrap the wire around the nail tightly.
- Using just your fingertip to hold the wire to the battery will hurt.
- Cover the connection between the wire and the battery with electrical tape. Even if there is no electrical load, the wire can become hot.

(An electrical load is a component or section of a circuit that uses (active) electric power. Loads in electric power circuits include appliances and lights. The term can also refer to the amount of power used by a circuit.)

- Put your electromagnet to the test. Connect one end of the wire to the positive end of the battery and the other to the negative end.
- Now place the nail and coil of wire over the pins or paper clips. The nail transforms into a magnet! You've just created an electromagnet.
- Simply release one side of the wire or battery connection to drop the paper clips or pins.

Elaborate: (5 min)

- Make groups of three to four students.
- Have a friendly competition among student groups to see who can collect the most paperclips.
- Students can also be asked to move the paperclips from one side of the room to the other. Students must pick up and drop paperclips using an electromagnet. No hands may come into contact with the clips.

Evaluate: (5 min)

- Worksheet 2 will be given to the students.
- Attempt Q1 and 4 on page 65 and 68 of workbook.

Home Assignment:

Complete Q6 on page 148 of student book.

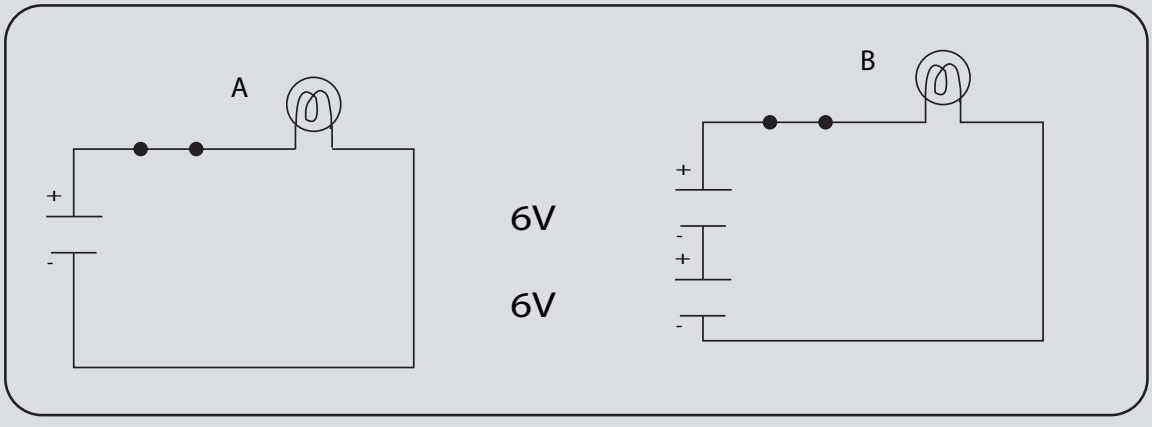
Worksheet 1:

Explain the relationship between resistance, current, and voltage in a circuit in your own words.

What happens to the current in a circuit when a 1.5 volt battery is replaced with a 9 volt battery?

How much current flows through a circuit consisting of a 9-volt battery and a bulb with a resistance of 3-ohm ?

Examine the diagram to find the answer:



How much total voltage is there in each circuit?

If the light bulb has a resistance of 6 ohms, how much current would be measured in each circuit?

Worksheet 2:

Tick the most important uses of electromagnets:

	Home Appliances
	Craft
	Industrial Appliances
	Cooking
	Transport

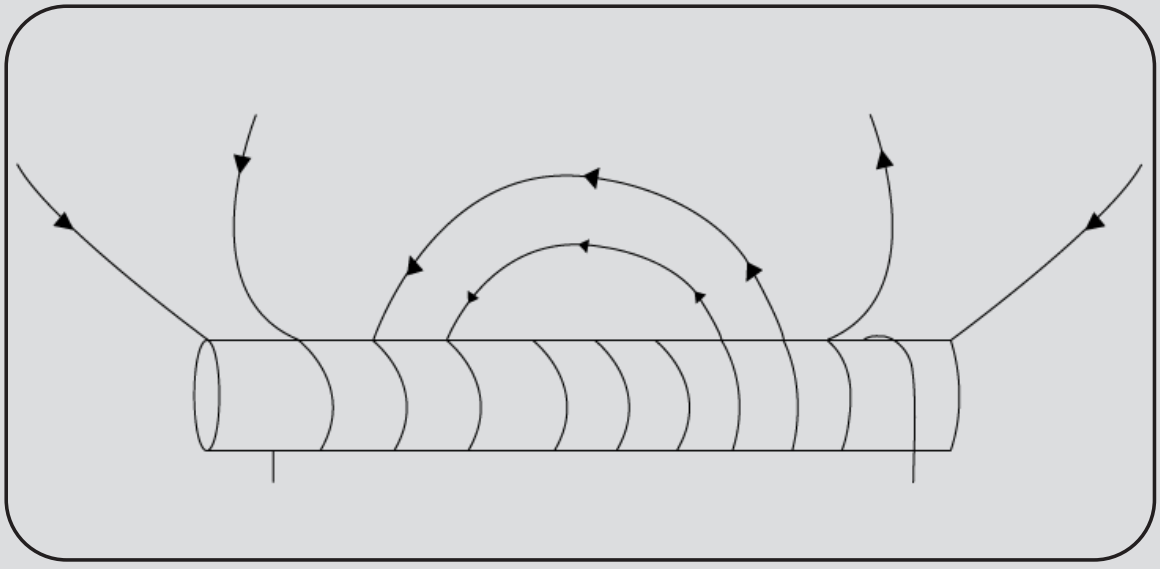
Complete the sentences with the correct option:

1. An electromagnet can be turned on and off with the _____.
2. The _____ carries the electrical current.
3. The _____ is created by an electric current.
4. The more electric _____ there is, the stronger the magnetic field field will be.

SWITCH	**CURRENT**	**MAGNETIC FIELD**	**COIL**

The diagram below depicts half of an electromagnet's magnetic field. Draw the other half of the magnetic field lines.

Also write S and N at the correct ends of the electromagnet.



Answers for Worksheet 1:

Explain the relationship between resistance, current, and voltage in a circuit in your own words.

Ohm's law describes the relationship between voltage, current, and resistance. This equation, I= V/R, states that current I flowing through a circuit is directly proportional to voltage (V) and inversely proportional to resistance (R). In other words, increasing the voltage causes an increase in current. However, increasing the resistance causes the current to decrease.

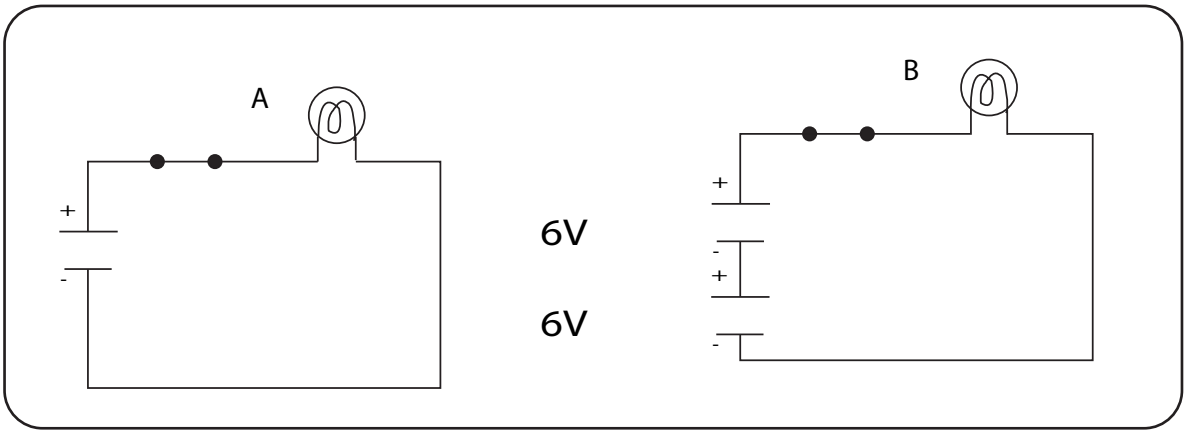
What happens to the current in a circuit when a 1.5 volt battery is replaced with a 9 volt battery?

Because V = IR, doubling the voltage without changing the resistance doubles the current.

How much current flows through a circuit consisting of a 9-volt battery and a bulb with a resistance of 3-ohm ?

The total effective resistance of everything connected across the battery determines the current. If the only component present is the bulb, the current is V/R = 12/3 = 4 amperes.

Examine the diagram to find the answer:



How much total voltage is there in each circuit?

A= 6 V
B= 12V

If the light bulb has a resistance of 6 ohms, how much current would be measured in each circuit?

A- I=V/R	B- I=V/R
=6/6	=12/6
=1A	=2A

Answer for Worksheet 2:

Tick the most important uses of electromagnets:

✓	Home Appliances
	Craft
✓	Industrial Appliances
	Cooking
✓	Transport

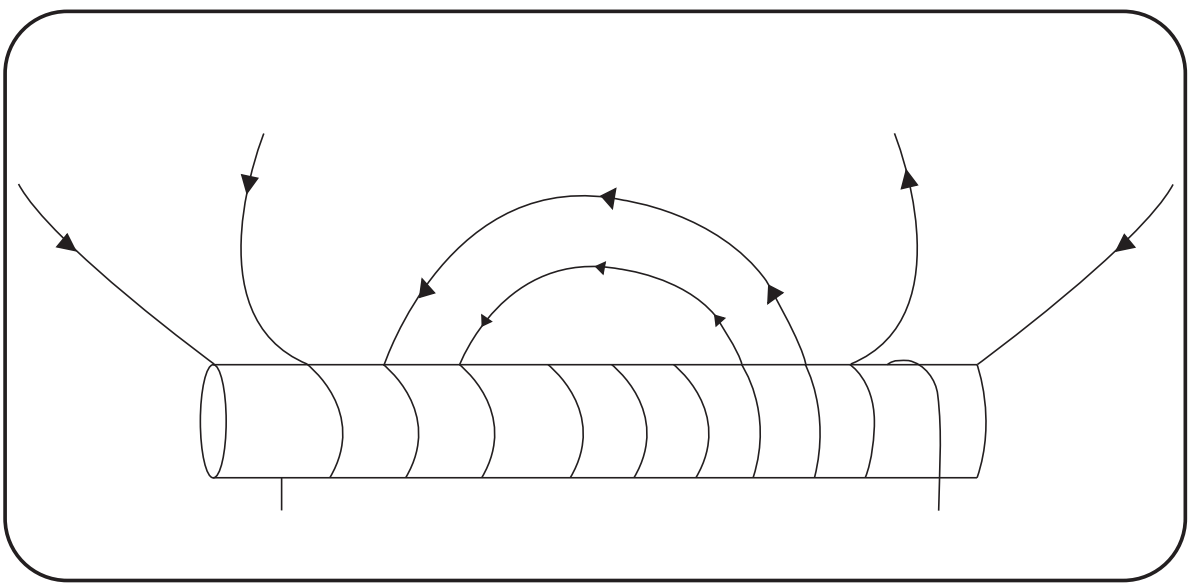
Complete the sentences with the correct option:

1. An electromagnet can be turned on and off with a switch.
2. The coil carries the electrical current.
3. The magnetic field is created by an electric current.
4. The more electric current there is, the stronger the magnetic field will be.

SWITCH	**CURRENT**	**MAGNETIC FIELD**	**COIL**

The diagram below depicts half of an electromagnet's magnetic field. Draw the other half of the magnetic field lines.

Also write S and N at the correct ends of the electromagnet.



Exercise Answers

1. Choose the correct answer:

i. **a)** increasing the number of turns of wires will increase the magnetic field

ii. **b)** Switching wires

iii. **c)** Neutral

iv. **c)** Keeping at higher position

v. **c)** ampere

vi. **a)** Cans will move apart from the electromagnet

4. Short answer questions:

i. **a)** Current - The flow of electric charge.

b) Voltage - The electric potential difference or electric pressure.

c) Resistance - The opposition to the flow of electric current.

ii. Resistance (R) = Voltage (V) / Current (I)

iii. A fuse is a safety device used to protect electrical circuits from overcurrent. It melts or breaks the circuit when the current exceeds a safe level.

iv. Safety rules may include:

- Do not touch electrical appliances with wet hands.
- Turn off switches when appliances are not in use.
- Do not overload electrical sockets.
- Keep electrical cords and wires in good condition.
- Keep flammable materials away from electrical sources.

v. An Earth wire is a safety wire that provides a path for electric current to safely dissipate into the ground, preventing electrical shock or fire in case of a fault.

vi. Electric power is the rate at which electrical energy is consumed or produced, measured in watts (W).

5. Long answer questions:

i. Overloading in an electrical circuit occurs when too many devices are connected to a circuit, drawing more current than the circuit can safely handle. This can lead to overheating, fires, or damage to devices.

ii. The strength of an electromagnet can be changed by:

- Increasing the current through the coil.
- Increasing the number of turns of wire in the coil.
- Using a soft iron core inside the coil.

iii. The poles of an electromagnet can be reversed by reversing the direction of the electric current in the coil.

iv. The working of an electric bell involves the following steps:

- When the switch is closed, current flows through the coil, creating a magnetic field.
- The soft iron armature is attracted to the electromagnet's core, causing it to move and strike the gong.
- The circuit is then broken when the armature moves away from the contact, and the spring returns the armature to its original position.
- This cycle repeats, creating a ringing sound.

CHAPTER 11

Our Universe

Student Book Pages 150-161

Learning outcomes

- explore and understand the terms star, galaxy, milky way and the black holes
- compare the types of galaxies
- relate the life of a star with the formation of black hole, neutron star. pulsar white dwarf, red giant
- discuss the birth and eventual death of our Sun
- show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo)
- describe advancements in space technology and analyze the benefits generated by the technology of space exploration

Keywords

star, Galaxy, Milky way, Black hole, Neutron star, Pulsar, nebulae, collision theory, white dwarf, red giant, Telescope, Hubble Space Telescope, Space Probes, Galileo.

Overview of the Unit

Galaxies are massive collections of matter, possibly dark matter, dust, gases, and, of course, stars, all held together by gravity. All of these things are required to create planets, which are the building blocks of all galaxies.

All of these elements are essential in the formation of galaxies. There are many different types of galaxies, as well as galaxies of various shapes and sizes. These are all strange and wonderful places, the majority of which have yet to be discovered.

The shape of galaxies tells us how many stars they contain.

Stars are hot, explosive gas balls that generate their own light and heat energy. They are mostly composed of the gases hydrogen and helium. You may have even experimented with helium by inhaling it from a floating balloon, which caused your voice to sound high and squeaky.

Stars generate heat and light energy through explosions that use hydrogen as fuel, similar to how a car uses gasoline, and convert it to helium via a process known as nuclear fusion.

Astronomers use the big bang theory to explain how the universe came into being. It is the idea that the universe began as a single point, then expanded and stretched to become the size it is now, and that it is still stretching.

A telescope is a device that magnifies images of distant objects. The telescope is without a doubt the most important research tool in astronomy. It allows for the collection and analysis of radiation from celestial objects, including those in the far reaches of the universe.

Space exploration is of great benefit to mankind:

Experiments in space help us understand health issues on Earth.

Satellites collect data on climate change, measure pollution, and aid in environmental protection.

Space technologies improve everyday products, weather forecasts, and global communications.

By exploring the unknown, scientific breakthroughs are challenging our hypotheses and pushing our boundaries.

Lesson Plan 1	Student Book pages	Time	Workbook pages
Our Place in the Universe	150-152	45 Minutes	-

Objective:

- explore and understand the terms star, galaxy, milky way and the black holes
- compare the types of galaxies

Keywords

Asteroid
Galaxy
Stars
Spiral galaxy
Elliptical galaxy

Engage: (5 min)

- Inquire if students are interested in space. Encourage them to shout out their favourite aspects of space and write some of their most common responses on the board.

- To get students excited about the lesson, hang a large poster on the wall or use a projector to show images of galaxies in space.

Explain: (10 min)

Useful Link

https://youtu.be/aNpjckf8DhQ

- Galaxies are simply massive clusters of stars, planets, and other solar remnants. Astronomers believe the expanding universe contains up to 100 billion galaxies.
- The Kepler and Hubble Telescopes are used to observe galaxies. Galaxies are flat because rotating objects flatten out on rotational access.

  Spiral Galaxy Classification
  - o The Milky Way
  - o The Andromeda Galaxy
  - o MILKY WAY: The Milky Way galaxy rotates clockwise. Its disc is made up of dust, stars, and gas that rotate around a central point.
  - o THE ANDROMEDA GALAXY: Our closest neighbour is the Andromeda Galaxy, which is also a spiral galaxy.

Lenticular and irregular galaxies:

Irregular galaxies have no symmetrical structure. They differ from spiral galaxies in that they lack distinct rotating arms. They are also distinct from elliptical galaxies in that they lack a distinct centre bulge.

Explore: (15 min)

In this astronomy activity, you will make a mobile of the different types of galaxies.

What do we need:

- Construction paper in various colours.
- Scissors
- Glitter
- Glue
- String
- scotch tape
- Galaxies on two PDF pages
- A square of cardboard

What to do:

- Copy the galaxies images onto different colours of construction paper.
- Cut out each galaxy and label it with its type using a pen.
- Glitter can be used to decorate the galaxies to represent the galaxy's stars.
- Tie a string around each galaxy, leaving enough to connect it to the cardboard square.
- Randomly tape the galaxies to the cardboard square.
- Hang it from the ceiling to see the various types of galaxies.
- You can also display your galaxies by hanging them from a metal coat hanger.

Elaborate: (5 min)

- Students will make posters to show different types of galaxies.
- They will use colour paints, glitter, markers and spray bottles to make their posters.
- The best posters will be displayed on classroom walls.

Evaluate: (5 min)

- Complete Concept Check on page 152 of student book.
- Complete Q3 (i-ii) on page 160 of student book.

Home Assignment:

- We live in the Milky Way Galaxy. This galaxy is a barred spiral galaxy. Draw your galaxy in your notebook.
- Provide worksheet 1 to solve at home.

Lesson Plan 2	Student Book pages	Time	Workbook pages
Stars	152	45 Minutes	-

Objective:

- relate the life of a star with the formation of black hole, neutron star. pulsar white dwarf, red giant
- discuss the birth and eventual death of our Sun

Keywords

Giant
Dwarf

Engage: (5 min)

Ask the students to share what they know about stars

- How are stars different from planets?
- How big or small are stars?
- How do they get illuminated?
- Do they get their light from the Sun?

Useful Link

https://youtu.be/PeNuj2GH8xg

Explain: (10 min)

- Stars are the Universe's lighthouses, and life would not exist without them. Our Sun is a star, and there are billions of them in the Universe.
- Stars, like planets, are celestial objects; however, they are a ball of plasma held together by their own gravity.
- Interstellar mediums, such as molecular clouds of gas and dust, give birth to stars.
- Stars can grow to enormous proportions in an interstellar medium rich in materials, but their lifespan is limited as a result.
- When a star dies, it either explodes as a supernova or merges with another star to form a black hole or neutron star.
- When a star explodes, it releases a large amount of material into space, which can lead to the formation of new stars and even planets or moons over time.
- When the gas and dust combine due to gravity and reach the proper temperature, the star is born.
- The temperature of stars determines their classification. They are assigned letters to indicate their hotness.
- This classification of stars uses letters such as O, B, A, F, G, K, and M.
- The letter O is the hottest, while M is the coldest. For example, our Sun is a G-type star.

Explore: (10 min)

- Construct a portable planetarium flashlight.
- What do we need:
- Black paper board/black foam sheet roll
- scissors

What to do:

- To completely cover the flashlight lens, cut circles out of black foam or thick paperboard.
- Cut one circle for each constellation you want to make.
- Poke holes in each circle with a needle/hole puncher, according to the position of the star in each constellation.
- You must ensure that the holes are punched all the way through so that no residue blocks any of the holes.
- You're now ready for the show.
- Turn off the lights and turn on the flashlight to make the room dark. To project the constellations onto the ceiling or walls, place one circle after another directly on the flashlight lens.

Elaborate: (10 min)

- Decorate a class wall with different coloured glitter papers.
- Make three to four groups of students.
- Each group should be assigned a section of the wall.
- Each group will use glitter paper cutouts to create a night sky with stars on the portion of the wall that has been assigned to them.

Evaluate: (5 min)

Worksheet 2 will be distributed.

Lesson Plan 3	**Student Book pages**	**Time**	**Workbook pages**
The Sun, Black Hole	152	45 Minutes	-

Objective:

- relate the life of a star with the formation of black hole, neutron star. pulsar white dwarf, red giant
- discuss the birth and eventual death of our Sun

Keywords

Nuclear fusion
Sunspot

Engage: (5 min)

Ask students to share some interesting facts regarding the Sun.

1. Teacher can also share the following facts to build up the interests of students.
2. The Sun is over 4.5 billion years old.
3. The temperature of Sun's surface is 5,505ºC.
4. The Sun is made from Hydrogen and Helium.
5. The Sun is the largest object in our solar system. However, its size is average compared to other stars.

Useful Link

https://www.youtube.com/watch?v=ZRHy8AkLOvU

https://www.youtube.com/watch?v=p24SQlhJVZo

Explain

- Show them the following videos.

- Ask students to read pages 153-154 of student book.

Explore

Students will explain what they have understood from the videos and the student book.

Elaborate

- Attempt Activity 'What if the sun dies?'' on page 161 of student book.
- Students will draw a flow chart regarding the stages of life and death of the Sun.
- Explain students that when bigger stars collapse they end up forming black holes, which have a very strong gravitational field.

Evaluate

Students will complete Concept Check page 154 of student book.

Homework

Complete Q6 on page 74 of workbook.

Lesson Plan 4	**Student Book pages**	**Time**	**Workbook pages**
How the Universe Began	154-155	45 Minutes	-

Objective:

Explore and understand the terms star, galaxy, Milky Way and the black holes

Keywords

Big bang
Heat wave
Hydrogen
Helium

Engage:

Ask students what they know about how universe was formed.

Explain

Show them the following video.

https://www.youtube.com/watch?v=LinWJsangs4

Useful Link

https://www.youtube.com/watch?v=LinWJsangs4

Explore

Ask students to read page 154-155.

Elaborate

Ask students to explain what they have understood so far.

Evaluate

Ask students to summarize their understanding of the topic on their notebooks.

Homework

Ask students to search what evidences scientists found which support The Big Bang Theory.

Lesson Plan 5 Uses of Telescopes	**Student Book pages** 155-158	**Time** 45 + 45 Minutes	**Workbook pages** 71-73

Objective:

- show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo)
- describe advancements in space technology and analyze the benefits generated by the technology of space exploration

Engage:(5 min):

Make a list of tools that astronauts can use to collect data and information from space with the assistance of students.

Useful Link

https://youtu.be/VpBRPpmE3tM

Explain: (10 min)

- A telescope is a device that uses electromagnetic radiation to observe distant objects through their emission, absorption, or reflection.
- A space telescope, also known as a space observatory, is a telescope in space that is used to observe astronomical objects.
- The Hubble Space Telescope (abbreviated HST) is a space telescope that was launched into low Earth orbit in 1990 and is still operational today. It was not the first space telescope, but it is one of the largest and most versatile, known for its importance as a research tool as well as a public relations great boost for astronomy. The Hubble Space Telescope is one of NASA's Great Observatories and is named after astronomer Edwin Hubble.
- A space station is a type of space habitat that is capable of supporting a human crew in orbit for an extended period of time. It lacks significant propulsion and landing systems.
- A space station is a type of space habitat that is capable of supporting a human crew in orbit for an extended period of time. It lacks significant propulsion and landing systems.
- A probe is a spacecraft that travels across space to gather scientific data. Astronauts are not present on probes. Scientists can study the data that probes send back to Earth.
- The First Probes Sputnik 1 was the first space probe to launch. The former Soviet Union launched it on October 4, 1957. The United States launched Explorer 1 into space on January 31, 1958. From space, the first probes studied the Earth. They also got a taste of what it's like to be in space. This marked the start of the Space Race between the United States and the Soviet Union.
- Numerous probes examine Earth or measure space-related variables. Other probes use telescopes or other instruments to study distant planets, stars, and galaxies. Probes that travel to other planets have evolved from simple machines capable of studying only a few features of a planet to sophisticated probes capable of studying a wide range of features on planets, moons, asteroids, and comets. These more sophisticated probes are referred to as spacecraft, orbiters, landers, and rovers.

Explore: (10 min)

- You want your students to think about stars, moons, and planets as you teach them about astronomy. However, it is also critical that they learn about the instruments that astronomers have used over the years to study all of these things. A lot of students will wonder how we came to know what we do about the sky, and some will want to do their own research.
- This activity will make learning about telescopes enjoyable and exciting for your students. Divide

your students into small groups and distribute a telescope picture to each group.

- You can show the same image to each group, or you can assign different types of telescopes to each group.
- The group's task is to research and label as many of the telescope's components as possible.
- Labels should include the names of each component as well as a sentence or two about how it fits into the overall function of the telescope.

Elaborate: (10 min)

Building your own telescopes is an exciting project for students.

What do we need:

- Cardboard tube with a diameter of about an inch.
- A cardboard tube about 1.4 inches in diameter.
- Magnifying glass with a diameter of about 1 inch.
- Magnifying glass with a diameter of about 2 inches cm.
- Broad adhesive tape.
- Stickers for decoration.

What to do:

2. Place the large magnifying glass at one end of the large tube and tape it in place.
3. Attach the smaller magnifying glass to the cardboard with tape at one end of the narrower tube.
4. Place the smaller tube inside the larger tube, with the magnifying glasses on each end.
5. Examine the image with the smaller magnifying glass and slide the larger tube until it improves.
6. Tape the tubes together once you've determined the distance.
7. Decorate the tube with moon and star stickers.
8. Grip your telescope with the magnifying glass handles.
9. Start exploring the sky with your telescope.

Evaluate: (5 min)

Concept Check page 158 of student book.

Home Assignment:

Complete Q1-5 on page 71-73 of Workbook.

Worksheet 1:

Write down the name of the galaxy given in the pictures below:

Use the clues given in the box to answer.

SOLAR SYSTEM
NEBULA
MILKYWAY
BIGBANG
THE UNIVERSE
STARS
GALAXY\

1. Large clouds of dust and gases like hydrogen and helium. _____
2. It is made up of everything that exists around us. _____
3. A spiral galaxy of large to medium size with approximately 200 billion stars._____
4. A hot gas ball that generates its own power. _____
5. The Milky Way galaxy contains the Sun and eight planets. _____

Worksheet 2:

Describe the following stars:

1. Neutron Star:

2. Red Giants:

3. White dwarf:

4. The Sun:

Complete the following sentences:

1. Two things that stars give off: _____.
2. Which star is closest to us? _____.
3. Group of stars are called _____.
4. Another name for north star is _____.
5. Stars are made of _____.

Answer for Worksheet 1:

Write down the name of the galaxy given in the pictures below:

Elliptical Galaxy	Spiral Galaxy	Irregular galaxy



Use the clues given in the box to answer.

SOLAR SYSTEM
NEBULA
MILKYWAY
BIGBANG
THE UNIVERSE
STARS
GALAXY\

1. Large clouds of dust and gases like hydrogen and helium. **Nebula**
2. It is made up of everything that exists around us. **Universe**
3. A spiral galaxy of large to medium size with approximately 200 billion stars. **Milkyway**
4. A hot gas ball that generates its own power. **Star**
5. The Milky Way galaxy contains the Sun and eight planets. **Solar system**

Answer for Worksheet 2:

Describe the following stars:

1. Neutron Star:

Neutron stars are city-sized stellar objects with 1.4 times the mass of the sun. These tiny objects are the result of the explosive death of another, larger star.

2. Red Giants:

A red giant is a luminous giant star of low or intermediate mass (roughly 0.3-8 solar masses) in the late stages of stellar evolution. The outer atmosphere is inflated and tenuous, resulting in a large radius and a surface temperature of 5,000 K or less.

3. White dwarf:

A white dwarf is a remnant of a stellar core made mostly of electron-degenerate matter. A white dwarf is extremely dense: its mass is comparable to that of the Sun, while its volume is comparable to that of the Earth. The faint luminosity of a white dwarf is caused by the emission of residual thermal energy.

4**.** The Sun:

The Sun is the central star of the Solar System. Its core undergoes nuclear fusion reactions, transforming it into a nearly perfect ball of hot plasma that is incandescent. The Sun, which is the most important source of energy for life on Earth, radiates this energy primarily as light, ultraviolet, and infrared radiation.

Complete the following sentences:

1. Two things that stars give off:
   i. Light
   ii. heat
2. Which star is closest to us?**Sun**
3. Group of stars are called **constellation**.
4. Another name for north star is **Polaris.**
5. Stars are made of **gases**.

Exercise Answers

1. **i.** **d)** spectroscope
ii. **a)** reflecting telescope
iii. **d)** They have a crew of two
iv. **d)** gravitationa
v. **c)** emit light

2. Fill in the blanks:
i. Galileo Galilei
ii. Refracting
iii. Reflecting
iv. Stars
v. 15 million degrees Celsius
vi. Nuclear fusion
vii. Milky Way
viii. Hydrogen

3. Short answer questions:
i. A galaxy is a vast system of stars, star clusters, planetary systems, interstellar gas and dust, and dark matter bound together by gravity.
ii. The Milky Way is the galaxy in which our solar system is located.
iii. A black hole is an extremely dense region in space where the gravitational pull is so strong that nothing, not even light, can escape from it.
iv. Looking directly at the Sun can damage the eyes due to the intense light.
v. A light-year is the distance that light travels in one year, used to measure astronomical distances.
vi. Circumpolar constellations can be seen all year round and do not appear to move across the sky.
vii. Reflecting telescopes use mirrors to gather and focus light, while refracting telescopes use lenses.
viii. A radio telescope typically consists of a large parabolic dish that collects radio waves.
ix. A star's spectrum provides information about its temperature, composition, and motion.
x. The first artificial satellite was named Sputnik 1 and came from the Soviet Union (USSR).
xi. The first human in space was Yuri Gagarin, and he was from the Soviet Union (USSR).
xii. An astronaut is a term used for space travelers from the United States, while a cosmonaut is used for those from Russia (and previously the USSR).
xiii. The first person to walk on the Moon was Neil Armstrong, and he was from the United States.
xiv. A space station is a large spacecraft where astronauts live and work for extended periods.

4. Long answer questions:
i. A space telescope is a telescope placed in outer space to observe astronomical objects, free from the interference of Earth's atmosphere. These telescopes capture and transmit images and data back to Earth, allowing astronomers to study distant celestial objects

with exceptional clarity. The absence of atmospheric distortion results in sharper and more detailed images. Space telescopes are equipped with specialized instruments that can capture various wavelengths of light, such as visible, ultraviolet, and infrared, enabling scientists to study a wide range of phenomena in the universe.

ii. The light and high temperatures in the Sun or other stars are produced through a process called nuclear fusion. In the Sun, primarily composed of hydrogen, immense gravitational pressure causes hydrogen atoms to fuse together to form helium. This fusion process releases a tremendous amount of energy in the form of light and heat. The high temperatures are a result of the intense pressure at the core of the star, which is necessary for nuclear fusion to occur. This continuous process of hydrogen fusion powers the Sun and other stars, providing the energy required to emit light and heat.

iii. The 'Big Bang' theory is a scientific explanation for the origin of the universe. According to this theory, the universe began as an incredibly hot and dense point, known as a singularity, nearly 13.8 billion years ago. It then rapidly expanded and cooled, leading to the formation of all matter and energy in the universe. The key aspects of the Big Bang theory include the idea of cosmic inflation, the expansion of the universe, the abundance of light elements, and the cosmic microwave background radiation.

Evidence supporting the Big Bang theory includes the discovery of cosmic microwave background radiation, which is a faint remnant of the universe's early, extremely hot state. Additionally, the observed expansion of the universe, the abundance of light elements such as hydrogen and helium, and the large-scale distribution of galaxies all align with the predictions of the theory.

iv. The Hubble Space Telescope has several special features that make it a remarkable instrument for astronomical observations:

- Orbital Placement: The Hubble telescope is placed in low Earth orbit, allowing it to escape the distortion of Earth's atmosphere. This results in high-resolution, clear images of distant objects.
- Versatile Instruments: Hubble is equipped with a variety of instruments for observing different wavelengths of light, including ultraviolet, visible, and near-infrared. This versatility enables scientists to study a wide range of celestial phenomena.
- Remote Repairs: Hubble was designed with the capability for maintenance and repairs by astronauts using the Space Shuttle. This feature allowed for the replacement and upgrading of instruments to extend its operational life.
- Long Duration: Hubble has been operating for many years, providing a long-term dataset and observations of changes in the universe over time.

v. Two advantages of having a telescope in orbit include:

1. Reduced Atmospheric Interference: Telescopes in orbit are not affected by Earth's atmosphere, which can distort and absorb light, particularly at certain wavelengths. This results in clearer and more detailed observations of celestial objects.
2. Access to Multiple Wavelengths: Orbiting telescopes can observe a broad range of wavelengths, from ultraviolet to infrared, without the limitations imposed by the atmosphere. This versatility allows astronomers to study various aspects of the universe.

vi. A space probe is an unmanned spacecraft designed for scientific exploration, data collection, and observation of celestial objects or bodies. It is different from space shuttles and manned satellites in several ways:

- Space probes do not carry humans. They are autonomous or remotely controlled spacecraft designed for specific missions.

- Space shuttles are typically designed to transport astronauts to and from space stations or conduct space missions with human crew members on board.
- Manned satellites, such as the International Space Station, are space habitats or laboratories where astronauts live and work for extended periods.

vii. From the spectrum produced by stars, scientists can learn about several key characteristics:

- Composition: By analyzing the lines in a star's spectrum, astronomers can determine the elements present in a star's outer layers.
- Temperature: The spectrum reveals the star's temperature, with hotter stars emitting more energy in shorter wavelengths.
- Motion: Doppler shifts in the spectral lines provide information about a star's motion, whether it is moving toward or away from Earth.
- Luminosity: The spectrum helps estimate a star's luminosity, which is its intrinsic brightness.

5. Think About It:

i. Radio telescopes can capture radio waves from space, while refracting or reflecting telescopes primarily collect visible light. This allows them to detect objects or phenomena that emit radio waves.

ii. Space telescopes can provide clearer and sharper images since they are not affected by Earth's atmosphere. They can also observe wavelengths that are blocked by the atmosphere. However, they are costly to build and maintain.

iii. Benefits of space exploration include technological advancements, scientific discoveries, and international cooperation. Challenges include the high cost, potential dangers, and ethical considerations.

CHAPTER 12

Technology in Everyday life

Student Book Pages 162-174

Learning outcomes

- Make bioplastic from milk and vinegar as an application of biotechnology.
- Make toothpaste, soap and detergent as an application of acids and bases in daily life.
- Assemble a concave mirror type solar cooker to convert solar energy into heat energy.
- Assemble and operate a simple wind turbine to produce electricity.
- Demonstrate the working of UPS and use it to operate a fan or energy saver bulb

Keywords

Bioplastic, biotechnology, acid, base, safety measures.

Overview of the Unit

- A chemical reaction between the milk and vinegar produces plastic-like substance. When the casein protein in milk comes into contact with vinegar, the molecules do not mix, but rather move around and join forces to make the casein plastic.
- Soap is created by a simple chemical reaction between fats or oils and lye. Saponification is the process of achieving the chemical reaction. By carefully selecting a quality oil blend, adding your favourite fragrance or essential oils, and swirling in a vibrant colourant, your handmade soap takes on a delightful, rustic character.
- Detergent is a water-soluble cleansing agent that combines with impurities and dirt to make them more soluble, and it differs from soap because it does not form scum with hard water salts. With a few simple ingredients, we can make homemade laundry detergent.
- Solar energy is the energy derived from the sun. Light and heat energy are the primary forms of energy obtained from solar energy.Solar energy can be used in a variety of ways.
  The other energy obtained from solar energy is heat energy, thermal energy, and primarily light energy. Several other conversions can be made from these energies, one of which is solar energy to heat energy.
- Wind turbines operate on a simple principle: instead of using electricity to generate wind (as a fan does), wind turbines generate electricity. Wind turns a turbine's propeller-like blades around a rotor, which spins a generator, which generates electricity.
- A UPS works by converting the alternating current (a.c.) supply from the power grid to a direct current (d.c.) voltage. The rectifier is the part of the UPS that does this. The rectifier's output is then used to charge batteries, which can provide power during a power failure.

Lesson Plan 1	Student Book pages	Time	Workbook pages
How to make bioplastic from milk and vinegar as an application of biotechnology	162-163	45 Minutes	-

Objective:

Make bioplastic from milk and vinegar as an application of biotechnology.

Engage: (5 min)

- Ask students how many different ways plastic is used today.
- You are reminding them of the importance of plastic by doing so. Inform the students that the plastic used in all of these items is typically synthetic and derived from petrochemicals. However, there are other renewable materials for making plastic that can be obtained from corn, cotton, milk, and a variety of other plants.

Explain: (10 min)

- Biotechnology is propelling the development of new bio-plastics. Fermentation and genetic engineering are two biotechnology techniques used to create bio-plastics. For example, fermentation is used to extract cellulose from plants so that it can be used to make plastics. Casein, a protein, is found in milk molecules. Casein molecules unfold and form long chains called polymers (Polymers are molecules with a regular chain structure.)during the reaction between warm milk and vinegar. Because the polymer can be moulded and shaped, it is classified as a plastic. Because of the type of molecules that created the plastic, it is known as casein plastic or milk plastic in this case.
- This process, also known as casein plastic, has been used for over 100 years and was the method used to make plastics prior to 1945, when synthetic plastics were introduced. Many years ago, even royal people wore milk plastic jewellery.

Explore: (15 min)

Students will make bioplastic with milk and vinegar by following the instructions given on page .no. 162 of their textbooks.

Elaborate: (5 min)

Students can add various colours to the plastic to create toys or other shapes.

Evaluate: (5 min)

- Provide worksheet 1 to solve.
- You can also evaluate the students based on the quality of bioplastic they formed.

Home Assignment:

Find out the environmental impacts of plastic and bioplastic. Write them on your notebooks.

Lesson Plan 2	**Student Book pages**	**Time**	**Workbook pages**
Application of Acids and Bases in Daily Life	163-168	45 Minutes	-

Objective:

Make toothpaste, soap and detergent as an application of acids and bases in daily life.

Engage: (5 min)

Display soap, toothpaste, and detergent images on the walls of your classroom. Students will be eager to know what they will do today. Inform them that you will make these items today.

Explain: (10 min)

Toothpaste Making:

In the middle of the nineteenth century, products that resemble modern toothpaste first appeared. Before they were invented, people cleaned their teeth with a variety of tools and substances, if they cleaned them at all. Many of the procedures were unpleasant (e.g., ground fish bones, sand and pumice). Some were poisonous (e.g., green lead, verdigris, acid). Others were fairly ordinary (e.g., table salt).

Thankfully, the days of toothpaste made from ground fish bones and acid are over. Today's toothpaste ingredients work and flavours far better than their ancient counterparts.

- The following ingredients are commonly found in modern toothpastes:
- Water

- Abrasives (e.g., softened silica, chalk, baking soda)
- Sudsers (e.g., sodium lauryl sulphate, sodium lauryl sulfoacetate, dioctyl sodium sulfosuccinate)
- Humectants (e.g., sorbitol, glycerin, propylene glycol)
- Flavors (typically mint)
- Sweeteners (typically Saccharin)
- Whiteners
- Flourides
- Preservatives
- Binders (e.g., karaya gum, bentonite, sodium alginate, carrageenan)
- Soap Making:
- Soap is defined as fat or oil combined with an alkali. The oil is derived from an animal or plant, whereas the alkali is a chemical known as lye. The lye used in the production of bar soap is sodium hydroxide. Potassium hydroxide is required for liquid soap.
- Soap is produced by combining and then heating oil and lye. Saponification is the name given to this chemical reaction. Saponification is impossible without lye, so lye is required to make soap.
- Detergent making:
- A detergent is any cleaning agent that is not a soap. Detergents are typically manufactured using synthetic resources such as petroleum fractions.
- They were created in response to a shortage of animal fats and vegetable oils during World War II.
- Typically, detergents are sodium salts of sulphonic acid.
- A long-chain hydrocarbon derived from petroleum fractions is converted into an organic acid in a series of steps during detergent production.
- The organic acid is then neutralized with a solution of sodium hydroxide to produce a neutral salt that acts as a detergent.

Explore: (15 min)

- Divide the class into three sections.
- One group will make toothpaste, the second soap, and the third detergent.
- The groups will be given the necessary materials.
- Students will use the methods described in their textbooks.

Elaborate: (5 min)

Each group will have a litmus test to check the nature (acidic, basic or neutral) of their product.

Evaluate: (5 min)

Worksheet 2 will be distributed among students to solve.

Home Assignment:

Make a list of acids and bases that we use in our daily life. Write the names of the things with its nature. (acid or base)

Lesson Plan 3 Assemble a concave mirror type solar cooker to convert solar energy into heat energy:	**Student Book pages** 169-170	**Time** 45 Minutes	**Workbook pages** -

Objective:

Assemble a concave mirror type solar cooker to convert solar energy into heat energy.

Useful Link

https://youtu.be/X1aN9ADvgpw

Engage: (5 min)

Ask the students the following questions to stimulate their thinking.

- What are the advantages of solar energy?
- Can we convert this energy into another type of energy?
- What are the various forms that solar energy can take if it is transformable?

Explain: (10 min)

- Solar energy is merely the direct current from the sun that is converted into alternating current. Solar panels and solar cells are small devices that convert solar energy to heat energy. Using photovoltaic cells, solar energy is converted to heat energy, which is also known as thermal energy.
- When the sun's light strikes an object, the particles in the object vibrate, converting the solar energy to heat energy.
- When we see in a few places or in our daily lives, when solar radiation strikes any type of thermally heated up system, the solar radiation is instantly converted to heat and expelled as fumes.
- In several systems, this is how solar energy is converted to heat energy. And, using particular equipment, we can manually convert solar energy to heat energy.

Explore: (15 min)

Students will make a solar cooker by following the instructions given on page.no.183.

Elaborate: (5 min)

- Students will cook whatever they want in the solar oven. For example, noodles or a chicken piece.
- Put the food to be cooked inside the solar oven on a paper plate. To reflect the sun into the oven, hold the flap open with a ruler.
- Allow the food to bake in the sun. It could take up to an hour depending on the time of day, heat, and other factors.

Evaluate: (5 min)

Students will be graded based on how well they built their solar oven.

Home Assignment:

Write about how solar energy is converted into heat energy in your notebooks.

Lesson Plan 4	Student Book pages	Time	Workbook pages
Assemble and operate a simple wind turbine to produce electricity	172-173	45 Minutes	-

Objective:

Assemble and operate a simple wind turbine to produce electricity.

Resources:

- Diagrams or visual aids of wind turbines
- Small DC motor or generator
- Plastic or wooden blades (for the wind turbine)
- Strong stick or dowel
- Cardboard or foam board (for creating the turbine body)
- Electric wires
- Multimeter or LED light bulb
- Fan or hairdryer (to simulate wind)
- Adhesive materials (glue, tape)

Engage: (5 min)

Involve students in a discussion about renewable energy and wind turbines. Explain how wind turbines work and generate electricity using visual aids or diagrams. Ask questions such as, "What are some benefits of using wind energy?" or "Have you ever seen a wind turbine in your area?"

Explain: (10 min)

- Give an explanation of how wind turbines work. Explain how wind turns the blades, which turn a generator to generate electricity.
- Discuss the components of a wind turbine, such as the blades, tower, and generator.
- Explain how wind speed and blade design affect wind turbine efficiency.

Explore: (15 min)

DIY Wind Turbine Construction:

- Small direct current (DC) motor or generator, plastic or wooden blades, stick or dowel, cardboard or foam board, electric wires, adhesive materials
- Instruct students to build a simple wind turbine out of the materials provided.
- They should attach the generator's blades, mount the generator on the stick, and build a base out of cardboard or foam board.
- As a simulated wind source, use a small fan or a hairdryer.
- Connect the generator to a multimeter or an LED light bulb and have students test their wind turbines to see if they can generate electricity.

Elaborate: (10 min)

- Encourage students to discuss the key components that make the wind turbine work and the difficulties they encountered while assembling it.
- Examine the practical applications of using wind energy to generate electricity.

Evaluate: (5 min)

- Ask students to describe one key takeaway from the lesson about how wind turbines generate electricity.
- Examine their comprehension of the concepts covered.

Home Assignment:

- Provide a list of discussion questions about wind energy and wind turbines to each student. To broaden their knowledge, ask them to research and answer these questions.

Lesson Plan 5	**Student Book pages**	**Time**	**Workbook pages**
Working of UPS (Uninterruptible Power Supply):	172-173	45 Minutes	-

Objective:

Demonstrate the working of UPS and use it to operate a fan or energy saver bulb

Resources:

- Visual aids or diagrams of UPS systems
- UPS unit
- Fan or energy-saving bulb
- Power outlet
- Extension cord
- Handout for home assignment
- Whiteboard and markers

Engage: (5 min)

Start the lesson by having a discussion with students about power outages and the importance of backup power solutions.

Give examples of times when a power outage can be problematic, such as during a storm or in areas with unreliable power.

Explain: (10 min)

- Explain what a UPS (Uninterruptible Power Supply) is and how it works. Explain that an uninterruptible power supply (UPS) is a device that provides backup power during power outages or fluctuations.
- Discuss the UPS system's components, such as the battery, inverter, and automatic voltage regulator (AVR).
- Explain how a UPS can be used to protect sensitive electronic equipment and ensure continuity in critical operations.

Explore: (15 min)

UPS Demonstration and Operation:

Materials: UPS unit, fan, energy-saving bulb, power outlet, extension cord

- Connect a UPS to a fan or an energy-saving bulb to demonstrate how it works. Show the students how the UPS can provide power when the main power source is turned off.
- Discuss the UPS unit's features, such as battery backup time and automatic switching to battery

power during power outages.

Elaborate: (10 min)

- Encourage students to share their observations and questions about how UPS systems are used in real-world scenarios like homes, offices, and data centres.
- Choose one scenario and explain why a UPS is necessary in that context and how it will benefit the users. This assignment encourages students to consider the applications of UPS systems critically.

Evaluate: (5 min)

- Ask students to explain the function and purpose of a UPS, emphasizing its importance during power outages or fluctuations.

Home Assignment:

- Choose one scenario and explain why a UPS is necessary in that context and how it will benefit the users.
- This assignment encourages students to consider the applications of UPS systems critically.

Worksheet 1:

Complete the following sentences:

Regular plastics are usually made of

Bioplastics are made from

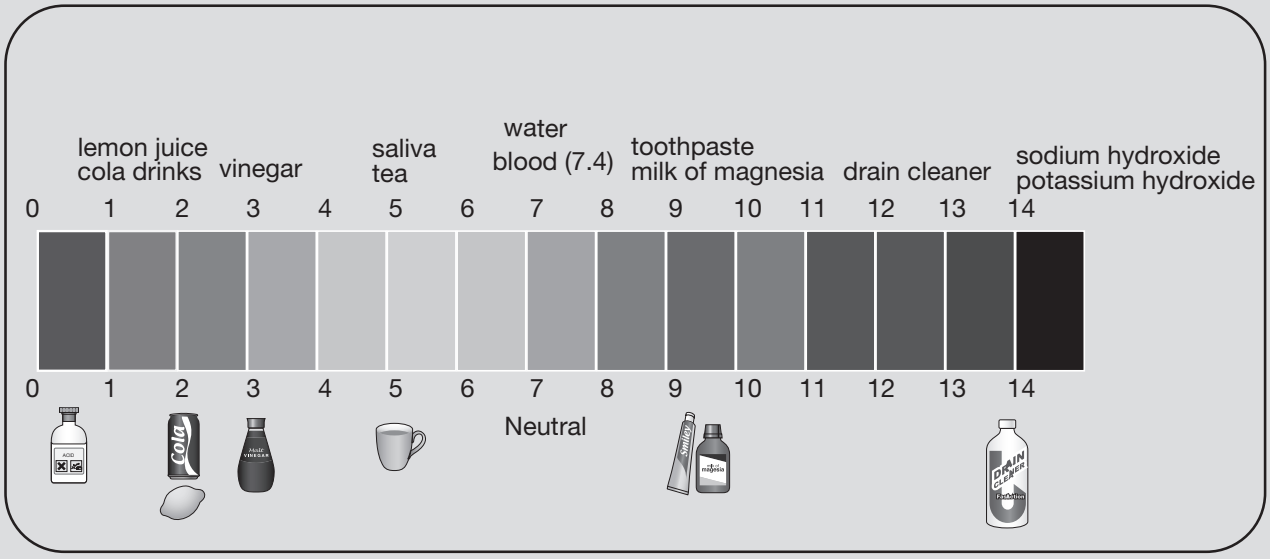
Difference between regular plastic and bioplastic is :

Plastic is used in:

We can reduce the plastic pollution by:

Worksheet 2:

Write down the names of acids and bases that we use in daily life:



ACID	BASE

Answer for Worksheet 1:

Complete the following sentences:

Regular plastics are usually made of **organic polymers**.

Bioplastics are made from **cellulose.**

Difference between regular plastic and bioplastic is:

The main difference between plastics and bioplastics is how they are manufactured.

Plastic is used in:

i. Bags

ii. Shoes

iii. Jewelry

iv. Bottles

v. Plates

vi. Construction material

vii. Transport etc.

We can reduce plastic pollution by:

i. Recycle the plastic.

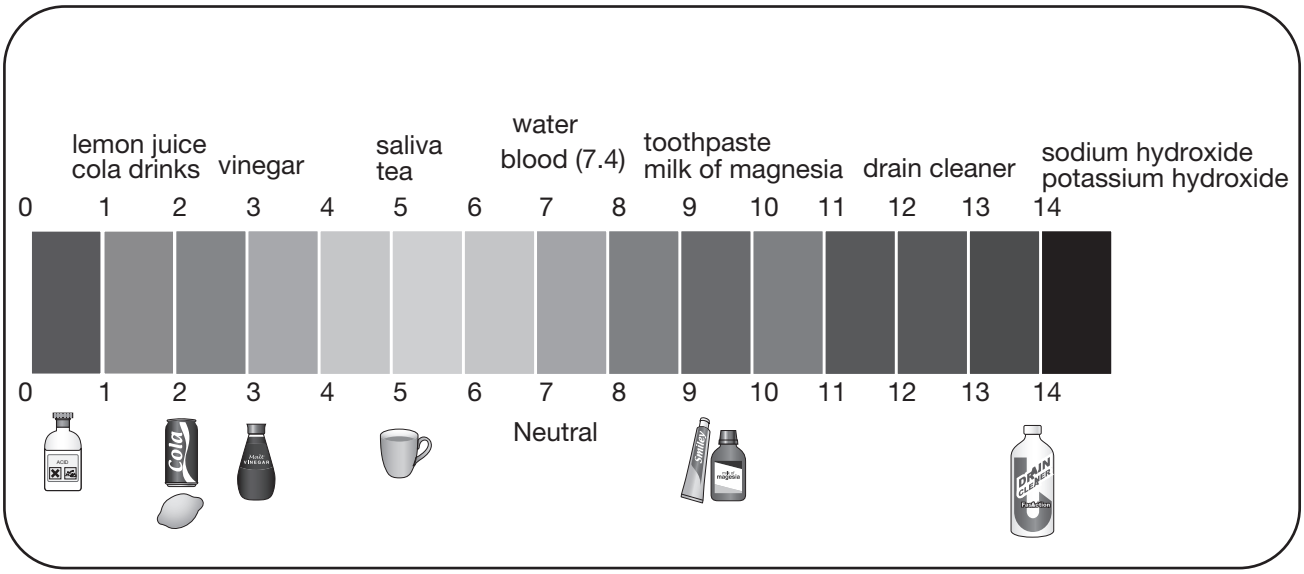
ii. Stop using plastic bags.

iii. Stop using plastic straws

iv. Educating people.

Answer for Worksheet 2:

Write down the names of acids and bases that we use in daily life:



ACID	BASE
1. Soft drinks	**1.** Soap
2. Battery acid	**2.** Drain cleaner
3. Stomach acid	**3.** Detergents
4. Apple juice	**4.** Bleach
5. Acid Rain	**5.** Baking Soda