PREFACE

Teacher's Guide for Grade 10 Science Textbook

How to use this Teacher's Guide

This Grade 10 Science Teacher's Guide is designed to make the features of the Grade 10 Science Textbook more useful to you as you teach the course, to give you information that aids in adapting the course to your teaching style, and to provide you with an additional information and resources you may want to use in your presentations, discussions, or other classroom teaching.

About this Teacher's Guide

This Teacher's Guide is intended for teachers who teach arts and social science students. There are three portions in this Teacher's Guide: Science (Chemistry), Science (Physics) and Science (Biology). Syllabus and Year Plan for each portion are also included.

The Teaching-Learning Process

Each lesson begins with learning outcomes which provide a clear focus on what students should learn. The teaching-learning process for each lesson comprises four major stages: Introduction, Teaching, Practice and, Review and Assessment.

❖ **Introduction**

This portion introduces the teachers to link the prior knowledge of the students and a new concept, and also helps the students to think more critically and analytically.

❖ **Teaching**

Being a teacher, the ideas, teaching strategies and activities must be accompanied by clear directions and wide knowledge on subject to achieve learning outcomes. Extending knowledge other than text will enhance teacher's creativity and help to stimulate interest in new technology and electronic resources.

❖ **Practice**

This is mainly student-centred. Students will be given opportunities to do exercises or/and activities on their own or in pairs or in groups.

❖ **Review and Assessment**

The teachers should reflect the student's achievement for learning objectives in each work. The activities, results and discussion of the students should be evaluated among themselves. Teachers can moderate the students' performance in the classroom. Schedule for conducting classroom level formative assessment and summative assessment should be asked at different stages of a lesson.

Syllabus and Year Plan

(1) Syllabus

The syllabus for Chemistry portion in Grade 10 Science includes three components, five soft skills and learning objectives.

Chapter & Soft Skills	Learning Objectives	Topics	Activities	Review
Chapter 1 Introduction to Chemistry *Collaboration* *Communication* *Critical Thinking*	• To analyse the breadth, depth and scope of chemistry • To recognise the importance of chemistry in daily life	• Importance of Chemistry	• Distinguish the chemicals used in food, medicine, agriculture and cleansing agent	• Summary • Key for Review Questions • Key for Exercises • Chapter Review
	• To understand the states of matter • To know the changes of states of matter: physical and chemical changes	• Matter	• Distinguish between physical change and chemical change	
	• To examine the characteristics of elements, compounds and mixtures • To investigate separation techniques applied to mixtures • To compare the behaviours of solute, solvent and solution	• Elements, Compounds and Mixtures	• Understand and distinguish between elements, compounds and mixtures • Verify the mixture using suitable separation techniques • Understand the nature of solute, solvent and solution	

Chapter & Soft Skills	Learning Objectives	Topics	Activities	Review
Chapter 2 Acids, Bases and Salts *Collaboration Communication Critical Thinking and Problem Solving*	• To realise the properties of acid used in daily life	• Acids	• Describe the formulae and uses of acids	• Summary • Key for Review Questions • Key for Exercises • Chapter Review
	• To understand the properties and uses of bases and alkalis in daily life	• Bases and Alkalis	• Decide whether the substances collected from the home are bases or not	
	• To investigate the role of indicators and the pH scale used in chemistry	• Indicators and the pH Scale	• Measure the pH of various substances using pH paper	
	• To identify the different types of salts and their uses	• Salts	• Predict the salts by the neutralisation of various acids and bases	
Chapter 3 Fossil Fuels *Collaboration Communication Critical Thinking and Problem Solving Creativity and Innovation*	• To identify the sources, properties, and uses of coal and coke	• Coal	• Classify the types of fuel as renewable or non- renewable based on the sources and time duration of their formation	• Summary • Key for Review Questions • Key for Exercises • Chapter Review
	• To identify the sources, properties, and behaviour of crude oil and natural gas	• Crude Oil and Natural Gas	• Get knowledge about fractional distillation product and some of their uses in society	

Chapter & Soft Skills	Learning Objectives	Topics	Activities	Review
	• To understand the separation of crude oil based on different boiling points of the constituents	• Fractional Distillation of Crude Oil	• motivate the learning skill on petroleum products and refinery process	
	• To understand the refining of the separated products by cracking • To describe the manufacture of useful products from by-product of catalytic cracking	• Cracking	• Understand the classes of gasoline	
	• To realise the preparation and uses of biodiesel, biogas and hydrogen as other kinds of fuels	• Other Kinds of Fuels	• Describe the sources of biogas and biodiesel	

(2) Year Plan

The year plan for Chemistry portion in Grade 10 Science Textbook includes 12 sections for 3 chapters, allocation of periods for each section, revision and exam periods.

Schedule week	Chapter	Section	Period	Total period for each chapter
1	Chapter 1 Introduction to Chemistry	1.1 Importance of Chemistry	2	10
2				
3		1.2 Matter	2	
4				
5		1.3 Elements, Compounds and Mixtures	4	
6				
7				
8				
9		Review Exercises	2	
10				
11	Chapter 2 Acids, Bases and Salts	2.1 Acids	2	10
12				
13		2.2 Bases and Alkalis	2	
14				
15	Revised Chapterwise			
16	Examination			
17		2.3 Indicators and the pH Scale	2	
18				
19		2.4 Salts	2	
20				
21		Review Exercises	2	
22				
23	Revised Chapterwise			
24	Examination			

Schedule week	Chapter	Section	Period	Total period for each chapter
25	Chapter 3 Fossil Fuels	3.1 Coal	1	10
26		3.2 Crude Oil and Natural Gas	1	
27		3.3 Fractional Distillation of Crude Oil	2	
28				
29		3.4 Cracking	2	
30				
31		3.5 Other Kinds of Fuels	2	
32				
33		Review Exercises	2	
34				
35	Revised Chapterwise			
36	Examination			

Syllabus and Year Plan

1. Syllabus

The syllabus for Physics portion in Grade 10 Science includes two content components, five soft skills and learning objectives.

Chapter & Soft skill	Learning Objective	Topics	Activities	Review
Chapter 1 Measurement and Motion • Collaboration • Communication • Creativity and Innovation • Critical Thinking and Problem Solving	• To explain the physical quantity • To distinguish between the basic units and the derived units	• Measurement and Physical Quantity	• Distinguished between the basic units and derived units.	• Answer from textbook • Section Review
	• To classify the different system of units • To determine the derived units of some physical quantities	• System of Units	• Examine the system of units for length, mass and time by asking each group.	
	• To distinguish scalar and vector quantities • To draw graphical representation of vector	• Scalar and Vector	• Draw a vector diagram.	
	• To recognize the difference between distance travelled and displacement, speed and velocity • To describe the acceleration of a moving object due to change of velocity	• Describing Motion	• Calculate the average velocity.	

Chapter & Soft skill	Learning Objective	Topics	Activities	Review
Chapter 2 Force and Pressure • Collaboration • Communication • Critical Thinking and Problem Solving	• To realize two initial states of motion and inertia of a body • To relate acceleration of a particle and net force acting on it • To discuss the important facts and examples of action-reaction pair	• Newton's Laws of Motion	• Study the relation between force and acceleration.	• Answer from textbook • Section Review
	• To discuss the gravitational force between objects	• Gravitational Force and Newton's Law of Gravitation	• Discuss which force causes the existence of solar system.	
	• To explain the difference between weight and mass • To formulate the relation between mass of an object and its weight	• Mass and Weight	• Discuss the relation between mass and weight.	
	• To realize difference between force and pressure • To discuss density and observe the density of different objects	• Pressure, Density and Relative Density	• Compare the densities of wax and water.	

Chapter & Soft skill	Learning Objective	Topics	Activities	Review
	• To compare the densities of different substances			
Chapter 3 Work, Energy and Heat • Collaboration • Communication • Critical Thinking and Problem Solving	• To recognize the concept of work done • To study how to relate work, force and displacement	• Work and Energy	• Calculate the amount of work produced by pullingt object.	• Answer from textbook • Section Review
	• To explain how to relate heat and temperature • To calibrate the thermometer and express the relationship between temperature scales	• Heat and Temperature	• Convert the scales between Celsius scale and Fahrenheit scale.	
Chapter 4 Wave, Sound and Light • Collaboration • Communication • Creativity and Innovation	• To perform two types of wave • To discuss the wave characteristics	• Transverse and Longitudinal Waves	• Perform the transverse and longitudinal waves by using string and slinky spring.	• Answer from textbook • Section Review

Chapter & Soft skill	Learning Objective	Topics	Activities	Review
	• To discuss the physical quantities of a wave such as velocity, frequency, wavelength, period and amplitude • To recognize the relation of these quantities	• Characteristics of Waves	• Draw a wave form by observing the vibrating string.	
	• To discuss the transmission of sound • To study audible range of sound	• Sound Wave and Speed of Sound	• Discuss the relation between speed of sound and density of medium.	
	• To distinguish between self-luminous bodies and non-luminous bodies	• Sources of Light	• Describe sources of light in the environment.	
	• To discuss the different types of light beams • To explain the laws of reflection of light	• Reflection of Light	• Discuss the parallel beam and divergent beam.	

Chapter & Soft skill	Learning Objective	Topics	Activities	Review
Chapter 5 Electricity and Magnetism • Collaboration • Communication • Critical Thinking and Problem Solving • Creativity and Innovation	• To express positive and negative charges • To show that unlike charges attract and like charges repel	• Electric Charges and Electric Forces	• Draw the force diagram between two like charges and unlike charges.	• Answer from textbook • Section Review
	• To recognize the electric charge of matter	• Matter and Electricity	• Draw a diagram to show a neutral atom.	
	• To idendify the characteristics of conductors and insulators • To distinguish between conductors and insulators and semiconductors	• Conductors, Insulators and Semiconductors	• Distinguished between conductors and insulators.	
	• To distinguish between magnetic and non-magnetic materials • To develop an explanation of the properties of magnets	• Magnets and Magnetic Materials	• Classify magnetic and non-magnetic materials.	

2. Year Plan

The year plan for Physics portion in Grade 10 Science Textbook includes 19 sections for 5 chapters, allocation of periods for each section, 5 review and assessment periods.

Week	Period	Chapter Title	Lesson Title	Total period for each chapter
1	1	Chapter 1 Measurement and Motion	Measurement and Physical Quantity	7
2	2		System of Units	
3				
4	1		Scalar and Vector	
5	2		Describing Motion	
6				
7	1		Review and Assessment	
8	1	Chapter 2 Force and Pressure	Newton's Laws of Motion	7
9	2		Gravitational Force and Newton's Law of Gravitation	
10				
11	2		Mass and Weight	
12				
13	1		Pressure, Density and Relative Density	
14	1		Review and Assessment	
15	3	Chapter 3 Work, Energy and Heat	Work and Energy	6
16				
17				
18	2		Heat and Temperature	
19				
20	1		Review and Assessment	
21	1	Chapter 4 Wave, Sound and Light	Tranverse and Longitudinal Waves	

Week	Period	Chapter Title	Lesson Title	Total period for each chapter
22	2	Chapter 4 Wave, Sound and Light	Characteristics of Waves	7
23				
24	1		Sound Wave and Speed of Sound	
25	1		Sources of Light	
26	1		Reflection of Light	
27	1		Review and Assessment	
28	2	Chapter 5 Electricity and Magnetism	Electric Charges and Electric Forces	7
29				
30	1		Matter and Electricity	
31	1		Conductors, Insulators and Semiconductors	
32	2		Magnets and Magnetic Materials	
33				
34	1		Review and Assessment	
35	2	Revision		2
36				

Syllabus

This syllabus for Biology portion in Grade 10 Science includes three components and learning objectives.

Chapter	Learning Objectives	Topics	Activities	Review
CHAPTER 1 INTRODUCTION TO BIOLOGY	- To know about all living things (organisms) - To understand that biology deals with the study of all organisms	THE STUDY OF BIOLOGY	Teacher should organize 4 or 5 students as a small group. Let students discuss the study of biology and different organisms.	• Review and assessment • Answers for review questions from textbook • Summary
	- To know how biology is important in daily life - To understand the role of living organisms in food production and disease control	The Importance of Biology in Everyday Life	Let each student fill up the given table	
	- To study the different fields of Biology based on the nature and methods of studying of organisms	The Different Fields of Study in Biology		
	- To know the main characteristics of living things	Characteristics of Living Things		
	- To know the classification of organisms - To study the variety of organisms in the world -To identify the plants and animals in nature - To know how organisms are named scientifically for identification and how they are classified into related groups	TAXONOMY		

Chapter	Learning Objectives	Topics	Activities	Review
CHAPTER 1 INTRODUCTION TO BIOLOGY	- To know the classification system of living things - To understand how and why organisms are placed in three domains and six kingdoms of systematic classification	Kingdoms of Living Things	(1) Name the kingdoms of living things shown in the following illustrations: (Note: teacher should ask the questions related to each illustration) (2) Prepare a few slides of microorganisms and let the students observe them under the microscope(s). Teacher can also prepare the vinyl or chart of microorganisms. Then, ask them the following question(s) to write down the answer(s) in their Workbooks. Identify organism(s) which you have seen in your environment.	
	- To know the nature and characteristics of viruses	Viruses		
	- To know about the nature of Kingdom Plantae - To understand the characteristics of Plantae - To know how they can be grouped based on their characteristics	Kingdom Plantae	(1) Names the Divisions of plants from the following images: (Teacher can carry out oral quiz) (2) Teachers have to prepare one or two or three of the plants concerning with this lesson by using Microscope(s) and let the students to observe. Then, ask them the following question(s) and write down the answer(s) in their Workbooks.	

Chapter	Learning Objectives	Topics	Activities	Review
	- To know the different characteristics of some vertebrate animals	Kingdom Animalia Phylum - Chordata (Vertebrata)		
CHAPTER 2 CELL STRUCTURE AND ORGANIZATION	- To know that all living organisms are composed of basic units called cells - To understand differences between single cells which perform all functions of life and cells in multicellular organisms which are specialized to carry out additional particular functions in plants and animals	CELLS AS THE BUILDING BLOCKS OF LIFE		• Review and assessment • Answers for review questions from Textbook • Summary
	- To know and understand the cell theory	The Cell Theory		
	- To know the nature of prokaryotic and eukaryotic cells - To know the differences between prokaryotic and eukaryotic cells	Prokaryotic and Eukaryotic Cells		
	- To know the diversity in cell shape, size, internal organization and function in organisms - To know about the organelles as found in plants and animals - To identify characteristics of the organelles and their functions	EUKAYOTIC CELL STRUCTURE - Differences in Cell Structure - Cell Components	After asking the questions, teacher should organize 3 or 4 students to small groups to investigate and discuss the structure of a cell, and cellular organelles of plant and animal cells by using a microscope, cards or charts. Students should select any organelles from a given list and could match it with the respective functions.	

Chapter	Learning Objectives	Topics	Activities	Review
CHAPTER 2 CELL STRUCTURE AND ORGANIZATION	- To study the structure and function of plants tissues - To understand the forms and functions of various parts of plant	Cell Organization (A) Plant Tissues		
	- To study the organs and organ systems of the plants - To understand the structure and functions of organs and organ systems of plants	Level of Organization in Plants - Organ Systems		
	- To gain knowledge about the animal tissues	(B) Animal Tissues		
	- To know and understand about the development of cell to organ systems	Organ systems		

Yearly Lesson Plan

Total Lesson hours : 27 hrs
Total Lesson periods : 36 periods
One Lesson period : 45 minutes

Months	Chapter title	Chapter outline		Lesson period	Total period for each chapter
JUNE - OCTOBER	CHAPTER 1 INTRODUCTION TO BIOLOGY	1.1	THE STUDY OF BIOLOGY	1	16
		1.1.1	The Importance of Biology in Everyday Life	1	
		1.1.2	The Different Fields of Study in Biology	1	
		1.1.3	Characteristics of Living Things	2	
		1.2	TAXONOMY	2	
		1.3	KINGDOMS	3	
		1.3.1	Kingdoms of Living Things		
			Virus	1	
		1.3.2	Kingdom Plantae	2	
		1.3.3	Kingdom Animalia	2	
			Review Questions	1	
			Concept map		

Months	Chapter title	Chapter outline		Lesson period	Total period for each chapter
NOVEMBER - FEBRUARY	CHAPTER 2 CELL STRUCTURE AND ORGANIZATION	2.1	CELLS AS THE BUILDING BLOCKS OF LIFE	1	20
		2.1.1	The Cell Theory	1	
		2.1.2	Prokaryotic and Eukaryotic Cells	3	
		2.2	EUKARYOTIC CELL STRUCTURE	6	
		2.2.1	Differences in Cell Structure		
		2.2.2	Cell Components (Table 2.2)		
		2.2.3	Cell Organization		
			(A) Plant Tissues	2	
			Level of organization in plants Organ system	2	
			(B)Animal Tissues	2	
			Organ systems	2	
			Review Questions	1	
			Concept map		
			Total	36	

Weekly plan

Chapter	Period (1)	Period (2)	Period (3)	Period (4)	Period (5)	Total periods	
1	1.1	1.1.1	1.1.2	1.1.3	1.1.3	5	16
	1.2	1.2	1.3, 1.3.1	1.3, 1.3.1	1.3, 1.3.1	5	
	1.3.1	1.3.2	1.3.2	1.3.3	1.3.3	5	
	Review questions (R.Q)/Concept map (C.M)						
2	2.1	2.1.1	2.1.2	2.1.2	2.1.2	5	20
	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	5	
	2.2, 2.2.1, 2.2.2	2.2.3 (A)	2.2.3 (A)	2.2.3 (A)	2.2.3 (A)	5	
	2.2.3(B)	2.2.3 (B)	2.2.3 (B)	2.2.3 (B)	Review questions (R.Q)/Concept map (C.M)	5	
					Totals	36	

CHAPTER 1

INTRODUCTION TO CHEMISTRY

Total Number of Lesson Periods: 10 (1 period - 45 minutes)

Learning Outcomes

It is expected that students will be able to:

- analyse the breadth, depth and scope of chemistry;
- recognise the importance of chemistry in daily life;
- understand the states of matter;
- know the changes of states of matter: physical and chemical changes;
- examine the characteristics of elements, compounds and mixtures;
- investigate the separation techniques as applied to mixtures;
- compare the behaviours of the solutes, solvents and solutions.

Skill Development

- Collaboration (when working successfully in groups)
- Communication (when reporting progress on exercises and activities)
- Critical Thinking (when finding solutions to problems)

Support Materials

- Effervescent tablets, milk, vinegar, ice cubes, beaker, measuring cylinder, glass rod, lime, salt, coffee powder, tamarind pulp, jaggery, sugar, water, hot water, worksheet papers with pictures

1.1 IMPORTANCE OF CHEMISTRY

Number of lesson periods: 2

Lesson Objectives

- To analyse the breadth, depth and scope of chemistry
- To recognise the importance of chemistry in daily life

Introduction

Most everything we do and encounter in daily life involves chemistry. Teacher should ask the students as follows: Do you know that chemistry plays a crucial role in addressing the challenges such as climate change, water contamination, air pollution and food shortages? We can find chemistry in the foods, the air, cleaning chemicals, emotions and every object made up of matter-even our own bodies.

The purpose of learning this section is to understand the role and impact of chemistry in daily life and in the network of every issue that we all face in our society.

Teaching

Teacher should explain that chemistry is the study of matter and the changes it can undergo. Understanding basic chemistry concepts is important for almost every profession. In all branches of science, chemistry takes part the central role that helps us to describe and explain the states of matter and the processes in our world.

More information for teacher

- All the activities of the human beings are controlled by chemicals.
- Chemical reactions also take place in plants and animals, and resulting in the formation of substances used to treat illness.
- The food that is consumed daily comes directly from chemical processes.
- Students should notice their lives involve chemistry. Making coffee, cooking curry, breathing and bathing involve chemistry. The products we use - like soap and shampoo, the fabrics we wear, the electronics and the click gadgets that keep us connected to our world - all of these and more involve chemical substances and processes.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on chemistry; a science that touches our society every moment.

Activity

The teacher should identify this activity as a group work depending on the class size.

Objective

- To distinguish the chemicals used in food, medicine, agriculture and cleansing agent

Instruction

- Make the class into four groups: A, B, C and D.
- Tell them to mention the name of chemicals used in the following:
- Group A: food
- Group B: medicine
- Group C: agriculture
- Group D: cleansing agent

Resources and Preparation

- Encourage the students to collect the name of chemicals used in food, medicine, agriculture and cleansing agent by using library / online resources before discussion.

Reflection on Learning

- For example,

Food	Medicine	Agriculture	Cleansing agent
protein, fat, carbohydrate, water, dietary fibre, vitamins and minerals, food colour, food sweetener	antibiotics, antiseptics, analgesics, penicillins, tetracyclines, amoxicillin, aspirin	pesticides, herbicides, insecticides and fungicides, fertilisers	water, soap or detergent, ammonia solution, sodium hypochlorite (liquid bleach), acetic acid (vinegar)

- Other appropriate answers should be accepted.

1.2 MATTER

Number of lesson periods: 2

Lesson Objectives

- To understand the states of matter
- To know the changes of states of matter: physical and chemical changes

Introduction

Matter is anything that has mass and takes up space. Chemistry is the study of all matter, their composition, properties and changes of states from one form to another by changing energy. Matter can exist in one of the three states: solid, liquid and gas. Teacher should recall students' basic knowledge by asking questions: burning magnesium ribbon, dissolving sugar in water, etc.. According to their answers, teacher should ask the students which changes can form new substances or not. Chemical change can form new substances and physical change cannot.

Teaching

Teacher should assess the students' understanding about arrangement of particles from the Grade 10 Science (Chemistry) Textbook. And then explain in detail with the help of the following question. How are particles arranged in solids, liquids and gases? By referring to the Textbook, the teacher should ask the students the names of changing processes from one state to another. Teacher should clearly explain the physical change and chemical change with suitable examples.

More information for teacher

- Matter is classified as solids, liquids and gases based on their physical properties.
- Energy is either lost or gained during a change of state. When energy is applied to a solid, the tightly packed particles of matter begin to move around, flowing over each

Continued from ***More information for teacher***

other. The solid then turns into a liquid. The shape becomes indefinite. The volume, however, does not change, because the particles are still part of one another. When energy is applied to a liquid, the particles of liquid begin to move about so rapidly that they can no longer hold themselves together. The liquid then turns into a gas. The shape is indefinite, and the volume becomes indefinite. The reverse process occurs when energy is taken away from gas.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the changes of matter.

Activity

The teacher should identify this activity as a group discussion in the class.

Objective

- To distinguish between physical change and chemical change

Instruction

- Make the class into three groups: A, B and C.
- Tell them to do as follows:
- Group A: to put one effervescent tablet into a beaker containing distilled water
- Group B: to mix 50 mL of milk and 30 mL of vinegar in a beaker [If it is not available, the volume of milk and vinegar can be reduced (5:3).]
- Group C: to add an ice cube into a beaker
- Let the students examine what type of changes is happening in these experiments.

Resources and Preparation

- Effervescent tablet, milk, vinegar, ice cube, beaker, measuring cylinder, glass rod

Reflection on Learning

- Group A: When adding one effervescent tablet into a beaker containing distilled water, effervescence took place and gas was evolved. Therefore, new substances were formed. (This is a chemical change.)
- Group B: When milk and vinegar were mixed, two separate layers appeared after a few minutes. New substances were formed. (This is a chemical change.)
- Group C: For a while, ice cube in a beaker melted and changed into water. In this change, no new substance was formed. (This is a physical change.)

1.3 ELEMENTS, COMPOUNDS AND MIXTURES

Number of lesson periods: 4

Lesson Objectives

- To examine the characteristics of elements, compounds and mixtures
- To investigate separation techniques applied to mixtures
- To compare the behaviours of solute, solvent and solution

Introduction

Teacher should ask the students to describe element, compound and mixture with examples. In this way, teacher should recall students' knowledge from Grade 6 Science Textbook in which they have learnt. From the students' answers, select the pure substances. Are these pure substances either element or compound? What is the main difference between pure substance and mixture? Pure substance has definite and constant composition but mixture has different compositions. Teacher should extend this lesson by making questions. Have you ever prepared a solution? Give an example of a solution. To make a solution, how many things are needed? Then teacher should refer to Grade 6 Science Textbook and explain again.

The purpose of learning this section is to understand the characteristics of elements, compounds and mixtures, and how to separate the mixtures.

Teaching

Teacher should ask the students how to differentiate between elements, compounds and mixtures with suitable examples. Teacher should focus on differences between molecular elements and molecular compounds with examples and explain the types of compounds based on the combination of numbers of atoms or elements and also the formation of mixture. Teacher should make the students to describe the examples for homogeneous and heterogeneous mixtures according to Table 1.1. By using Table 1.2, teacher should ask the students to decide the appropriate separation methods based on the physical states of mixture components. A solution is a mixture of solute and solvent. A solvent is the medium in which the solutes are dissolved. Solutes usually dissolve to give ions or molecules in solution.

More information for teacher

- According to their different physical and chemical properties, the useful parts or unwanted parts of mixtures can be separated by various methods such as decantation, filtration, evaporation, and crystallisation methods for solid and liquid mixture; magnetic separation for solids mixture, simple and fractional distillation for liquids mixture, centrifugation for solid and liquid mixture and chromatography for colouring mixture.
- Our daily life is encountered with this lesson. In making coffee, sugar, cream and coffee powder are solutes, hot water is solvent and hot coffee is a solution. The amount of solute that is soluble in the solvent depends on the temperature.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the classification of the substances around them whether they are elements or compounds or mixtures.

Activity (1)

The teacher should identify this activity as an individual work.

Objective

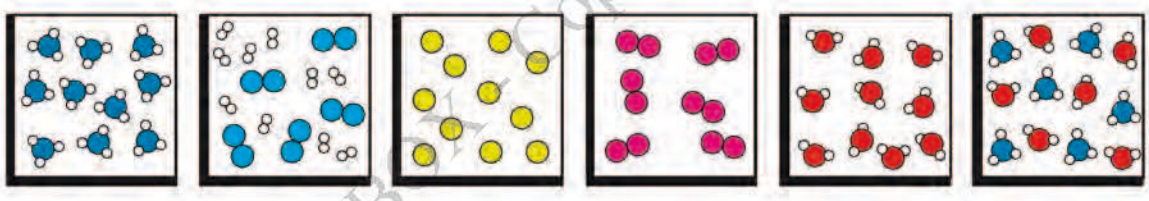
- To understand and distinguish between elements, compounds and mixtures

Instruction

- Tell the students to study the following Figures: A, B, C, D, E and F, and to answer the questions given.
- Which one represents the arrangement of atoms in each of the following molecules?
  (1) Molecules of ammonia (NH_3)
  (2) Molecules of water (H_2O)
  (3) Molecules of oxygen (O_2)
  (4) A mixture of two molecules
  (5) A mixture of two compounds
  (6) An element

Resources and Preparation

- Worksheet papers with pictures as shown below



(A) (B) (C) (D) (E) (F)

Reflection on Learning

- (1) A (2) E (3) D (4) B / F / both (5) F (6) C / D / both
- Ask more questions as below:
  (i) Give three examples each for metal and non-metal. (Metals: gold, aluminium, copper) (Non-metals: carbon, bromine, oxygen)
  (ii) How do you understand about the term "fixed proportion" in forming a compound? (constant composition or definite amount of composition)
  (iii) Differentiate between molecular elements and molecular compounds with appropriate examples. [(A molecule of an element (molecular element) consists of atoms of the same kind. e.g., H_2, O_2, O_3]; [A molecule of a compound (molecular compound) consists more than one kind of atoms. e.g., H_2O, CO_2, NO_2]

(iv) Give examples for diatomic, triatomic, and polyatomic molecules.
[Diatomic molecules are molecules made of two atoms chemically bonded together (e.g., O_2, CO), triatomic molecules are molecules composed of three atoms of the same or different elements (e.g., O_3, H_2O, CO_2), polyatomic molecules are groups of more than three atoms held together by covalent bond (e.g., C_2H_5OH, CH_3COOH).]

- Other suitable examples should be accepted.

Activity (2)

The teacher should identify this activity as a group discussion in the class and ask them to mention the types of mixture with suitable examples.

Objective

- To verify the mixture using suitable separation techniques

Instruction

- Make the class into four groups: A, B, C and D.
- Tell them to mention the following:
- Group A: the pairs of mixture (e.g., solid / solid)
- Group B: the suitable example
- Group C: the types (e.g., homogeneous or heterogeneous)
- Group D: name of the separation techniques
- Record the students' answer

Resources and Preparation

- Encourage the students to mention the types of mixture and the separation techniques by using Grade 10 Science (Chemistry) Textbook / online resources before discussion.

Reflection on Learning

No.	Pairs (Group A)	Example (Group B)	Types (Group C)	Separation techniques (Group D)
1	solid / solid	steel (mixture of carbon and iron)	homogeneous	electrolysis*
		sand and iron powder	heterogeneous	using magnet
2	solid / liquid	sugar solution	homogeneous	evaporation
		sand and water	heterogeneous	filtration
3	solid / gas	dust in air/cigarette smoke	homogeneous	filtration
		aerosol	heterogeneous	filtration

Continued from ***Reflection on Learning***

No.	Pairs (Group A)	Example (Group B)	Types (Group C)	Separation techniques (Group D)
4	liquid / liquid	alcohol and water	homogeneous	fractional distillation
		oil and vinegar	heterogeneous	decantation
5	liquid / gas	fizzy drink	homogeneous	shaking the container or stirring the liquid
		crude oil and natural gas	heterogeneous	fractional distillation
6	gas / gas	air	homogeneous	fractional distillation

*** Teacher should describe the answer just for knowledge.**

Activity (3)

The teacher should identify this activity as a group work depending on the class size.

Objective

- To understand the nature of solute, solvent and solution

Instruction

- Make the class into three groups, A, B and C.
- Tell them to mention the solute, solvent and solution for the given solutions: lime juice, coffee, tamarind juice.
- Group A : lime juice
- Group B : coffee
- Group C : tamarind juice

Resources and Preparation

- Lime, coffee powder, tamarind pulp, jaggery, sugar, milk, salt, water, hot water

Reflection on Learning

Group	Solute	Solvent	Solution
Group A:	sugar, lime, salt	water	lime juice
Group B:	coffee powder, sugar, milk	hot water	coffee
Group C:	tamarind pulp, salt, jaggery	water	tamarind juice

SUMMARY

The highlights of this chapter:

- the importance of chemistry
- changes the state of matter physically or chemically
- classification of mixtures- homogeneous and heterogeneous mixtures
- separation of mixtures - filtration, decantation, evaporation, crystallisation, distillation, fractional distillation, centrifugation, and chromatography, etc.
- dissolution of soluble substances in solvents (water) to form solutions

Key for Review Questions

Section 1.1

(1) Chemistry is important because everything you do is chemistry. Chemical reactions occur when you breathe, eat, or just sit there reading. You are surrounded by materials and substances, all chemicals. Even your body is made of chemicals. For example, the air we are breathing is a mixture of elements like oxygen and nitrogen. Any other examples should be accepted.

Section 1.2

(1)

Solid	Liquid	Gas
It has definite volume and shape.	It has definite volume but no definite shape.	It has no definite volume and shape.
It cannot be compressed and does not flow.	It cannot be compressed, and flows in all directions.	It can easily be compressed, and flows in all directions.

(2)

Solid	Liquid	Gas
iron, gold, copper	water, mercury, vinegar	argon

(3)

Physical change	Chemical change
(b) mixing sand and water	(a) boiling an egg
(d) evaporating alcohol	(c) making jelly
(h) crushing a can	(e) souring of milk
(i) breaking a glass	(f) baking a cake
	(g) digesting food

(4) Dissolving glucose in water is a physical change because when water is evaporated, the glucose will be recovered. No new substance is formed.

Section 1.3

(1) Substance A is an element because it cannot be broken down into other simpler substances through chemical means.

(2) The original substance is a compound because it can be broken down into other substances by chemical means.

(3) (a) sugar, glucose (b) sand, chalk (c) oil, petrol

KEY FOR EXERCISES **Number of review exercises periods: 2**

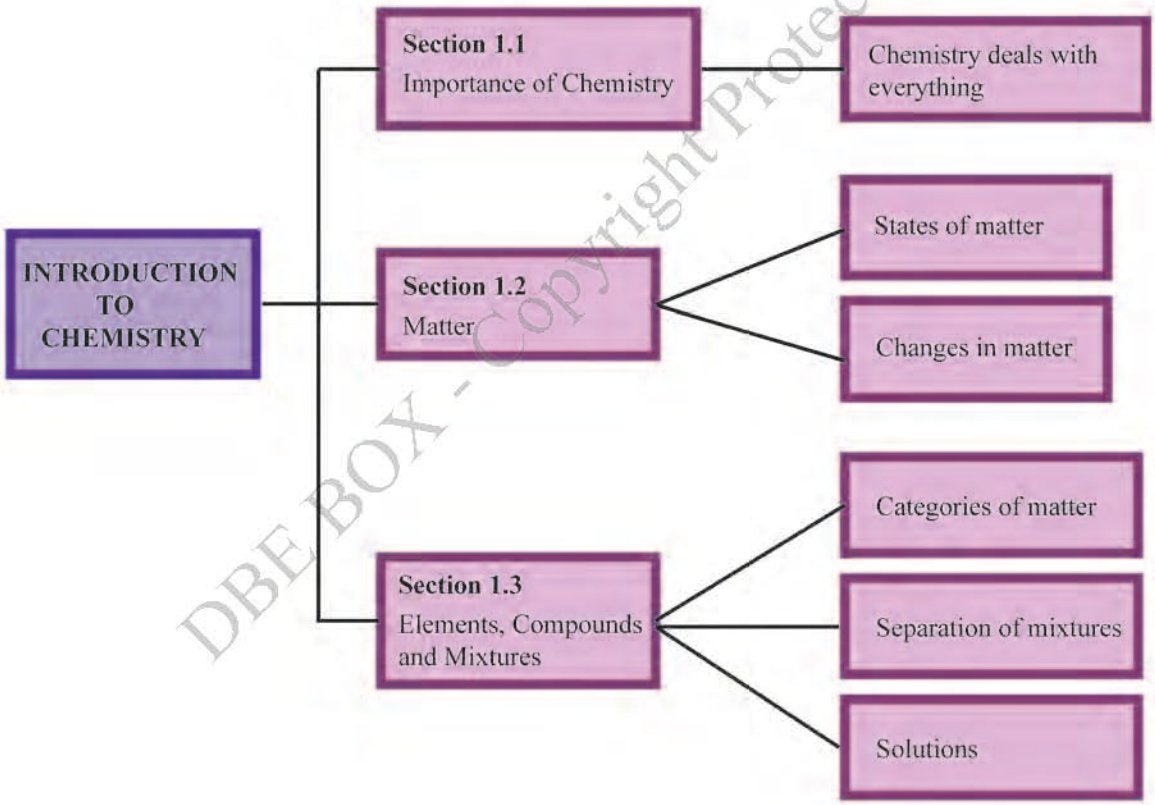
Understanding key ideas (Q.1 to Q.6)

1. (a) FALSE (Melting butter is a physical change.)
   (b) FALSE (Lighting of candle is a chemical change.)
   (c) FALSE (Mixtures consist of two or more different substances that are physically mixed.)
   (d) FALSE (Flour and rice powder are solid-solid heterogeneous mixture.)
   (e) FALSE (Separation of sugar from tea can be done by evaporation.)
   (f) TRUE
2. mixtures, separation, components, states, compounds
3. At room temperature and pressure,
   a solid element = gold
   a liquid element = mercury, bromine
   a solid compound = limestone
   a liquid compound = water
   a gas compound = carbon dioxide
   a homogeneous solution = vinegar
   a heterogeneous solution = milk
   a gas mixture = air
   a solid mixture = ash, soil
4. (a) yogurt, smoke, soap solution, silver coin
   (b) (i) A substance that cannot be separated into two or more substances by ordinary chemical (or physical) means

5.

List A	List B
(a) evaporation	(iii) the solvent is removed as a gas
(b) condensing	(v) a gas changes to a liquid, on cooling
(c) filtering	(vi) separates an insoluble substance from a liquid
(d) crystallising	(i) a solid appears as the solution cools
(e) distillation	(iv) this method allows you to recycle a solvent
(f) fractional distillation	(ii) used to separate a mixture of two liquids

CHAPTER REVIEW



CHAPTER 2

ACIDS, BASES AND SALTS

Total Number of Lesson Periods: 10 (1 period - 45 minutes)

Learning Outcomes

It is expected that students will be able to:

- identify the properties and behaviours of acids, bases and salts with examples;
- relate the role of indicators and the pH scale used in chemistry;
- distinguish between bases and alkalis;
- classify the salts based on acids used.

Skill Development

- Collaboration (working in groups, share ideas, and find solutions together)
- Communication (doing activities and practical work)
- Critical Thinking and Problem Solving (finding solutions to problems and correcting errors)

Support Materials

- ladyfinger (Yone-pa-tae-thee), stalks of roselles (Chin Baung), Tayaw, blue and red litmus / pH papers, lemon, vinegar, washing powder, milk, water, beaker, cards containing the formulae: HCl, HNO_3, H_2SO_4, H_2SO_3, H_2CO_3, H_3PO_4 and CH_3COOH; NaOH, KOH, NH_4OH, $Ca(OH)_2$, $Zn(OH)_2$ and $Ba(OH)_2$

2.1 ACIDS

Number of lesson periods: 2

Lesson Objective

- To realise the properties of acids used in daily life

Introduction

Teacher should recall previous knowledge about acid that students have learnt in Grade 8 Science Textbook and start with question. Why do some food and fruits have sour taste? They contain acids. Other familiar foods with sour taste obtain from acids: orange and lemon contain citric acid, soft drink contains carbonic acid, and wine contains tartaric acid. Where can acids be found else? Acids are commonly found in daily life: sulphuric acid in car batteries, hydrochloric acid in pickling metals parts for coating paint, and nitric acid in manufacturing fertilisers.

The purpose of learning this section is to understand the properties of acids and their uses.

Teaching

Teacher should explain the differences between strong acids and weak acids. By referring to Table 2.1 from Grade 10 Science (Chemistry) Textbook, teacher should assess the students' understanding on the strength of acids from their environment and then explain about the properties of acid and uses in daily life with more information other than Textbook.

More information for teacher

- Citrus fruits usually contain citric acid and ascorbic acid which is better known as vitamin C.
- Solid form of acids (e.g., oxalic acid) cannot conduct electricity. Aqueous solutions of acids are electrolytes, meaning that they can conduct electrical current.
- Strong acids are strong electrolytes because they ionise completely in water. Weak acids are weak electrolytes that exist primarily in a non-ionised form when dissolved in water.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the names, formulae and properties of acids.

Activity

The teacher should identify this activity as a group work depending on the class size.

Objective

- To describe the formulae and uses of acids

Instruction

- Make the class into two groups: A and B.
- Tell them to mention as follows:
- Group A: the formulae of acids
- Group B: their uses

Resources and Preparation

- Encourage the students to mention the uses of acids by using Textbook / online resources before discussion.

Reflection on Learning

Acids	Formulae (Group A)	Uses (Group B)
ethanoic acid	CH_3COOH	to produce vinegar
nitric acid	HNO_3	to prepare fertiliser
citric acid	$C_6H_8O_7$	in fruit juice
sulphuric acid	H_2SO_4	in car batteries
phosphoric acid	H_3PO_4	to prevent rusting

2.2 BASES AND ALKALIS

Number of lesson periods: 2

Lesson objective

- To understand the properties and uses of bases and alkalis in daily life

Introduction

Generally, base is defined as a substance which can produce hydroxide ions (OH^-) in water solution. Alkali, a special type of base, is a base dissolved in water, but not all bases are alkalis because not all bases dissolve in water. Bases can be used in anti-acid drugs for stomachache, degreasing agents and glass cleaner, and production of soap.

The purpose of learning this section is to identify the bases, alkalis and their properties.

Teaching

By referring to Grade 10 Science (Chemistry) Textbook, teacher should assess the students' understanding on the properties of bases and alkalis, and explain about the properties of bases and alkalis and uses in daily life with more information other than Textbook.

More information for teacher

- Many substances we use in home are bases. Dishwasher cream, washing powder and cleaning liquids all contain bases.
- Antacid tablets used to treat indigestion contain bases such as magnesium oxide or magnesium hydroxide.
- Most strong bases (alkalis) contain hydroxides. Bases can be oxides, hydroxides or carbonates of metals.
- Strong alkalis are corrosive in nature.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the bases and their properties.

Activity

Teacher should identify this activity as a group work depending on the class size.

Objective

- To decide whether the substances collected from the home are bases or not

Instruction

- Make the class into groups.
- Tell them to do as follows:
- to collect any substances by each group

- to chop the sample (if it is a solid form), immerse it in the water and then filter
- to dissolve the sample in water (if it is a powder or paste form) and then filter it
- to examine whether it is slippery or not, and record it
- to test the aqueous layers with litmus papers / pH paper

Resources and Preparation

- Any substances such as ladyfinger (Yone-pa- tae-thee), stalks of roselles (Chin Baung), Tayaw, washing powder, etc., water, beaker, blue and red litmus papers / pH paper

Reflection on Learning

Substances	Slippery	Litmus paper	Base
ladyfinger	yes	no change	no
stalks of roselle	yes	no change	no
washing powder	yes	red litmus paper turns blue	yes
tayaw	yes	red litmus paper turns blue	yes

2.3 INDICATORS AND THE pH SCALE

Number of lesson periods: 2

Lesson Objective

- To investigate the role of indicators and the pH scale used in chemistry

Introduction

The acidic or basic nature of a liquid is important in determining the uses of liquid. Since the students have learnt about acids and bases in previous sections, the teacher should ask them the following questions and make them recognise the differences between acid and base. How can you identify the given solution as acid or base? The acid or base condition of given solution can be identified by litmus papers, indicators, or pH meters (Figures 2.2 and 2.3). What is an indicator? An indicator is a substance whose solution changes colour due to changes in pH. An indicator is not useful outside of its pH range (0 – 14).

The purpose of learning this section is to understand the acidic or basic characters of a solution by using indicators and pH values.

Teaching

Teacher should extend the students' understanding about indicators that can occur not only in laboratory but also in household items, for example, coloured fruits (dragon fruit, red cabbage, etc.) and household items (turmeric, yellow in acid and neutral, but turns bright red when it is exposed to basic solutions). Moreover, teacher should explain the pH range in acidic and basic solutions (Table 2.2).

More information for teacher

- Indicators are used in titration process to signal the completion of the acid-base reaction. They change colour with pH.
- Indicators are usually weak acids or bases. When dissolved in water, they dissociate slightly to form ions.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the pH values in solutions.

Activity

Teacher should identify this activity as an individual work in the class.

Objective

- To measure the pH of various substances using pH paper

Instruction

- Tell the class to do the following:
- to collect the substances from their surrounding and make them liquefy
- to test the liquids with pH paper
- to match it with standard colour index and determine whether it is acidic, basic or neutral

Resources and Preparation

- Any substances; e.g., lemon, vinegar, washing powder, milk, water, etc., pH paper

Reflection on Learning

- There are 14 colour bars in Reference with respect to pH = 1 to pH = 14.
- If the observed colour matches with colour of pH = 1 to pH = 6, the substance is acidic.
- If the observed colour matches with colour of pH = 7, the substance is neutral.
- If the observed colour matches with colour of pH = 8 to pH = 14, the substance is basic.

2.4 SALTS

Number of lesson periods: 2

Lesson objective

- To identify the different types of salts and their uses

Introduction

Teacher should ask the students how salts can be obtained and how it is related with acids. Salts are compounds that are formed by the neutralisation of acids and bases.

A salt consists of a positively charged metallic ion and negatively charged ion which is derived from the corresponding acid by loss of H^+.

The purpose of learning this section is to understand the acid-base neutralisation, classification of salts and their uses.

Teaching

By referring to Table 2.3 from Grade 10 Science (Chemistry) Textbook, teacher should assess the students' understanding on the classification of salts based on acids.

More information for teacher

- Salts are formed by the reaction of acids with bases, and they always contain either a metal cation or ammonium (NH_4^+) ion. Some examples of salts are NaCl, NH_4F, $MgCO_3$ and $Fe_2(HPO_4)_3$.
- Table salt contains sodium ion, which is an essential nutrient needed by the body in small amounts. It is needed to transmit nerve impulses, contract and relax muscle fibers (including those in the heart and blood vessels), and maintain a proper fluid balance. When salt is added in the processing of meats, it restructures the proteins, which then acts as a binding and emulsifying agent.

Suggestion for Practising and Evaluation

A range of activity can be used to evaluate the students' progress and understanding on the formation of salts.

Activity

Teacher should identify this activity as a group work depending on the class size.

Objective

- To predict the salts by the neutralisation of various acids and bases

Instruction

- Make the class into four groups: A, B, C and D.
- Prepare 7 cards of the acids with their respective formulae and 6 cards of the bases with their respective formulae.
- Tell them to mention as follows:
- Group A: acids
- Group B: bases
- Group C: names of salts
- Group D: formulae of salts

Resources and Preparation

- Cards containing the formulae: HCl, HNO_3, H_2SO_4, H_2SO_3, H_2CO_3, H_3PO_4, and CH_3COOH;
- NaOH, KOH, NH_4OH, $Ca(OH)_2$, $Zn(OH)_2$ and $Ba(OH)_2$

Reflection on Learning

For example,

- Group A: nitric acid
- Group B: ammonium hydroxide
- Group C: ammonium nitrate
- Group D: NH_4NO_3

SUMMARY

The highlights of this chapter:

- the importance of acids in everyday life: in food, industry and medicine
- physical and chemical properties of acids
- bases or alkalis which can produce hydroxide ions in water and neutralise with acids
- an indicator that is a substance with different colours in acidic and alkaline solutions
- a measure of the acidity or alkalinity of a solution known as pH. (Solutions with < 7 acidic, and > 7: alkaline, pH.7: neutral.)
- the classification of salts as soluble and insoluble

Key for Review Questions

Section 2.1

(1) After rubbing an old copper coin with lemon juice, the coin is shiny once again. Old copper coin is dull because patina is formed on surface of copper or brass by atmospheric oxidation, consisting of copper(II) carbonate / copper salt. Lemon juice contains citric acid. When old copper coin is rubbed with lemon juice, copper(II) carbonate / copper salt dissolves in citric acid. As a result, shiny and bright coin is obtained. (Patina is thin layer that variously forms on the surface of copper, bronze, and similar metals during exposure to atmospheric oxidation.)

(2) It can be detected by blue litmus paper. Acid turns blue litmus paper red.

(3) The organ of ant contains methanoic (formic) acid. Injection of acid by ant causes the pain at the place of bite.

(4) Baking powder which is base, neutralises the methanoic acid injected by bee.

Section 2.2

(1) A base is usually a metallic oxide and hydroxide. Most bases are not soluble in water. The bases that soluble in water are called alkalis. All alkalis are bases but all bases are not alkalis.

(2) (a) hydrogen (b) metallic (c) salt (d) hydroxide (c) ammonia

Section 2.3

(1) (a) acidic (b) acidic (c) neutral (d) alkaline

(2) Pancreatic juice is basic.

Reflection on Learning

For example,

- Group A: nitric acid
- Group B: ammonium hydroxide
- Group C: ammonium nitrate
- Group D: NH_4NO_3

SUMMARY

The highlights of this chapter:

- the importance of acids in everyday life: in food, industry and medicine
- physical and chemical properties of acids
- bases or alkalis which can produce hydroxide ions in water and neutralise with acids
- an indicator that is a substance with different colours in acidic and alkaline solutions
- a measure of the acidity or alkalinity of a solution known as pH. (Solutions with < 7 acidic, and > 7: alkaline, pH.7: neutral.)
- the classification of salts as soluble and insoluble

Key for Review Questions

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(2) It can be detected by blue litmus paper. Acid turns blue litmus paper red.

(3) The organ of ant contains methanoic (formic) acid. Injection of acid by ant causes the pain at the place of bite.

(4) Baking powder which is base, neutralises the methanoic acid injected by bee.

Section 2.2

(1) A base is usually a metallic oxide and hydroxide. Most bases are not soluble in water. The bases that soluble in water are called alkalis. All alkalis are bases but all bases are not alkalis.

(2) (a) hydrogen (b) metallic (c) salt (d) hydroxide (c) ammonia

Section 2.3

(1) (a) acidic (b) acidic (c) neutral (d) alkaline

(2) Pancreatic juice is basic.

(3) Whether soil is acidic or basic can be detected by litmus paper.
Mix a small amount of soil with distilled water and touch the litmus paper to the soil-water solution. If blue litmus paper turns red, the soil is acidic and if red litmus paper turns blue, the soil is basic.

(4) (a) baking soda (b) vinegar (c) purified water

Section 2.4

(1) Hydrochloric acid which is spilled on the floor can be neutralised by using baking soda (sodium hydrogen carbonate).

(2) Many plants do not grow properly in highly acidic soil. The purpose of adding lime is to neutralise the acidic soil.

(3) Farmers treat the alkaline soil by using gypsum ($CaSO_4$. $2H_2O$) to lower the soil alkalinity.

(4) The gastric juice is hydrochloric acid. The gastric medicine is actively neutralised to acidic juice which causes stomach pain.

KEY FOR EXERCISES **Number of review exercises periods: 2**

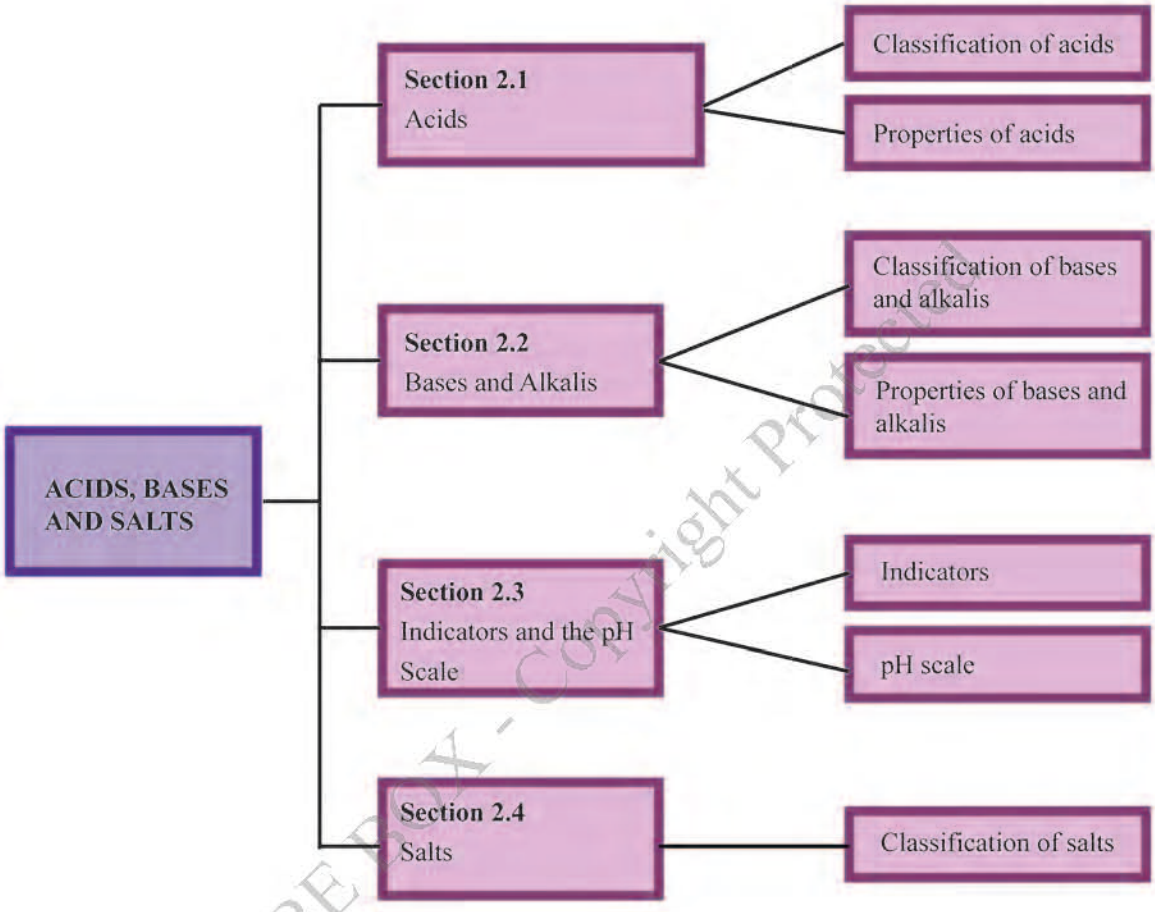
1. (a) TRUE
   (b) FALSE (Copper(II) hydroxide is a base.)
   (c) TRUE
   (d) TRUE
   (e) TRUE

2. (a) sodium hydroxide
   (b) ammonia
   (c) strongly alkaline
   (d) calcium oxide

3. (a) neutralisation
   (b) 7
   (c) red
   (d) pH
   (e) acids

4. (a) dissolves, hydrogen, salt, oxides, hydroxides, water
   (b) soluble, ammonia, hydroxide, acids, salt
   (c) scale, alkaline, acidic, high, neutral, seven, universal

CHAPTER REVIEW



CHAPTER 3

FOSSIL FUELS

Total Number of Lesson Periods: 10 (1 period - 45 minutes)

Learning Outcomes

It is expected that students will be able to:

- identify the sources, properties, and uses of coal and coke;
- identify the sources, properties, and behaviour of crude oil and natural gas;
- explain the process of fractional distillation as applied to crude oils;
- understand the refining of the separated products (cracking);
- describe the manufacture of useful products from by-product of catalytic cracking;
- realise the preparation and uses of biodiesel, biogas and hydrogen as other kinds of fuels.

Skill Development

- Collaboration (when working successfully in groups)
- Communication (when reporting progress on exercises and activities)
- Critical Thinking and Problem Solving (when exploration of new source of fuels)
- Creativity and Innovation (when making of useful materials from cracking by-products)

Support Materials

- Puzzle worksheet

3.1 COAL

Number of lesson period: 1

Lesson Objective

- To identify the sources, properties and uses of coal and coke

Introduction

Teacher should recall students' prior knowledge about fuel by making the questions as follows: What is fuel? A fuel is a substance that is changed in some way to produce heat, electricity, or other forms of energy.

The purpose of learning this section is to understand how the coal is formed, what compositions and properties of coal and coke are, and why these are important in our society.

Teaching

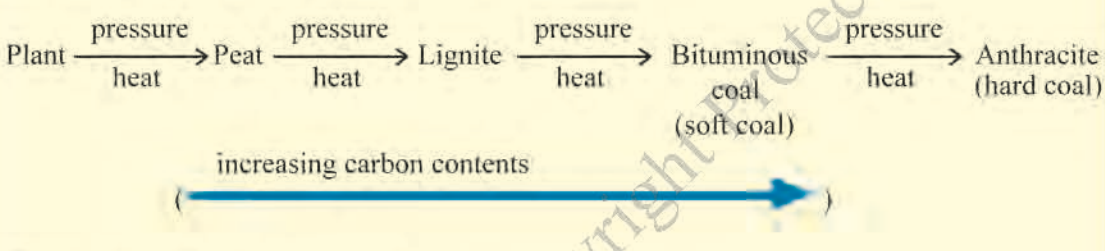
Teacher should explain the source of coal and time duration of its formation.

Then, by referring to Figure 3.1 from Textbook, teacher should assess the students' understanding on the differentiation between coal and coke, and their uses. At the end of lesson, teacher should make some cross questions on their understanding.

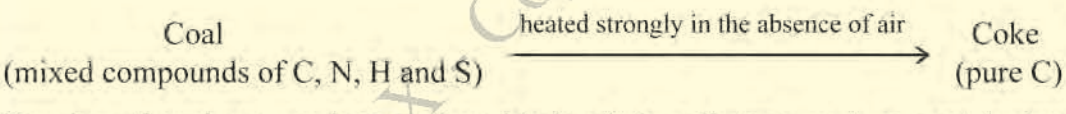
More information for teacher

- Coal comes from fossil plant residues by the action of pressure and temperature through geological forces.
- Crude oil and natural gas come from marine microorganisms by the action of high pressure and temperature for millions of years.
- Coal is composed mainly of carbon together with hydrogen, nitrogen and sulphur.
- The plant residues were gradually changed as shown below:

Plant residue to anthracite



- **Production of coke from coal**



- Burning of coal can produce various kinds of air pollutants such as soot (unburnt carbon), oxides of sulphur and nitrogen, and solid residue or particulate matter (commonly known as ash). However, burning of coke does not produce such pollutants.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the sources of fuels and their renewability.

Activity

The teacher should identify this activity as a group work depending on the class size.

Objective

- To classify the types of fuel as renewable or non-renewable based on the sources and time duration of their formation

Instruction

- Make the class into four groups A, B, C and D.
- Tell them to mention as follows:
- Group A : the name of fuel;
- Group B : how this fuel comes from (fossil or plant source);
- Group C : types of resource (renewable or non-renewable);
- Group D : time duration

Resources and Preparation

- Encourage the students to collect the name and source of fuel by using library / online resources before discussion.

Reflection on Learning

Fuel	Source	Resource	Time duration of formation
kerosene, butane (gas), gasoline and coke	fossil	non-renewable	over millions of years
wood, charcoal, dry leaves and bamboo sticks	plants	renewable	can be grown successively within a few years

3.2 CRUDE OIL AND NATURAL GAS Number of lesson period: 1

Lesson Objective

- To identify the sources, properties, and behaviour of crude oil and natural gas

Introduction

Coal, crude oil and natural gas belong to fossil fuels. Teacher should recall about coal and continue the teaching by making the questions as follows: What is the usefulness of fuel at present time? Nowadays, crude oil and natural gas are very important resources for our modern society. It is essential for transportation, manufacturing processes, production of electricity, and cooking and heating for domestic use.

The purpose of learning this section is to understand how the crude oil and natural gas are formed, what the composition and properties of these fuels are, and why these are very important in our society.

Teaching

Teacher should explain the sources of three major fossil fuels and time duration of their formation. Then, refer to Figure 3.2 from Textbook, and assess the students' understanding on the formation and extraction of crude oil. The students should be encouraged to connect the lesson and their surrounding by studying the information mentioned in 'Chemistry in Society'.

More information for teacher

- Crude oil and natural gas come from marine microorganisms by the action of high pressure and temperature for millions of years.
- Crude oil and natural gas can be extracted not only from offshore but also from inland area due to geological nature of the ground.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the knowledge of formation and composition of fossil fuels.

Activity

The teacher should identify this activity as the individual work.

Objective

- To get knowledge about fractional distillation products and some of their uses in society

Instruction

- Tell the students to do individually as follows:
- to give the name of the first product (lowest boiling point product) of fractional distillation
- to describe its constituents
- to mention the materials that can be prepared from the first product

Resources and Preparation

- Encourage the students to collect the fractional distillation product by using library / online resources before discussion.

Reflection on Learning

- Refinery gas
- Refinery gas consists mainly of hydrogen, methane, ethane, and olefins (alkenes).
- Olefins (alkenes) are starting materials for the production of plastics and other useful synthetic polymers.

3.3 FRACTIONAL DISTILLATION OF CRUDE OIL

Number of lesson periods: 2

Lesson Objective

- To understand the separation of crude oil based on different boiling points of the constituents

Introduction

After studying fossil fuels from Sections 3.1 and 3.2, teacher should start Section 3.3 with questions as follows: Which materials can be produced from crude oil? Refinery gas, petrol, naphtha, paraffin, diesel oil, lubricating oil, fuel oil and bitumen can be obtained from crude oil. How can the components of crude oil be separated? The components of crude oil can be separated by fractional distillation based on their different boiling points.

The purpose of learning this section is to realise what physical properties of these components are used in the separation process based on.

Teaching

Teacher should point out the differences between the components of crude oil due to the number of carbon atoms present by referring to Table 3.1. Teacher should inform the different terms of fuel used in UK and USA. At the end of lesson, teacher should make some short questions on their understanding.

More information for teacher

- In the fractional distillation column in an oil refinery, the fractions condense and come out of the column at different heights depending on their boiling points.
- Due to high intermolecular forces among long chain hydrocarbons, the forces are more difficult to break. Such long chain hydrocarbons are strong, viscous liquids, or waxy solids.
- Paraffin is suitable for indoor uses because it produces less soot. Kerosene produces more soot, so it is suitable for outdoor uses.
- Fractional distillation method can also be used in the manufacture of ethanol and methanol industrially.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the knowledge of fractional distillation products and some of their uses in society.

Activity

The teacher should identify this activity as the individual work.

Objective

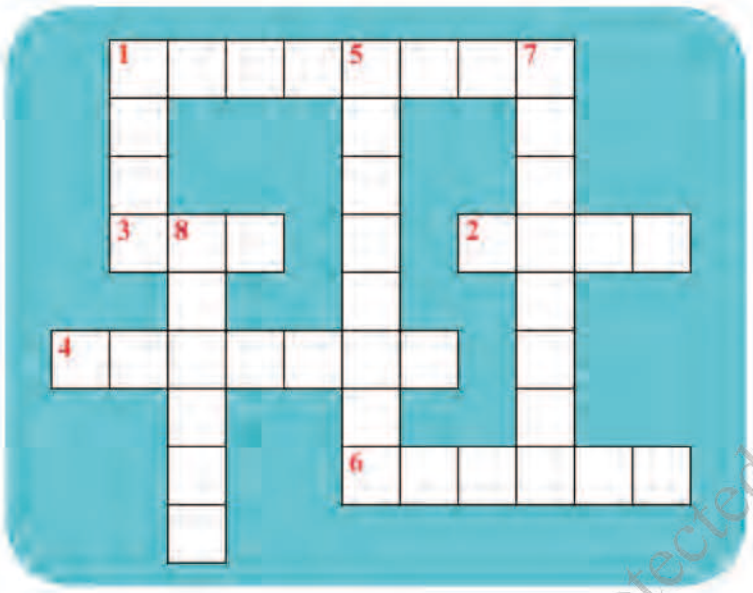
- To motivate the learning skill on petroleum products and refinery process

Instruction

- Give the students the following puzzle worksheet.
- Tell them to complete it according to the description given.

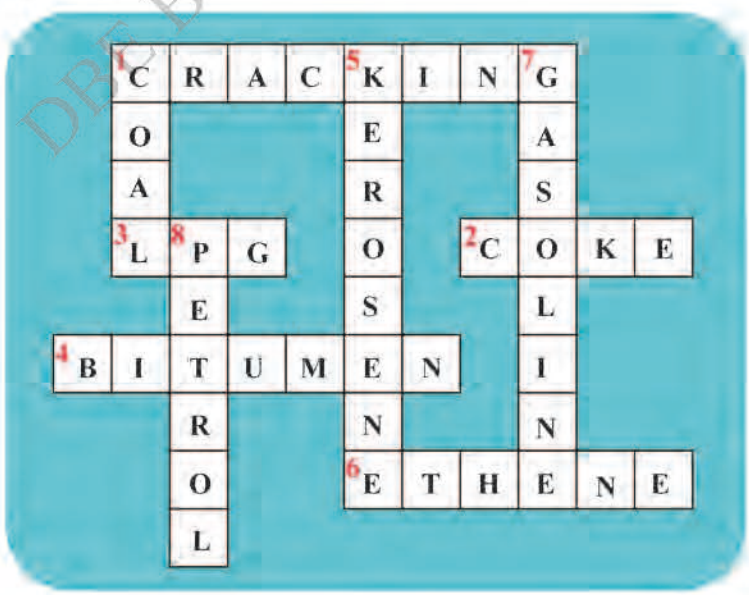
Resources and Preparation

- Blank puzzle worksheet and descriptions
- Encourage the students to search about the fuel and refinery process by using Textbook / library / online resources before discussion.



CROSS →	DOWN ↓
1 process of breaking a large molecule into useful small molecules	1 plant fossil fuel
2 pure form of coal	5 jet fuel oil
3 short form of petrol gas in liquid state	7 fuel containing $C_5 \sim C_{10}$ used in car
4 road surfacing material	8 other name of gasoline
6 starting material for plastics	

Reflection on Learning



3.4 CRACKING

Number of lesson periods: 2

Lesson Objectives

- To understand the refining of the separated products by cracking
- To describe the manufacture of useful products from by-product of catalytic cracking

Introduction

In the previous section, the students have learnt the separation of components of crude oil. Teacher should make the following questions and upgrade the students' interest in this lesson. Among the refinery products from fractional distillation, which one is more demandable? It is gasoline because it is eco-friendly and most of the vehicles and generators use it. Is it harmony between production and consumption? Why and how to solve the problem? Refined crude oil often contains too many large hydrocarbon molecules and not enough small hydrocarbon molecules to meet demand. Consequently, cracking is important to convert the larger hydrocarbon molecules to smaller ones.

The purpose of learning this section is to realise why the cracking is needed to make the refined crude oil.

Teaching

Firstly, teacher should inform that cracking process is essential to harmonise the production and consumption of fuels, and it is required to make catalytic cracking. Based on Figure 3.3, teacher should explain the useful products from ethane, and relate the information obtained from society.

At the end of lesson, teacher should make some cross questions on their understanding and promoting their knowledge on cracking products in society based on the students' activities.

More information for teacher

- Knocking in engines can be reduced by adding tetraethyl lead **(TEL, $(C_2H_5)_4Pb$)** to gasoline. But it can cause harmful effect on the environment due to the presence of lead that can come out from combustion of gasoline.
- The most common type of octane rating worldwide is the **Research Octane Number (RON)**. RON is determined by running the fuel in a test engine with a variable compression ratio under controlled conditions, and comparing the results with those for mixtures of *iso*-octane and *n*-heptane.
- Ethene produced from the cracking can be successively utilised to produce ethanol. Ethanol can be used as beverages, alternative fuel and solvent for extracting natural products from plants.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the knowledge for necessary of cracking and octane number of fuels.

Activity

The teacher should identify this activity as the individual work.

Objective

To understand the classes of gasoline

Instruction

- Tell the class to do individually as follows:
- to look at the display on the signboard in the gasoline stations
- to record the names of fuels and their prices

Resources and Preparation

- Encourage the students to collect the classes of gasoline by using library / online resources before discussion

Reflection on Learning

- Name of fuels: '92 RON', '95 RON','97 RON', 'diesel', or 'premium diesel'.
- Price is for 1 litre of fuel.
- Teacher should explain that '92' and '95' show the octane number, and '95' contains more amount of *iso*-octane than '92'.

3.5 OTHER KINDS OF FUELS

Number of lesson periods: 2

Lesson Objective

- To realise the preparation and uses of biodiesel, biogas and hydrogen as other kinds of fuels

Introduction

In previous section, the demand of petrol and diesel has been supported by various methods such as fractional distillation and catalytic cracking. Furthermore, fossil fuels are used not only as fuel but also as other useful products. Teacher should explain that by the present rate of consumption of fossil fuels, crude oil and natural gas may run out within 50 years and coal will only last for a further 250 years. Teacher should lead the students to describe the energy sources other than fossil fuels for our society. Solar power, hydropower, wind power and nuclear power are the energy sources for our society.

The purpose of learning this section is to understand how the shortage of fossil fuel compensates by exploration of other kinds of fuels.

Teaching

Based on Table 3.2, teacher should encourage the students to point out the sources, composition and uses of other kinds of fuels. Teacher should inform that Myanmar has many sources for the production of alternative fuels such as biodiesel from plant and animal oils, hydrogen from offshore natural gas, and biogas from cow breeding farms of milk and dairy factories.

At the end of this lesson, teacher should assess the students' feedback on their understanding about alternative fuels.

More information for teacher

- Biogas can be obtained from organic waste (biomass) by anaerobic fermentation. Biogas is mainly composed of methane that can contribute to the greenhouse effect.
- It must be noted that the composition of biogas and natural gas are nearly the same, but natural gas can only be obtained together with the formation of crude oil.
- Hydrogen can be manufactured from natural gas. This fuel can be used in space shuttles, rockets and experimental hydrogen powered cars.
- Among the other kinds of fuels, biodiesel, biogas and plant oils are renewable; LPG, CNG, hydrogen fuel and gasohol are non-renewable fuels.

Suggestion for Practising and Evaluation

A range of activities can be used to evaluate the students' progress and understanding on the sources and preparation of alternative fuels.

Activity

The teacher should identify this activity as the group work.

Objective

- To describe the sources of biogas and biodiesel

Instruction

- Make the class into two groups: A and B.
- Tell them to mention sources of the following:
- Group A: biogas
- Group B: biodiesel

Resources and Preparation

- Encourage the students to collect the sources of biogas and biodiesel by using library / online resources before discussion.

Reflection on Learning

- Group A: cow dung, kitchen waste, plant residue
- Group B: any plant oil

SUMMARY

The highlights of this chapter:

- the meaning and importance of fuels
- main resources of fuel: coal (from fossil plants), crude oil and natural gas (from marine microorganisms)
- the separation of different components of hydrocarbon molecules by fractional distillation

- the relation between boiling points and viscosities of hydrocarbon molecules: the greater the number of carbon atoms per molecule of the distillate, the higher the boiling points and their viscosities
- catalytic cracking of large hydrocarbon molecules into smaller and more useful molecules
- compensation of the shortage of fossil fuels by exploring other kinds of fuels

Key for Review Questions

Sections 3.1 and 3.2

(1) Petroleum is called a fossil fuel because it has been formed from the fossilised remains of prehistoric plants and animals.
(2) Coal is used in many countries to produce electricity and is also used to produce coke.
(3) Natural gas consists mainly of methane (85 ~ 95 %) with varying amounts of ethane, propane and other gases such as carbon dioxide, nitrogen, hydrogen sulphide, etc.

Section 3.3

(1) (a) kerosene (b) petroleum gas (c) bitumen (d) lubricating oil
(2) (a) naphtha (b) bitumen (c) lubricating oil (d) paraffin
(e) diesel oil
(3) Turn off the lights if unnecessary.
Use energy-saving bulbs
Walk or use bicycle instead of car, bus, etc.
Any other reasonable answers must be accepted.

Section 3.4

(1) The conditions for cracking are high temperature (about 500 °C), moderately low pressure and catalyst (silica / alumina / zeolites).
(2) All cracking reactions give two types of products: (i) an alkane with a shorter chain than the original and (ii) a short-chain alkene molecule.

Section 3.5

(1) (a) biogas (b) biodiesel (c) biomass (d) diesel oil

(2)

Fuels	Source	Composition	Uses
diesel	petroleum	C_{15} ~ C_{20} hydrocarbons	as a fuel in buses, cars and lorries
gasohol	petrol and ethanol	90 % petrol + 10 % ethanol, 15 % petrol + 85 % ethanol (US)	as a fuel in vehicles

KEY FOR EXERCISES **Number of review exercises periods: 2**

Understanding (Q.1 to Q.5)

1. (a) FALSE (Nowadays, all fossil fuels are used up rapidly.)
   (b) TRUE
   (c) TRUE
   (d) FALSE (At present, there are alternative fuels to fossil fuels.)
   (e) TRUE

2.

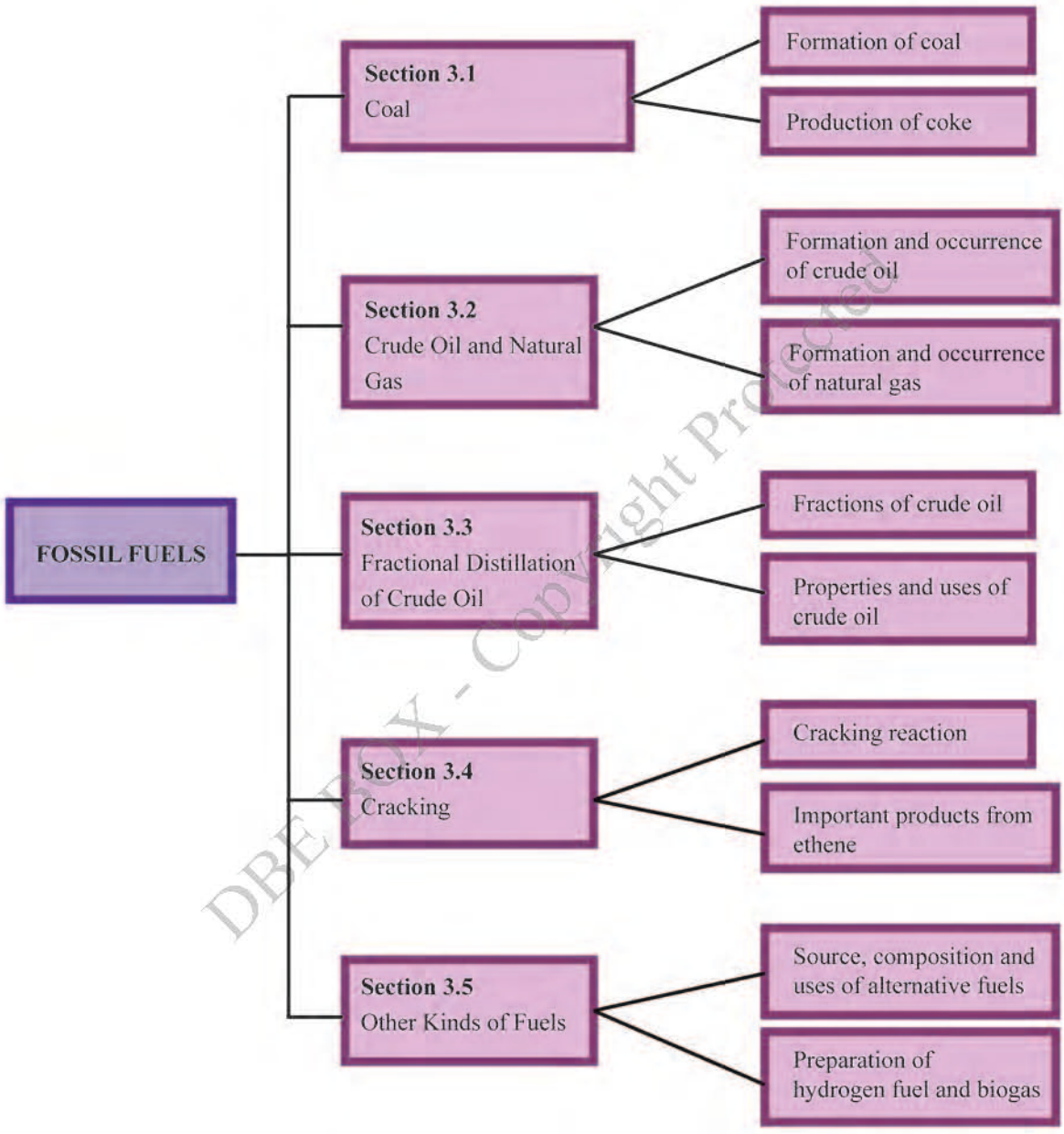
List A	List B
(a) coke	(iv) a reducing agent
(b) methane	(v) main constituent of natural gas
(c) biodiesel	(i) produced from plant oil
(d) biogas	(ii) formed from waste organic matter
(e) gasohol	(iii) blended fuel from petrol and ethanol

3. (a) Fractional distillation, boiling point
   (b) (i) as fuel in car
   (ii) to make chemicals
   (iii) as fuel in jet engines
   (iv) to make surface roads and roofing

4. (a) bitumen
   (b) petroleum gas
   (c) lubricating oil
   (d) lubricating oil

5. When coal is strongly heated in the absence of air, a solid called coke is produced. The main use of coke is as a reducing agent in the blast furnace for making iron. It is also used to produce zinc.

CHAPTER REVIEW



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CHAPTER 1
MEASUREMENT AND MOTION

Total number of lesson Periods: 6 (1 period 45 minutes)

Learning Outcomes

It is expected that the students will

- work accurately with basic and derived units of measurement.
- distinguish between a scalar quantity and a vector quantity.
- explain distance, displacement, speed, velocity and acceleration.

Skill Development

After teaching Measurement and Motion instructed by this teacher's guide, the students will get skills in

- Collaboration - when working in group
- Communication - when solving the problem
- Creativity and Innovation - when thinking the units for derived units
- Critical Thinking and Problem Solving - when thinking to solve challenging problem of motion.

1.1 MEASUREMENT AND PHYSICAL QUANTITY

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- explain the physical quantity.
- distinguish between the basic units and the derived units.

Teaching Aids

Charts (basic units, derived units)

Introduction

A physical measurable quantity is specified by two items: (i) a number and (ii) a unit.

Teaching

Teacher should explain the following facts:
physical quantity, unit, standard, basic unit, derived unit

The derived units from the basic units are as follows:

Units derived from the unit of length are

- square metre (m^2), (the unit of area)
- cubic metre (m^3), (the unit of volume)

Practice

Students will work in a small group to solve the problems.

- Which of the followings are basic units? Which are the derived units?
  m, cm, m^3, kg, g, s

Review and Assessment

- Determine the basic units of the following:
  (i) velocity(= distance/time) (ii) volume(= length × length × length)

Teacher can assess the students' focus on contents of measurement and physical quantities.

1.2 SYSTEM OF UNITS

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- classify the different system of units.
- determine the derived units of some physical quantities.

Teaching Aids

Metre rule, ruler

Introduction

In the present physics course for Basic Education we shall be using the following three systems of units: the British system, the metric system and the SI units.

Teaching

Teacher should explain the following facts; almost all quantities in the physical world can be expressed in terms of only three fundamental measurements: length, mass and time. Units for these quantities have been specified and standardized. A set of such specified units is termed a system of units.

Practice

Students will work in a small group to examine the system of units for length, mass and time by asking each group.

Review and Assessment

1. What is the unit of length in SI unit?
2. What is the unit of mass in SI unit?
3. What do the following symbols stand for?
   g, kg, lb, m, cm, ft.

Teacher can assess the students' understanding by discussing system of units and dimensional analysis.

1.3 SCALAR AND VECTOR

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- distinguish scalar and vector quantities.
- draw graphical representation of vector.

Teaching aids

Graph paper

Introduction

Teacher should make the students keeping in mind that the vector quantity has both magnitude and direction but the scalar quantity has only magnitude. In a vector diagram, a vector quantity is represented by an arrow.

Teaching

Teacher should explain the following facts:

(i) a vector may be represented by an arrow.

(ii) the length of the arrow is proportional to the magnitude of the vector.

(iii) the direction of the arrow gives the direction of the vector.

Practice

Students will work in a small group to draw a vector diagram of the following vectors.

$\vec{A}$ = 3 units (east) , $\vec{B}$ = 5 units (south)

$\vec{C}$ = 10 units (west) , $\vec{D}$ = 20 units (northeast)

Review and Assessment

1. Draw the vector diagrams of the following vectors.
   (a) 2 m (east)
   (b) 4 m (north)
   (c) 3 m (west)

Teacher can assess the students' understanding by asking the procedure of drawing the vector diagram.

1.4 DESCRIBING MOTION

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- recognize the difference between distance travelled and displacement, speed and velocity.
- describe the acceleration of a moving object due to change of velocity.

Teaching Aids

Stopwatch, measuring tape, metre rule, track

Introduction

Students have learnt the motion of an object. In this chapter, the distance travelled, displacement, speed, velocity and acceleration of a moving object are defined exactly.

Teaching

Teacher should make the students will able to distinguish between distance and displacement, then average speed and average velocity by means of an example. The students will understand that motion with changing velocity is called accelerated motion.

Practice

Students will work in a small group to calculate the average velocity for each second from the following data.

time / s	0	1	2	3	4	5
distance / m	0	4	8	12	16	20

Review and Assessment

- A toy car covers a distance of 100 cm (due east) during 4 s. What are the average speeed and average velocity?

Answer

- Average speed = 25 cm s^{-1}

  Average velocity = 25 cm s^{-1} (due east)

Teacher can assess the students' understanding by discussing quantities of motion.

Answers from textbook

1. It cannot be said that. The distance travelled by him is equal to twice of the distance between shop and his home, the magnitude of the displacement is zero.
2. The magnitude of the displacement walked by the one who gives up half-way is greater.
3. (i) not true (ii) true.

CHAPTER 2

FORCE AND PRESSURE

Total number of lesson Periods: 6 (1 period 45 minutes)

Learning Outcomes

It is expected that the students will

- explain force as a cause for change of state of motion.
- recognize gravitational force between two masses which obeys inverse square law.
- distinguish between mass and weight.
- explain pressure and its units of daily usage.
- distinguish between the density and the specific gravity.

Skill Development

After teaching Force and Pressure instructed by this teacher's guide, the students will get skills in

- Collaboration - when working in group to discuss the net force acting on a body
- Communication - when discussing the daily usage of pressure
- Critical Thinking and Problem Solving - when thinking the importance of density and uses of density in daily life.

2.1 NEWTON'S LAWS OF MOTION

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- realize two initial states of motion and inertia of a body.
- relate acceleration of a particle and net force acting on it.
- discuss the important facts and examples of action-reaction pair.

Teaching Aids

Two different mass of wooden blocks, trolley

Introduction

Teacher should introduce that in this section, they will look at how forces affect objects as they move. The effects of balanced forces (net force = 0) and unbalanced forces (net force $\neq$ 0) on an object are described. Forces appear when two objects interact with each other.

Teaching

Force can be defined precisely and explicitly in physics by Newton's laws of motion.

Practice

Students will work in a small group to discuss the relation between force and acceleration by using trolley, horizontal plane and different masses to discuss. They can notice the relation between mass and acceleration. They will observe that when the mass on the trolley is increased, the acceleration of trolley decreases.

Precaution

- Action-reaction forces are not balanced forces.

Review and Assessment

- A 4.0 kg object is moving across a friction-free surface with a constant velocity of 2 m s^{-1}. How much the horizontal forces is needed to maintain this state of motion?

Answer

- $\vec{v}$ = constant, $\vec{F}_{net} = 0$, Since frictional force is zero, no horizontal force is needed.

Teacher can assess the students' understanding by discussing the relation between mass and acceleration, concept of inertia and action-reaction forces.

2.2 GRAVITATIONAL FORCE AND NEWTON'S LAW OF GRAVITATION

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- discuss the gravitational force between objects.

Teaching Aids

Balls, chart of orbiting satellite around the earth

Introduction

Teacher should introduce the causes of gravitational forces and emphasize Newton's law of gravitation.

Teaching

Teacher starts the lessons by explaining the causes of tides and orbiting satellite.

Practice

Students will work in a small group to calculate the gravitational force between two objects for the following data and discuss on the results.

(i) mass of satellite = 2 100 kg, mass of earth = 6×10^{24} kg, distance between satellite and earth = 3.7×10^{7} m, Gravitational constant (G) = 6.67×10^{-11} N m^2 kg^{-2}

(ii) Mass of the object on the earth = 10 kg , mass of the earth = 6×10^{24} kg , radius of the earth = 6.4×10^{6} m

Review and Assessment

- If you throw up a ball in air, the ball comes down again. Which force causes this effect?

Answer

- Gravitational force

Teacher can assess the students' understanding by asking the advantages of gravitational force.

2.3 MASS AND WEIGHT

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- explain the difference between weight and mass.
- formulate the relation between mass of an object and its weight.

Teaching Aids

Beam balances, spring balance, weight box

Introduction

Mass is a measure of actual amount of material contained in an object while weight is the force of gravity on an object.

Teaching

Teacher should start the lesson with the facts;

Mass is a measure of inertia, $m = \frac{F}{a}$. It is also called inertial mass.

Weight of an object is a measure of gravitational force between the object and the earth.

Practice

Students will work in a small group to explain what will happen to mass and weight of an object when it is taken to the moon.

Review and Assessment

- When the location of a body is changed, do mass and weight change?

Answer

- The mass of a body cannot change according to its location. Mass is always constant. Weight can change according to gravitational acceleration.

Teacher can assess the students' understanding by discussing how to measure the mass and weight.

2.4 PRESSURE, DENSITY AND RELATIVE DENSITY

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- realize difference between force and pressure.
- discuss density and observe the density of different objects.
- compare the densities of different substances.

Teaching Aids

Balance, measuring cylinder, weight box, wooden block

Introduction

Teacher should introduce that pressure is the force applied perpendicular to the unit area of the surface of an object. Density is the amount of mass per unit volume. Teacher should give the information that density is a characteristic property of a substance.

Teaching

Teacher should start the lesson with following question;

- What does pressure mean?

Relative density has no units. It is the number whose value is the same as that of the density. It is used to be known as specific gravity.

Practice

Students will work in a small group to explain why a wax block floats in water by comparing the densities of wax and water.

Review and Assessment

- The density of water is 1 000 kg m^{-3}. What is the mass of 1 litre water?

Answer

- 1 kg.

Teacher can assess the students' understanding by discussing the observation of practice.

Answers from textbook

1. The pressure is the most when a person standing on the floor because the surface area is the least.The pressure is the least when a person lying on the floor because the surface area is the most.
2. the density of iron $= 7.9\,\text{g cm}^{-3}$

$$= \frac{7.9 \times 10^{-3}\,\text{kg}}{10^{-6}\,\text{m}^3}$$

$$= 7\,900\,\text{kg m}^{-3}$$

CHAPTER 3
WORK, ENERGY AND HEAT

Total number of lesson Periods: 5 (1 period 45 minutes)

Learning Outcomes

It is expected that the students will

- realize the relationship between work and energy.
- apply basic knowledge of work and energy to daily-life phenomena.
- explain why heat is a form of energy.

Skill Development

After teaching Work, Energy and Heat instructed by this teacher's guide, the students will get skills in

- Collaboration - when working to apply the work done by different forces
- Communication - when discussing forms of mechanical energy and energy conservation
- Critical Thinking and Problem Solving - when analysing the thermometric properties of thermometer for suitable purposes.

3.1 WORK AND ENERGY

Number of lesson periods: 3

Learning Objectives

After completing this section, the students will be able to

- recognize the concept of work done.
- study how to relate work, force and displacement.

Teaching Aids

Box, the rubber band of a catapult, spring

Introduction

When an object moves under the influence of a force, work is done by the force. Energy is a measurement of the ability of something to do work. Energy can be measured in many different forms. Energy can be transformed from one form into another. Whenever work is done energy changes from one form to another. Therefore energy and work are the same unit.

Teaching

We can calculate the work done by the force as follow:

Work = force × distance travelled in the direction of the force

(or)

Work = component of force in the direction of motion × distance travelled

$$W = Fs\cos\theta$$

Force is measured in newton (N), displacement is measured in metre (m), work is measured in joule (J).

There are two forms of mechanical energy : kinetic energy and potential energy.
Kinetic energy is defined as the energy possessed by an object due to its motion. The amount of kinetic energy possessed by a moving object depends on its mass and speed.

$$KE = \frac{1}{2}mv^2$$

Potential energy is the energy stored due to its position (or) configuration. There are different types of potential energy : gravitational potential energy and elastic potential energy. Gravitational potential energy is the energy stored in a body due to its height from the ground. An object possesses gravitational potential energy when it is lifted to a height above the ground.

$$PE = mgh$$

Practice

Students will work in a small group to calculate the amount of work for the following case.

A child pulls a toy car with a force of 10 N. The direction of the force makes an angle of 20° with the horizontal plane and then calculate the work if it moves 5 m.

Review and Assessment

- Are both the force and the energy the vector quantities?

Answer

- No. Only the force is the vector quantity where else the energy is the scalar quantity.

Teacher can assess the students' understanding by discussing the usefulness of the concept of work in daily life.

3.2 HEAT AND TEMPERATURE

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- explain how to relate heat and temperature.
- calibrate the thermometer and express the relationship between temperature scales.

Teaching Aids

Thermometers, beakers

Introduction

Heat is a form of energy. Temperature is the quantity that determines how cold (or) how hot the object is.

Every thermometer uses a physical property that varies with temperature. This property is referred to as the thermometric property of the thermometer. For example, the thermometric property of a liquid-in-glass thermometer is the thermal expansion of the liquid.

Teaching

The study of heat and thermal properties of matter is actually a study of energy and energy transfer. Heat is a form of energy. When heat is applied to various kinds of energies, it can supply forces to do work.

Teacher should explain the following facts:

- properties of thermometric liquid.
- accurate temperature can only be measured with a thermometer.

Practice

Students will work in a small group to calculate the temperature on the Fahrenheit scale correspond to 80°C.

Review and Assessment

- What are the units of heat and temperature in SI units?

Answer

- The unit of heat is joule (J) and the unit of temperature is kelvin (K).

This assessment will be linked back to the learning outcomes that is explanation of heat is a form of energy.

Answers from textbook

1. $W = F\,s$

   where W = Work done

   F = Force acting on a chair = 300 N

   (i) s = Distance moved by pushing = 2 m

   Work done = 300 N × 2 m

   = 600 J

   (ii) If the chair does not move at all, Workdone = 0

2. 40 °C

CHAPTER 4
WAVE, SOUND AND LIGHT

Total number of lesson Periods: 6 (1 period 45 minutes)

Learning Outcomes

It is expected that the students will

- examine wave motion as a form of energy transfer.
- compare transverse and longitudinal wave and give suitable examples of each.
- discuss sound wave and speed of sound.
- identify sources of light.
- examine reflection of light and the laws of reflection.

Skill Development

After teaching Wave, Sound and Light instructed by this teacher's guide, the students will get skills in

- Collaboration - when discussing the transfer of energy by the wave without transferring matter
- Communication - when performing the transverse and longitudinal waves and discussing characteristics of wave
- Creativity and Innovation - when explaining new ideas for daily use of parallel and divergent beam.

4.1 TRANSVERSE AND LONGITUDINAL WAVES

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- perform two types of wave.
- discuss the wave characteristics.

Teaching Aids

Rope(string), slinky spring

Introduction

Teacher should introduce the lesson with two basic types of waves. Waves are classified as transverse and longitudinal waves depending on vibration of particles in the medium through which they propagate.

Teaching

Teacher should explain how can the basic waves be created. **Teacher should introduce the types of waves.** Waves that require a medium for their propagation are called mechanical waves (water wave, wave in a vibrating string, sound wave, wave in coiled spring). Electromagnetic waves consist of vibrating electric and magnetic fields. Electromagnetic waves transmit energy through matter (or) across vacuum. Electromagnetic waves include radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays.

Practice

Students will work in a small group to perform the transverse and longitudinal waves by using string and slinky spring respectively. The transverse waves can be simply created on a horizontal length of string by anchoring one end at the wall and moving the other end up and down.

A longitudinal wave can be created in a slinky spring. It is stretched out in a horizontal direction and the first parts of the slinky spring are vibrated horizontally.

Review and Assessment

1. Describe the movement of particles in a transverse wave.
2. Give an example of waves which travels as a longitudinal wave.

Answers

1. In a transverse wave the displacements of particles of the medium are perpendicular to the direction of the wave.
2. Compressional waves in a slinky coiled spring.

Teacher can assess the students' understanding by asking how transverse and longitudinal waves can be distinguished.

4.2 CHARACTERISTICS OF WAVES

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- discuss the physical quantities of a wave such as velocity, frequency, wavelength, period and amplitude.
- recognize the relation of these quantities.

Teaching Aids

String (rope)

Introduction

Teacher should start the lesson by introducing the five characteristics of waves.

Teaching

The highest and the lowest points are called wave crest and wave trough respectively the distance between two consecutive wave crests (or) two consecutive wave troughs is called wavelength. The unit of wavelength in SI unit is metre. (See Figure 4.4 in textbook.)

The number of complete waves passing a point per second is called frequency of waves.

The time required for the wave to travel through a distance equal to its wavelength is called period of a wave.

Velocity of wave is the speed with which a wave crest travels. The amplitude of a wave is the maximum value of displacement of vibrating element.

Practice

Students will work in a small group to form a transverse wave by vibrating one end of a string. Then they will draw a wave form by observing the vibrating string.

Review and Assessment

- Write down the relation between wavelength, velocity and frequency. Explain it.

Answer

- $v = \frac{\lambda}{T}$, $T = \frac{1}{f}$, $v = f\lambda$

Teacher can assess the students' understanding by asking the relationship between the wavelength and velocity of a wave.

4.3 SOUND WAVE AND SPEED OF SOUND

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- discuss the transmission of sound.
- study audible range of sound.

Teaching Aids

Any source of sound

Introduction

Teacher should give the knowledge that any vibrating object produces sound. Sound is a form of energy that is transferred from one place to another in a certain medium. Sound wave is produced by vibrating object placed in the medium.

Teaching

Teacher starts the lessons with illustrations of pressure-distance graph of propagated sound waves.

The compression is created in the medium as the vibrating object moves forward, since it pushes air molecules together. The compression region has higher pressure. When the object moves back, the molecules are spread out and rarefaction is created and the air pressure of that region is low. Sound energy is transferred through the medium by the successive pressure changes.

We cannot observe the displacement of air particles, but if we dip a vibrating tuning fork in water, we will see the movement of water.

Generally, the speed of sound depends on the density of the medium. The denser the medium is, the greater the speed.

Practice

Students will work in a small group to discuss about the relation between speed of sound and density of medium, then explain this phenomena.

Review and Assessment

- Sound travels faster in iron than in water. Suggest an explanation for this difference.

Answer

- The denser the medium is, the greater the speed of sound because the particles of the medium are tightly bound together. The energy of sound can be transfered more quickly from one particle to next.

Teacher can assess the students' understanding by discussing how the pressure of the medium changes when the sound wave passes through it.

4.4 SOURCES OF LIGHT

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- distinguish between self-luminous bodies and non-luminous bodies.

Teaching Aids

Candle, fluorescent lamp, books, cloths

Introduction

In this lesson, the different sources of light are explained. Two sources of light are luminous bodies and non-luminous bodies.

Teaching

Teacher should show the candle flame, fluorescent lamp, books and cloths to students. The teacher should explain the following facts: the things give out their own light and light from them enters our eyes. They are self-luminous bodies. Non-luminous bodies such as books, cloths are visible because the reflected light from a luminous source enters into our eyes.

Practice

Students will work in a small group to describe sources of light in the environment and to distinguish between self-luminous bodies and non-luminous bodies.

Review and Assessment

- Which of the following things are luminous bodies and which are non-luminous bodies? books, stars, sun, candle flame, fluorescent lamp, trees and moon

Teacher can assess the students' understanding by choosing the luminous and non-luminous bodies.

4.5 REFLECTION OF LIGHT

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- discuss the different types of light beams.
- explain the laws of reflection of light.

Teaching Aids

Ruler, pencil, white paper, protractor

Introduction

Teacher should recall the knowledge of students about the parallel rays and the reflection of light from previous levels. Reflection of light is one of the phenomena of light. If light beam strikes on the surface, some of light rebounds from the surface. This phenomenon is called reflection of light.

Teaching

Teacher should provide class room level activities and develop the knowledge of rays of light and beams of light.

A beam of light received from a distant source can be considered as a parallel beam.

If the rays of light are directed towards a point (or) if the rays of light converge to a point, the beam of light is called a convergent beam. If the rays of light diverge from a point (or) if they appear to come from a point, the beam of light is called a divergent beam.

Practice

Students will work in a small group to give examples of parallel beam and divergent beam. Students can notice that the rays (or) beam from searchlight used in train is parallel beam. And also they can notice that the rays of beam from any luminous (or) non-luminous are divergent beam.

Review and Assessment

- A ray of light is incident on a smooth plane surface. If the angle of incidence is 30°, find (i) angle of reflection, (ii) angle between incident ray and reflected ray.

Answer

- (i) 30° (ii) 60°

After completing this exercise, the students will be able to explain the laws of reflection. Teacher can assess the student's explanation.

Answers from textbook

1. D
2. Yes.

CHAPTER 5

ELECTRICITY AND MAGNETISM

Total number of lesson Periods: 6 (1 period 45 minutes)

Learning Outcomes

It is expected that the students will

- investigate electric charges.
- distinguish the repulsive and attractive force between two charges.
- discuss that a charged body has electron deficiency (or) excess.
- identify the characteristics of conductors, insulators and semiconductors.
- differentiate between the magnetic and non-magnetic materials.
- determine the magnetic properties of the magnets.

Skill Development

After teaching Electricity and Magnetism instructed by this teacher's guide, the students will get skills in

- Collaboration - when working successfully in groups
- Communication - when reporting progress on exercises and activities
- Critical Thinking and Problem Solving - when finding solutions to problems
- Creativity and Innovation - when draw magnetic field pattern formed by pairs of poles of the magnets.

5.1 ELECTRIC CHARGES AND ELECTRIC FORCES

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- express positive and negative charges.
- show that unlike charges attract and like charges repel.

Teaching Aids

Charts of positive charge and negative charge

Introduction

In this lesson, students will learn about electric charges: positive charge and negative charge. Electric charges may be either at rest (static charges) or in motion (moving charges). In this chapter, charges at rest and interacting forces between them are studied. The two kinds of static electric charge are positive charge and negative charge.

Teaching

Teacher should explain the following facts: Like charges repel and unlike charges attract. When two charged objects are brought together, they produce either attractive or repulsive

force. The electric force between two charged objects is one of the fundamental forces of nature. Charged objects can exert forces to other charged objects without being in contact with them. This is possible because there is an electric field around each charge. The amount of electric charge is one of the quantized physical quantities. Electric charges take only discrete values that are integral multiples of charge of an electron (elementary charge). Charge is measured in coulomb (C). The charge of an electron 'e' is 1.6×10^{-19} C.

Practice

Students will work in a small group to draw the force diagram between two like charges and unlike charges.

- How many electrons are there in 1.6×10^{-10} C?

Review and Assessment

- If the electric force between two charged objects is attractive force, what type of charges they carry?

Answer

- The electric force between two charged objects is attractive force, these charges are unlike charges (positive charge and negative charge).

Teacher can assess the students' understanding by observing their calculation.

5.2 MATTER AND ELECTRICITY

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- recognize the electric charge of matter.

Teaching Aids

Chart illustrates the structure of an atom

Introduction

In this lesson the structure of atoms are introduced. Matter is composed of atoms. An atom consists of a core called nucleus around which the particles called electrons are moving in orbits. A nucleus consists of two kinds of particles called proton and neutron. The nucleus has net positive charge because a proton is a positively charged particle and a neutron is an uncharged particle.

Teaching

A normal uncharged piece of matter has equal number of positive and negative electric charges. It is electrically neutral. If an atom gains one (or) more electrons, it carries a negative charge. If an atom loses one (or) more electrons, it becomes positively charged. When an atom becomes a charge atom, it is called an ion.

Practice

Students will work in a small group to draw a structure of a neutral atom.

Review and Assessment

1. If a normal atom has four protons, how many electrons are there? Comment your answer.
2. Although a normal atom consists of positive charge (proton) and negative charge (electron), why is it electrically neutral?

Answers

1. There are four electrons. Because a normal atom has an equal number of electrons and protons.
2. A normal atom has equal number of positive and negative electric charges. So it is electrically neutral.

According to their answers, teacher should evaluate the students' understanding on matter and electricity.

5.3 CONDUCTORS, INSULATORS AND SEMICONDUCTORS

Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- idendify the characteristics of conductors and insulators.
- distinguish between conductors and insulators and semiconductors.

Teaching Aids

Dry cell, wire, bulb, copper, aluminium, iron, rubber, plastic, wood, paper

Introduction

In this lesson, students will learn to distinguish between conductors and insulators. Some of electrons are near the nucleus while other electrons are further away from the nucleus. The electrons closer to the nucleus, tightly bound by the nucleus are called bound electrons. The electrons far away from the nucleus, loosely bound by the nucleus are called free electrons.

Teaching

Teacher should explain that conductors is substance which has plenty of free electrons is called conductor and the substance which has very few (or) no free electrons is called an insulator. Some substances which contain a moderate amount of free electrons are called semiconductors.

Practice

Students will work in a small group to choose the conductors and insulators from substances in teaching aids.

Review and Assessment

- Dry cell is connected to the bulb with some piece of wire (conductor). Plastic rope is used instead of wire. Write down the observation on each case.

Review and Assessment

1. If a normal atom has four protons, how many electrons are there? Comment your answer.
2. Although a normal atom consists of positive charge (proton) and negative charge (electron), why is it electrically neutral?

Answers

1. There are four electrons. Because a normal atom has an equal number of electrons and protons.
2. A normal atom has equal number of positive and negative electric charges. So it is electrically neutral.

According to their answers, teacher should evaluate the students' understanding on matter and electricity.

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Number of lesson periods: 1

Learning Objectives

After completing this section, the students will be able to

- idendify the characteristics of conductors and insulators.
- distinguish between conductors and insulators and semiconductors.

Teaching Aids

Dry cell, wire, bulb, copper, aluminium, iron, rubber, plastic, wood, paper

Introduction

In this lesson, students will learn to distinguish between conductors and insulators. Some of electrons are near the nucleus while other electrons are further away from the nucleus. The electrons closer to the nucleus, tightly bound by the nucleus are called bound electrons. The electrons far away from the nucleus, loosely bound by the nucleus are called free electrons.

Teaching

Teacher should explain that conductors is substance which has plenty of free electrons is called conductor and the substance which has very few (or) no free electrons is called an insulator. Some substances which contain a moderate amount of free electrons are called semiconductors.

Practice

Students will work in a small group to choose the conductors and insulators from substances in teaching aids.

Review and Assessment

- Dry cell is connected to the bulb with some piece of wire (conductor). Plastic rope is used instead of wire. Write down the observation on each case.

Answer

- The bulb will light when using a wire (conductor).
  The bulb will not light when using a plastic rope (insulator).

According to their answers, teacher should evaluate the students' understanding on conductors,insulators and semiconductors.

5.4 MAGNETS AND MAGNETIC MATERIALS

Number of lesson periods: 2

Learning Objectives

After completing this section, the students will be able to

- distinguish between magnetic and non-magnetic materials.
- develop an explanation of the properties of magnets.

Teaching Aids

Erasers, pieces of paper, pins, iron paper clips, bar magnet, cotton thread, iron filings

Introduction

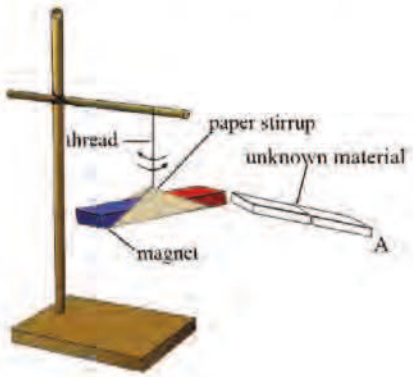
Students have learnt about on some properties of magnets, magnetic materials and non-magnetic materials from previous grade level. In this section, students will learn these properties in detail. Students have learnt that piece of magnets have always two poles: south pole and north pole.

Teaching

Teacher should explain magnets, magnetic materials, non-magnetic materials and properties of magnets. Magnetic materials are materials that can be attracted by a magnet. Non-magnetic materials are materials that cannot be attracted to a magnet. Steel, iron, cobalt and nickel are magnetic materials. Copper, wood, plastic, and brass are non-magnetic materials.

Students are asked to identify magnets, magnetic materials and non-magnetic materials. To test whether an object is a magnet, we can bring one end of this object towards one end of a suspended bar magnet. If repulsion occurs then we can conclude that the object is a magnet because repulsion occurs between like poles. If the object remains stationary, it is a non-magnetic material.

If attraction occurs, then we can conclude that the end of the object is either of opposite polarity to the end of the suspended bar magnet (or) that the object is simply a magnetic material



Effect on A	Conclusion; A is
attracted	magnetic material (or) magnet
repelled	magnet
remain stationary	non-magnetic material

Practice

Students will work in a small group to classify magnetic and non-magnetic materials (erasers, pieces of paper, pins, iron paper clips and pins) by using a magnet. Students will perform to identify the north-seeking pole (north pole) and south-seeking pole (south pole) of a bar magnet.

Review and Assessment

1. Give examples of magnetic materials and non-magnetic materials.
2. What happen when some steel pins are sprinkle onto a bar magnet? Explain why most of the pins are attracted to the two ends of the bar magnet which are poles.

Answers

1. Magnetic materials are steel, iron, alcomax and alnicol. Non-magnetic materials are wood, plastics, brass and copper.
2. Most of the pins are attracted to the two ends of the bar magnet. Most of the pins are attracted to the two ends of the bar magnet which are poles because at poles the magnetic effects are strongest and attractive force on magnetic materials is strongest.

It can be seen that the above assessment can focus on contents of magnets, magnetic materials and non-magnetic materials.

Answers from textbook

1. (i) D

   (ii) A

   (iii) B

   (iv) C
2. D

1.1.1 The Importance of Biology in Everyday Life Period (2)

Lesson objectives

- To know how biology is important in daily life
- To understand the role of living organisms in food production and disease control

Preparation for lesson

Study the different types of food and ingredients of plant and animal products in our daily diet.

Introduction

Teacher should start the introduction with the following questions: What kind of food did you have for breakfast? What is your house built of? What do you use as cosmetics? Actually, our food, shelter, cosmetics, clothes, etc. are concerned with biology. Therefore, biology is very important in our everyday life.

Teaching

Teachers should explain **Biology** as follows: **Biology** as a science helps human **life** in many ways. It tells us about our body, helping us to develop cures and treatments for many diseases. It also tells us about the bodies of other animals and it can provide clinical treatment for farm animals and also for pets.

Human population is increasing day by day. As the results, farmers are growing high yield, disease resistant crop and advance method of animal husbandry. Tree woods are used for buildings and furniture. These are the examples of how biology is used in everyday life.

In the new field of biology, **bacteria**, the microorganisms are the first organisms to be genetically modified in the laboratory that could insert the desired characters into their gene to control pests and weeds that reduce yields.

Practice

First of all, when you enter the class room please make some questions to students as follows:

1. Why do you eat every day?
2. List the items that you usually eat for breakfast, lunch and dinner.
3. What contents are included in your daily food?
4. Which type of medicines do you usually use in your daily life?
5. What kind of cosmetics do you usually use in your daily life?
6. What kind of livelihood does your family depend on? (Different farming systems or others)
7. What kind of furniture and buildings are used in your home?
8. Teacher must gather all above informations and make the table as in the Textbook and fill up in the relevant column with the information obtained from the students.
10. What kinds of livestock are reared in your area?
11. Which crops are available in your place?
12. Do you occasionally use herbal medicine when you are sick?
13. How is your house built of?

14. Apart from the above items you can insert any other items useful to human and let them know the value of biology in daily life.

Activity - Let each student fill up the given table:

Student's name - .....

No.	Items	What I usually take/used/construct
1	morning breakfast	
2	lunch	
3	dinner	
4	cosmetics	
5	medicines	
6	my house	

Review and assessment

1. Who have modified organisms to yield greater amount of food and how do they improve food production in plants?

   Plant and animal breeders have modified organisms to yield greater amount of food and they improve food production in plants with better farming practices.

2. State about biological research in improved food production.

   Biological research has improved food production by developing controls for the diseased organisms, pests and weeds that reduce yields. Biologists must understand the nature of these harmful organisms to develop effective control methods.

3. What is veterinary?

   It is relating to the diseases, injuries and treatment of farm and domestic animals.

4. Why do we need to increase food production?

   We need to increase food production because the size of human population is gradually increasing.

5. What do you think which kind of cosmetics is secured for your skin?

   Thanakhar

6. What do you usually use for washing your hair, traditional or chemical shampoo? What are they made up of?

   I usually use traditional shampoo for washing my hair. They are made up of Kim-mon-thee and Tayaw.

7. Match the following items:

i. Hut	a. are mostly seen along the road-side
ii. Thanakhar	b. is famous for rice and timber
iii. Mega 3	c. is made of bamboo
iv. Our country	d. is good for skin care
v. Paddy fields	e. is extracted from salmon oil

Answers: i. (c), ii. (d), iii. (e), iv. (b), v. (a)

1.1.2 The Different Fields of Study in Biology Period (3)

Lesson objective

- To study the different fields of Biology based on the nature and methods of studying of organisms

Preparation for lesson

Collect illustrations from the internet websites and from the Textbooks of the various Grade levels showing their different fields of study in biology before teaching this lesson.

Introduction

Students have learned some of the nature, structures and functions of plants and animals in previous Grades.

Teaching

Teacher should start the lesson by identifying and explaining the nature, structures and functions of plants and animals which they have learned previously.

Teacher should explain and analyze the different fields of study in biology with the help of collected illustrations and students' answers as correlated with this lesson.

Practice

Teacher should ask the following questions to students:

1. How many branches of biology are there? Mention as much as you can.
2. Define the term fossils.
3. What subject is bioinformatics?

Review and assessment

1. State the main branches of biology.

   The main branches of biology are:

   Botany : study of plants
   Zoology : study of animals
   Microbiology : study of microscopic organisms

2. Fill in the blanks with different fields of the study in biology.

i.		study of utilization of living organisms in industrial processes
ii.		study of fungi
iii.		study of varieties among living organisms
iv.		study of living processes
v.		study of cells
vi.		study of forms and structures of organisms

Answers: i. Biotechnology, ii. Mycology, iii. Biodiversity, iv. Physiology, v. Cytology, vi. Morphology

1.1.3 Characteristics of Living Things Periods (4, 5)

Lesson objective

- To know the main characteristics of living things

Preparation for lesson

Teacher should make charts with words and pictures showing the characteristics of living things.

Introduction

To start this lesson, teacher can ask questions to know if students understand "What are living things? And what are non-living things? What are the characters of living things?" Students can answer in many ways. Teacher should guide whether their answers are correct or not. Then teacher can continue to explain the main characteristics of living things as mentioned in the Textbook.

Teaching

Teachers should first go through explaining the seven important characteristics of living things. Make sure that the important points could be explained step by step.

The main characteristics of living things include their cellular structure, metabolism, growth, movement, irritability, reproduction and adaptability.

Practice

Teacher should construct questions and ask:

1. What are the characteristics of living things?
2. Do you know the terms respiration and excretion?
3. What are the differences between in the movement of animals and plants?
4. Can you explain the property of irritability in living things?
5. How do you understand the reproduction?
6. Can you explain the adaptability?

Review and assessment

1. What is stored in the nucleus?
   DNA (Deoxyribonucleic acid) is stored in the nucleus.
2. How can animals move?
   Animals can use different body parts to walk, jump, fly, hop, crawl or swim.
3. What do you mean by irritability? Give examples.
   Textbook Page 3, Irritability
4. Outline the different characters between asexual and sexual reproductions.
   Textbook Page 3, Reproduction [In asexual reproduction ..... new organisms.]
5. Why do some birds migrate from one continent to another continent?
   Some birds migrate from one continent to another continent because change of seasons or a shortage of food may cause certain birds to migrate to another place where the conditions are more favourable.

6. Decide which five of these characteristics are found in all living things.

movement	blood system	sight	growth	photosynthesis
nutrition	sensitivity	speech	excretion	

Answers: movement, growth, sensitivity, nutrition, excretion

1.2 TAXONOMY Period (6, 7)

Lesson objectives

- To know the classification of organisms
- To study the variety of organisms in the world
- To identify the plants and animals in nature
- To know how organisms are named scientifically for identification and how they are classified into related groups

Preparation for lesson

Teacher should prepare paper charts or vinyl sheets showing the classification of paddy and humans as examples. Teacher should also prepare to give other examples to get more familiar to plants and animals such as padauk and domestic cat in their surroundings.

Introduction

Teacher should introduce the hierarchic system of classification from the Textbook. The common names used by the people vary from culture to culture, for example, khwe in Myanmar, dog in English, chien in French, perro in Spanish, and cane in Italian. Often different names are used in different regions within a country to identify the same organism. Therefore, Taxonomy is the science of naming organisms and grouping them into logical categories.

Teaching

Teacher should know that the branch of biology that groups and names organisms based on their characteristics is called **taxonomy,** and that the **classification** and **nomenclature** are essential to biology. Moreover, teacher will continue to explain in detail the process of classification described in the Textbook. Scientists who study taxonomy are called taxonomists. They try to identify and classify organisms based on different characters. Taxonomists also consider the genetic makeup of organisms to reveal their evolutionary relationships to other organisms.

Teacher should explain how the **taxonomic hierarchy** (classification) is made for *Oryza sativa* (paddy), *Pterocarpus macrocarpus* (padauk), *Homo sapiens* (human) and *Felis catus* (cat) as follows:

Example - Paddy	
Kingdom	: Plantae (Plants - Organisms able to manufacture their own food)
Division	: Magnoliidae (Flowering plants that produce seeds enclosed in an ovary)
Class	: Monocots (Flowering plants with an embryo that bear a single cotyledon)
Order	: Poales (Monocot flowering plants which include sedges and grasses)

6. Decide which five of these characteristics are found in all living things.

movement	blood system	sight	growth	photosynthesis
nutrition	sensitivity	speech	excretion	

Answers: movement, growth, sensitivity, nutrition, excretion

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Order	: Poales (Monocot flowering plants which include sedges and grasses)

Family	: Poaceae (Grass family of monocotyledonous flowering plants)
Genus	: *Oryza* (thrive in hotter climates with longer daylight hours)
Species	: *Oryza sativa* L.

Example - Padauk	
Kingdom	: Plantae (Plants - Organisms able to manufacture their own food)
Division	: Magnoliidae (Flowering plants that produce seeds enclosed in an ovary)
Class	: Eudicots (Flowering plants with an embryo that bear two cotyledons)
Order	: Fabales (The Fabales includes herbs, vines and trees with compound leaves.)
Family	: Fabaceae (Legume, pea, or bean family, which is physiological and economically important because they possess root nodules that maintain the nitrogen balance in the soil, which is necessary for plant growth.)
Genus	: *Pterocarpus* (genus of tropical trees or climbers having usually broadly winged pods)
Species	: *Pterocarpus macrocarpus* Kurz

Example - Human	
Kingdom	: Animalia (Animals - Organisms able to move on their own)
Division	: Chordata (Chordates - Animals with a backbone)
Class	: Mammalia (Mammals - Chordates with fur or hair and milk glands)
Order	: Primates (Primates - Mammals with collar bones and grasping fingers)
Family	: Hominidae (Hominids - Primates without tail, with relatively flat faces and three-dimensional vision)
Genus	: *Homo* (Hominids with upright posture and large brains)
Species	: *Homo sapiens*

Example - Domestic cat	
Kingdom	: Animalia (Animals - Organisms able to move on their own)
Division	: Chordata (Chordates - Animals with a backbone)
Class	: Mammalia (Mammals - Chordates with fur or hair and milk glands)
Order	: Carnivora (Carnivore - eat meat)
Family	: Felidae (Cats)
Genus	: *Felis*
Species	: *Felis catus*

Practice

After teaching, teacher should ask and discuss the following questions:

1. Explain the term taxonomy.
2. Mention the taxonomic hierarchy.
3. State the aims of studying characteristics of organisms.

4. How many words should be used in scientifically naming of each plant and animal as stated in binominal system of nomenclature? Give examples.

Review and assessment

1. Define the terms:
   (a) Taxonomy
   Taxonomy is the branch of biology concerned with the grouping and naming of organism.
   (b) Classification
   Classification is essential to biology because there are too many different living things to sort out and compare unless they are organized into manageable categories.
   (c) Binomial nomenclature
   Textbook Page 4, No. 1.2.5. [**Linnaeus** ..... *Oryza sativa*.]
2. Select the genus name from the given scientific names:
   (a) *Rosa acicularis* (Answer: *Rosa*)
   (b) *Clarias gariepinus* (Answer: *Clarias*)
3. Choose the species name from the followings:
   (a) *Bacillus anthracis* (Answer: *anthracis*)
   (b) *Escherichia coli* (Answer: *coli*)

1.3 KINGDOMS Period (8-10)

1.3.1 Kingdoms of Living Things

Lesson objectives

- To know the classification system of living things
- To understand how and why organisms are placed in three domains and six kingdoms of systematic classification

Preparation for lesson

Study different forms of living things from the internet websites and also from the Textbooks of the previous Grades concerning with the microorganisms, unicellular and multicellular organisms, flowering and non-flowering plants, and invertebrates and vertebrates.

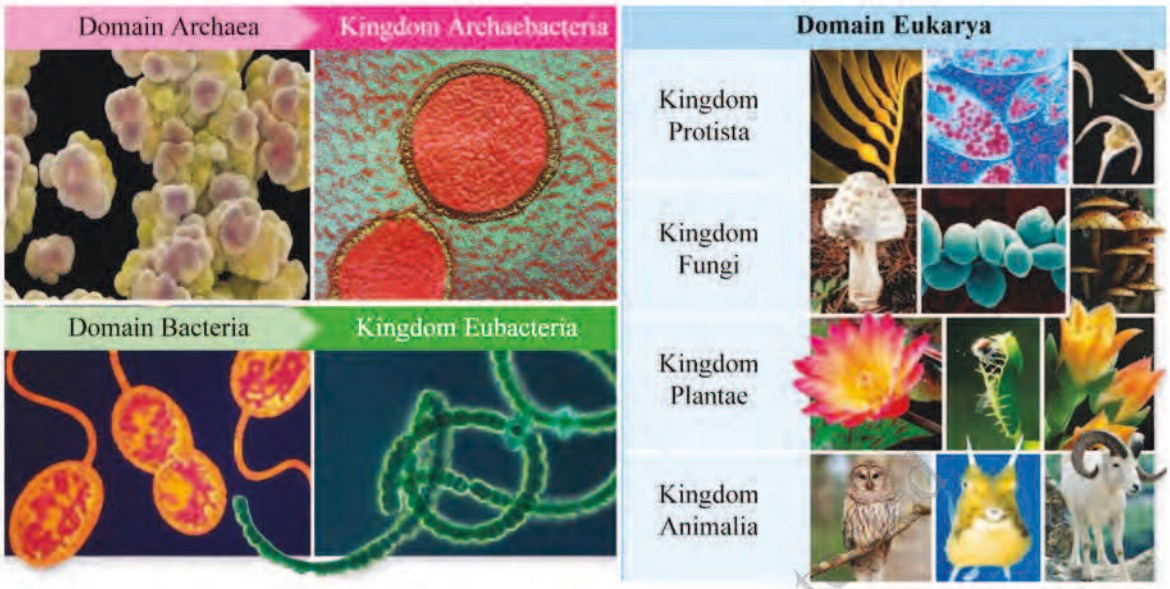
Introduction

Recall the forms and nature of plants and animals including microorganisms from the previous Grades. Then, introduce the meaning of classification, domains and kingdoms.

Teaching

Teacher and students interactively discuss the biology lessons which they have learned in the previous Grades.

Teacher must explain about the forms and nature of living things together with the classification system with the help of illustrations as related to this lesson.



Practice

Teacher should ask the following questions to the students and discuss:

1. Which plants and animals do you know?
2. How are their structures organized?
3. Are they similar or different in structures?

Review and assessment

1. State the domains and kingdoms in living organisms.

   The three domains in living organisms are Archaea, Bacteria and Eukarya. The six kingdoms in living organisms are Archaebacteria, Eubacteria, Protista, Fungi, Plantae and Animalia.

2. Give a diagrammatic representation showing the relationship between the three domains and six kingdoms of living things.

   Textbook Page 5, Figure 1.1

3. Give the examples of the kingdom that includes those living in the extreme environments and their characteristics.

   Textbook Page 5, Table 1.1 Archaebacteria

4. Name the kingdoms with their respective examples.
   1. Archaebacteria (e.g., Thermophiles, Methanogens)
   2. Eubacteria (e.g., Bacteria, Cyanobacteria)
   3. Protista (e.g., *Amoeba*, *Euglena,* Slime mould, *Paramecium*)
   4. Fungi (e.g., Yeast, *Rhizopus,* Mushroom)
   5. Plantae (e.g., Algae, Liverworts, Mosses, Ferns, Conifers, Angiosperms)
   6. Animalia (e.g., Earthworms, Insects, Fish, Birds, Mammals)

Activity 1

Name the kingdoms of living things shown in the following illustrations:
(Note: teacher should ask the questions related to each illustration)

Activity 2

Prepare a few slides of microorganisms and let the students observe them under the microscope(s). Teacher can also prepare the vinyl or chart of microorganisms. Then, ask them the following question(s) to write down the answer(s) in their Workbooks. Identify organisms which you have seen in your environment.

Viruses **Periods (11)**

Although viruses are not placed under any kingdom, they are studied as pathogens in microbiology.

Lesson objective

- To know the nature and characteristics of viruses

Introduction

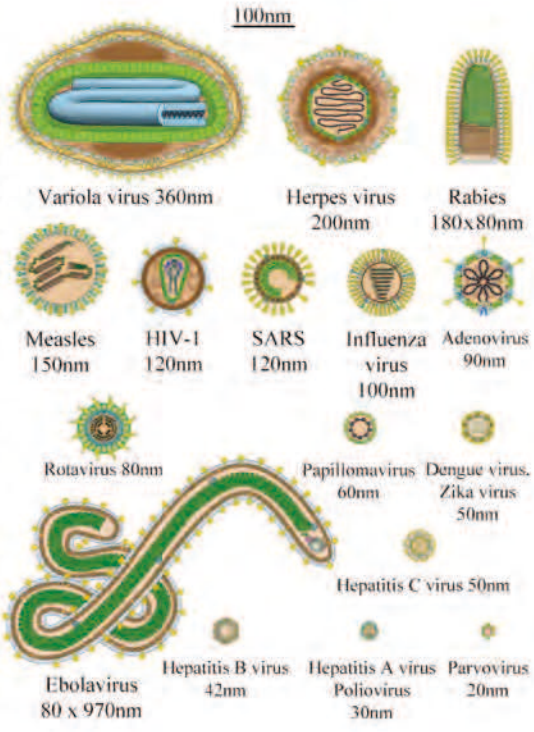
Viruses are not living organisms.

Teaching

Teachers should understand the seven characteristics of living things from the Textbook. To give more knowledge of viruses to the students, teacher should explain that viruses do not possess the seven characteristics of living things but a virus is a small infectious agent that replicates only inside the living cells of an organism. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.

Prepare the following diagrams on a cardboard paper or on vinyl chart. Ask the students about the different types of viruses shown in the diagrams. Discuss the human diseases caused by respective viruses and the symptoms of each disease.

Human diseases caused by **viruses** include chickenpox, herpes, influenza, rabies, small pox, Acquired Immuno Deficiency Syndrome (AIDS) and Ebola virus disease (EVD).



Practice

Teacher should make the oral test to the students with the following questions:

1. Are the viruses living or non-living?
2. Can the viruses be harmful to plants and animals? Give examples of harmful viruses.
3. Name the human diseases which are caused by viruses.

Review and assessment

1. Why are not viruses regarded as living organisms?

   Viruses are not generally considered to be alive. They cannot move, feed, excrete, grow or show sensitivity but can reproduce only in the living host cells. Viruses cannot survive outside the host cells.

2. Mention the main particles that contain in the viruses?

   The main particles that contain in the viruses are DNA or RNA and a protein coat.

1.3.2 Kingdom Plantae — Periods (12, 13)

Lesson objectives

- To know about the nature of Kingdom Plantae
- To understand the characteristics of Plantae
- To know how they can be grouped based on their characteristics

Preparation for lesson

Study the different forms of flowering and non-flowering plants from the internet websites and from the Textbooks of the previous Grades concerning with the plants before teaching this lesson.

Introduction

The plant kingdom includes all the plants, trees, flowers and seeds which we can see around us. They are autotrophic eukaryotes which they can make their own food.

Teaching

Teacher should explain about plants with examples that found in school environs. Then, students are asked to identify the forms and nature of plants, which they have learned.

Teacher has to explain about the forms, nature and structures of plants with the help of illustrations based on students' answer as related to this lesson.

Practice

Then, teacher should ask the following questions to the students:

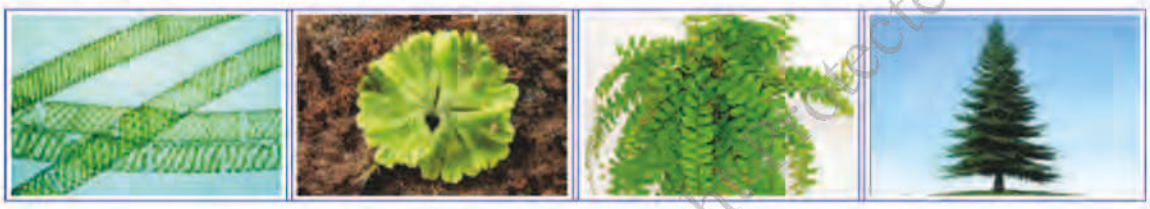
1. Which types of plants do you know among the kingdom Plantae?
2. How are the structures organized in Bryophyta?
3. What are the differences between mosses and ferns?
4. Name the most primitive land plant, its habitats and structure of its thallus.
5. Mention the different methods of reproduction found in plants.

Review and assessment

1. What are the characteristics of the Kingdom Plantae?
   Textbook Page 9, 1.3.4 Characteristics of Plantae
2. In Plantae, how many groups are subdivided based on their characteristics and name these groups?
   There are five groups based on their characteristics. They are Thallophyta, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae.
3. Discuss the characteristics on each division of plants. (Students' group work)
   Textbook Page 10 - 11, Table 1.4 Division of Plantae

Activity 1

Name the Divisions of plants from the following images:
(Teacher can carry out oral quiz)



Activity 2

Teachers have to prepare one or two or three of plants concerning with this lesson by using microscope(s) and let the students observe. Then, ask them the following questions and write down the answers in their workbooks.

1. Identify and classify the organisms which you have seen.
2. State the characteristics of the organisms which you have seen.
3. Match the different groups of Plantae with the relevant characteristics.

A.	Thallophyta	(i)	Reproduction by spores
B.	Bryophyta	(ii)	Seed-bearing vascular plants
C.	Pteridophyta	(iii)	Flowering vascular plants'
D.	Gymnospermae	(iv)	Plant body is simple (thallus)
E.	Angiospermae	(v)	Gametophytic and sporophytic generations alternate with each other in a single life cycle.

Answers:	A. (iv), B. (v), C. (i), D. (ii), E. (iii)

4. Mention the functions of two different organelles of a plant.
   (a) Chlorophyll (b) Cell wall

Answers:	(a) Photosynthesis, generate chemical energy as glucose molecules. (b) Give the cell strength and structure and to filter molecules that pass in and out of the cell.

1.3.3 Kingdom Animalia **Periods (14, 15)**

Phylum - Chordata (Vertebrata)

Lesson objective

- To know the different characteristics of some vertebrates

Preparation for lesson

Teacher should prepare the charts, sheets or vinyl of diagrams from Table 1.6 of the Textbook showing different vertebrate groups under Phylum Chordata.

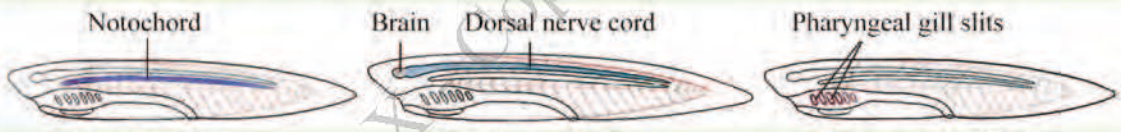
Introduction

Teacher should introduce the two major groups of animals: the **invertebrates** and the **vertebrates**. All the chordates are vertebrates with bilateral symmetry, three cell layers of ectoderm, endoderm and mesoderm, and hollow dorsal nerve cord. Distinct features of chordates are notochord, a dorsal nerve cord, pharyngeal gill slits and tail in embryo or in adults. All these features form in the early embryo of a chordate; they persist or are altered or may disappear in the adult.

Teaching

Teacher should explain in detail of fish, amphibians, reptiles, birds and mammals from Table 1.6 of the Textbook.

More information for teacher



Notochord Dorsal nerve cord Pharyngeal gill slits

The above characters can be seen in the adults of lower chordates but in the rest of the phylum these characters can be seen only in the embryological stages.

Practice

Teacher may ask the following questions:

1. How many major groups are there among the vertebrates? Name them giving examples for each group.
2. What are poikilothermic and homeothermic vertebrates?
3. Are invertebrates cold blooded or warm blooded?

Review and assessment

1. Describe the distinctive characters of chordates.
   Textbook Page 13, [All the chordates ..... trunk and tail.]
2. Name some vertebrates that are warm blooded.
   Birds and mammals

3. Are mammals living in water cold blooded?

   No. Mammals living in water are warm blooded animals.

4. How do different vertebrates obtain oxygen?

   Animals get oxygen in a number of ways. Aquatic animals, like fish, typically breathe through gills. Gills are flaps located on both sides of the fish or in its pharynx. As water flows into its gills, the blood vessels inside the gill arch, absorb oxygen through its red blood cells. Mammals breathe using lungs. Lungs are a pair of spongy, hollow organs on either side of the heart. The lungs have thousands of capillaries, on its air sac that help the gas exchange for oxygen. The muscle of the lung expands to let air in and contract to let air out.

5. Use the **key given to identify** each species in the illustrations below. Write the letter for each species (A to G) in the correct box beside the key. One has been done for you. Following figures show seven different species of amphibians to identify. Common names are given.

Rana temporaria (Grass frog)
A

Gymnopis multiplicata (Caecilian)
B

Triturus cristatus (Crested newt)
C

Necturus maculosus (Mudpuppy/Salamander)
D

Oreophrynella quelchii (Toad)
E

Polypedates leucomystax (Shrub frog)
F

Ambystoma tigrinum (Tiger salamander)
G

Key			
1(a)	long, narrow body, with or without legs	go to 2	
(b)	body not long and narrow, back legs are larger than the front legs	go to 5	
2(a)	body without legs	*Gymnopis multiplicata*	B
(b)	body with legs which are all of the same size	go to 3	
3(a)	Raised crest along the back of the body		
(b)	no crest along the back of the body	go to 4	
4(a)	gills present		
(b)	no gills present		
5(a)	skin is smooth	go to 6	
(b)	skin is not smooth		
6(a)	digits end in swellings		
(b)	digits do not end in round swellings		

Answers: 3 (a) = C, 4 (a) = D, 4 (b) = G, 5 (b) = E, 6 (a) = F, 6 (b) = A

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK

1. Page 1, No. 1.1.2 [The main branches of biology ..... microscopic organisms.]
2. Page 1-2, No. 1.1.2 [The different fields of biology ..... biology data.]
3. Page 2, No. 1.1.2 [Taxonomy is the study of classification of organisms.]
4. Page 2, No. 1.1.2 [Biodiversity ..... living organisms.]
5. Page 5, No. 1.3 [A Kingdom ..... set of characteristics.]
6. Page 4, No. 1.2.5 [Linnaeus introduced the Binomial ..... *Oryza sativa*.]
7. Page 5, Figure 1.1 [The three domains are Archaea, Bacteria and Eukarya. The six kingdoms are Archaebacteria, Eubacteria, Protista, Fungi, Plantae and Animalia.]
8. Page 5, Table 1.1 Archaebacteria and Eubacteria
9. Page 5, No. 1.3.1 [Organisms are divided ..... Plantae and Animalia.]
10. Page 7, Table 1.2 Bryophyta
11. Page 8, Table 1.2 Angiospermae
12. Page 8, Table 1.3 Fish
13. Page 9, Table 1.3 Amphibians
14. Page 9, Table 1.3 Birds
15. Page 9, Table 1.3 Mammals

SUMMARY

Biology is the study of living things which includes bacteria, protista, fungi, plants and animals. Out of many advances in biology, food production and disease control are improved by biological research. Main branches of biology are Botany (study of plants) and Zoology (study of animals and humans) and Microbiology (study of microscopic organisms). Some branches of biology, as mentioned in paragraph 1.1.2, are based on the method of studying organisms in different ways.

The main characteristics of living things are simplified under subheadings: cellular structure, metabolism, growth, movement, irritability, reproduction and adaptability are presented in this chapter. In addition, this chapter includes taxonomy, the study of classification of organisms, which is essential to biology as there are too many different living things to sort out, compared and organized into categories. In classification, similar organisms are grouped together into species, similar species into the same genus, then family, order, class, phylum and kingdom. Linnaeus introduced the Binomial System of Nomenclature in the year 1753, each plant and animal is given a two-word scientific name in Latinized Form. Scientific names become essential as a common factor for all scientists to understand the referred plant or animal.

Characteristics of viruses, although not considered as living organisms, are outlined. Organisms are divided into six kingdoms. Within the domains Archaea and Bacteria, kingdoms Archaebacteria and Eubacteria are placed, respectively. The remaining four kingdoms Protista, Fungi, Plantae and Animalia are placed within the domain Eukarya. The plants belonging to the kingdom Plantae are eukaryotes. They contain chlorophyll and can make their own food by photosynthesis. Cellulose cell wall is present. The characteristics of five divisions of plantae are mentioned in Table 1.2. Kingdom Animalia is categorized into invertebrates (animals without a backbone) and vertebrates (animals with a backbone). Vertebrates are presented in Tables 1.3. This would serve as basic knowledge to comprehend the evolutionary and biodiversity trends of plants and animals.

CHAPTER 2
CELL STRUCTURE AND ORGANIZATION

Total Number of Lesson Periods : 20

2.1 CELLS AS THE BUILDING BLOCKS OF LIFE Period (1)

Lesson objectives

- To know that all living organisms are composed of basic units called cells
- To understand differences between single cells which perform all functions of life and cells in multicellular organisms which are specialized to carry out additional particular functions in plants and animals

Preparation for lesson

Teacher needs to prepare teaching aids (vinyl, posters, sheets, charts, etc.) with figures or photos of single cell organisms (*Amoeba, Paramecium*, etc.) and multicellular organisms (humans, tigers, etc.).

Introduction

Teacher must introduce one-celled organisms and multicellular organisms from the previous Grades.

Teaching

Teacher should start with explanation on the structure and functions of a cell using a diagram showing some organelles as found in this cell. Then teacher differentiates the characters between the cells of unicellular organisms (bacteria) and multicellular organisms (plants, animals, humans) from the Textbook Pages 18, 19, Figures 2.1, 2.3.

Practice

Teacher then should ask the following question:

1. What is the basic unit of all living things and how are these units composed of?

Review and assessment

1. Differentiate the features of a single organism and a multicellular organism (for example, bacteria and cat).

   Textbook Pages 17, 18, Figure 2.1 [The simplest organisms ..... functions in plants or animals.]

2.1.1 The Cell Theory Period (2)

Lesson objective

- To know and understand the cell theory

Preparation for lesson

Teacher should prepare teaching aids (vinyl, cards, charts with figures and labels, etc.) to explain the cell theory. The figures should include:

1. Diagrams of a cell and its components
2. Sperm and egg uniting to form a zygote
3. Chromosomes in mitotic cell division

Introduction

Teacher will introduce previous chapter (Textbook Chapter 1) which describes that organisms are either unicellular or multicellular and all cells arise from preexisting cells.

Teaching

Teacher should explain each point of the cell theory.

Practice

Teacher should ask the following questions:

1. What is the basic unit of organisms?
2. What information is carried in the cell?
3. Where do the chemical reactions occur in cells?

Review and assessment

1. What do you understand about the cell theory?
   Textbook Page 17, 2.1.1 The Cell Theory

2.1.2 Prokaryotic and Eukaryotic Cells — Periods (3-5)

Lesson objectives

- To know the nature of prokaryotic and eukaryotic cells
- To know the differences between prokaryotic and eukaryotic cells

Preparation for lesson

Teacher should prepare the teaching aids (charts with figures and diagrams, etc.) for the prokaryotic and eukaryotic cells described in the Textbook. Teacher should explain by using fully labelled figures in the large charts and compare the structure of prokaryotic and eukaryotic cells in detail.

Introduction

Teacher should point out the differences of prokaryotic cells and eukaryotic cells starting with prokaryote means a cell lacking a membrane-bounded nucleus and membrane-bounded organelles (e.g., a bacterium), eukaryote means a cell with most notably the membrane-bounded nucleus. The teacher will also point out that a eukaryote is an organism composed of such cell or cells with nucleus (e.g., plant cells and animal cells). Teacher also needs to tell that protists and fungi are also eukaryotes.

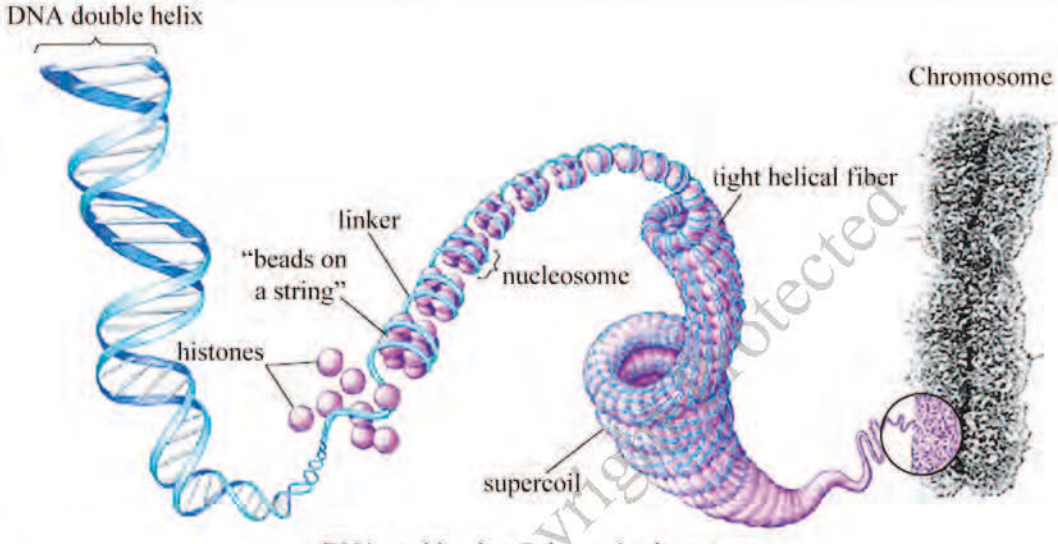
Teaching

Teacher should explain that the prokaryotic cells are mostly small and simple, for example, bacteria. The eukaryotic cells are bigger and more complex. They are multicellular organisms that are made up of many cells, for example, rabbit.

Teacher should outline in detail on differences and similarities between prokaryotic and eukaryotic cells using Page 20, Table 2.1 of the Textbook.

More information for teacher

A crucial aspect of DNA packing is the association of the DNA with small proteins called **histones**. In fact, histone proteins account for about half the mass of eukaryotic chromosomes.



DNA packing in a eukaryotic chromosome

Practice

Teacher should ask the following questions:

1. How does the cell size differ in prokaryotic and eukaryotic cells?
2. Where are DNA located in the prokaryotic and eukaryotic cells?

Review and assessment

1. What is a eukaryote?

   A eukaryote is an organism consisting of a cell or cells in which the genetic material is DNA in the form of chromosomes contained within a distinct nucleus. Eukaryotes include all living organisms apart from the eubacteria and archaea.

2. What is a prokaryote?

   A prorokaryote is a microscopic single-celled organism which has neither a distinct nucleus with a membrane nor other specialized organelles, including the bacteria and cyanobacteria.

3. Differentiate the prokaryotic and eukaryotic cells.

   Textbook Page 19, [The major difference between ..... cell walls are present.]

4. What are organelles and where can they be found?

   An organelle is a tiny cellular structure that performs specific functions within a cell. Organelles are embedded within the cytoplasm of eukaryotic and prokaryotic cells.

5. What is meant by chromosome, DNA and histone?

Chromosome is a threadlike structure of nucleic acids and proteins are found in the nucleus of most living cells, carrying genetic information in the form of genes. DNA: Deoxyribonucleic acids, a self-replicating material is present in nearly all living organisms as the main constituent of chromosome. It is the carrier of genetic information. Histone is any of a group of five small basic proteins found in chromatin.

2.2 EUKARYOTIC CELL STRUCTURE Periods (6-11)

2.2.1 Differences in Cell Structure

2.2.2 Cell Components

Lesson objectives

- To know the diversity in cell shape, size, internal organization and function in organisms
- To know about the organelles as found in plants and animals
- To identify the characteristics of organelles and their functions

Preparation for lesson

Teacher should prepare the teaching aids (vinyl, chart, etc.) with clearly labelled figures of cell wall, cell membrane, cytoplasm, nucleus, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, chloroplast, vacuole, plasmodesma, centrosome and centrioles, and microvilli.

Introduction

Before teaching, teacher should explain about the nature of eukaryotic cells, containing various organelles as described in previous lesson of Chapter 1 of the Textbook. Teacher should explain the differences of plants and animals. Cell wall, chloroplast, and plasmodesmata are found in only plants cells, but vacuoles are found in both animal and plant cells. The vacuoles are much larger in plant cells as central vacuoles. Centrosome, centrioles and microvilli are found only in animal cells. The remaining parts or components are found in both plants and animal cells.

Teaching

Teacher should begin the lesson by explaining that eukaryotic cells are found in the body of plants and animals. Teacher should explain about the cell wall, which can be found only in plant cells. The cell wall is the protective outer layer of a plant cell. It is made up of cellulose. The cell membrane or plasma membrane of a cell surrounds the cytoplasm. Its functions include to surround and protect the cell to act as a partially permeable membrane for transport of substances in or out of the cell.

The teacher should also point out that cytoplasm is found in both plants and animals and also known as cytosol. Nucleus is located inside the cytoplasm. Also tell that nucleus is a spherical or oval structure that controls the cell structure and activities. Mitochondria are known as 'the powerhouse of the cell'. It takes in nutrients from the cell, breaks it down, and turns it into energy (ATP). The energy is then in turn used by the cell to carry out various functions. Teacher should also explain structures and functions of each organelle.

Practice

Teacher should ask the following questions:

1. Name some organelles of an animal cell.
2. List the three structures found only in plant cells.
3. What are the structure and functions of a nucleus found in a eukaryotic cell?
4. What are the locations and functions of lysosomes, Golgi apparatus and centrosome?
5. Why can chloroplast photosynthesize?
6. Why are microvilli present in some animal cells?

Activity

After asking the questions, teacher should organize 3 or 4 students as a small groups to investigate and discuss the structure of a cell, and cellular organelles of plant and animal cells by using a microscope, cards or charts. Students should select any organelles from a given list and could match it with the respective functions.

Review and assessment

1. What is the role of the cell wall?

   The cell wall is the protective, semi-permeable outer layer of a plant cell. A major function of the cell wall is to give the cell strength and structure, and to filter molecules that pass in and out of the cell.

2. Explain the composition of the cell membrane.

   Phospholipids form the basic structure of a cell membrane, called the lipid bilayer. Scattered in the lipid bilayer are cholesterol molecules, which help to keep the membrane fluid consistent. Membrane proteins are important for transporting substances across the cell membrane.

3. What is cytoplasm?

   Cytoplasm is semifluid jelly-like structure which includes organelles and acts as a site for chemical reactions.

4. Which organelles play a role in nuclear division of animal cells?

   Centrosomes play a role in nuclear division of animal cells.

5. What is the purpose of the mitochondria?

   Mitochondria are part of eukaryotic cells which perform cellular respiration. This means it takes in nutrients from the cell, breaks it down, and turns it into energy. They are known as the powerhouses of the cell.

6. What are the functions of chloroplasts?

   Chloroplasts are the food producers of the cell. These organelles are only found in plant cells and some protists such as algae. Animal cells do not have chloroplasts. Chloroplasts convert light energy of the sun into sugars that can be used by cells. The entire process is called photosynthesis. This process depends on the green chlorophyll molecules present in each chloroplast.

7. How does the structure of Smooth Endoplasmic Reticulum (SER) differ from the Rough Endoplasmic Reticulum (RER)?

   The main difference lies between the SER and RER is the presence of ribosomes, SER does not have ribosomes but RER has ribosomes. SER mainly produces and exports lipids and proteins and functions for detoxification while RER produces and secretes proteins and few hormones.

8. What is the purpose of the Golgi apparatus?

   The purpose of the Golgi apparatus is to make lysosomes.

9. What is a lysosome?

   A lysosome is an organelle that contains digestive enzymes. It digests excess or worn out organelles and food particles.

2.2.3 Cell Organization

(A) Plant Tissues **Periods (12, 13)**

Lesson objectives

- To study the structures and functions of plants tissues
- To understand the forms and functions of various parts of plant

Preparation for Lesson

Teacher should prepare the different types of cells and tissues of plant with illustrations (vinyl, chart or model) from other Textbooks and the internet websites.

Introduction

Teacher should ask the question about the previous lessons. For example, What is a cell? What organelles are found only in plant cell?

Teaching

Teacher should explain that organisms are classified into two groups; unicellular and multicellular. In multicellular organisms, tissues which are found in plant are called plant tissues. Plant tissue is a collection of similar cells performing an organized function for the plant. And then teacher should continue to explain the plant tissues from the Textbook.

Teacher should prepare the following information before teaching the lesson. And then explain word diagram in Figure 2.4 from the Textbook.

Practice

After teaching, teacher should ask the following questions:

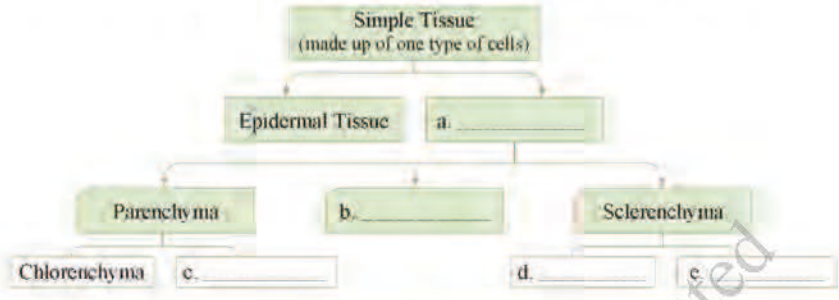
1. What is meristematic tissue?
2. What is permanent tissue?
3. Differentiate between simple tissue and complex tissue.

Review and assessment

1. Name the three basic types of permanent tissue found in the higher plant.

   Epidermal tissue, ground tissue and vascular tissue

2. Mention the two types of cells found in sclerenchyma tissues of plant.
   Fibre and sclereid cells
3. What are the components of xylem tissue?
   Vessel, tracheid, xylem parenchyma and xylem fibre
4. Fill in the boxes of the following chart with the correct words.



Answers: a. Ground tissue b. Collenchyma
c. Aerenchyma d. Fibre e. Sclereid

5. What are the components of ground tissue system of plant?
   Parenchyma, collenchyma and sclerenchyma
6. How many types of tissues are found in higher plant?
   Two types: meristematic tissues and permanent tissues

Level of Organization in Plants

Organ Systems **Periods (14, 15)**

Lesson objectives

- To study the organs and organ systems of plants
- To understand the structures and functions of organs and organ systems of plants

Preparation for lesson

Teacher should collect teaching aids and prepare the different types of cells and tissues, organs and organ systems of plants with illustrations (vinyl, chart or model) from the internet websites. All parts of plant should also be prepared from any available plants.

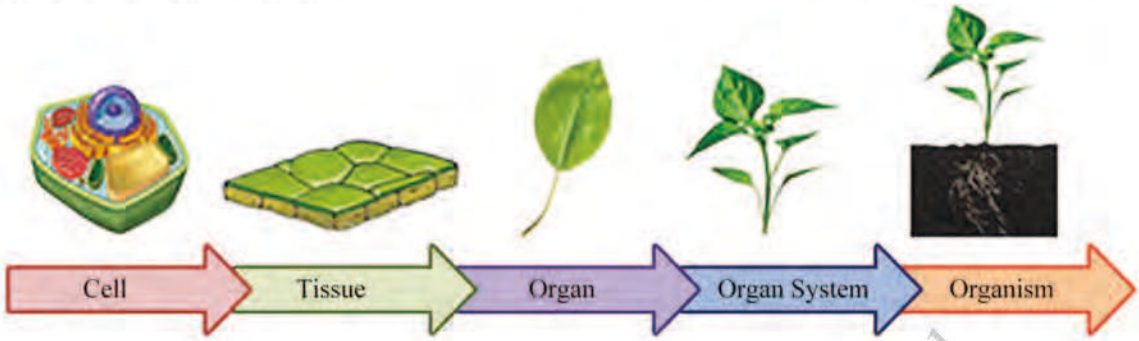
Introduction

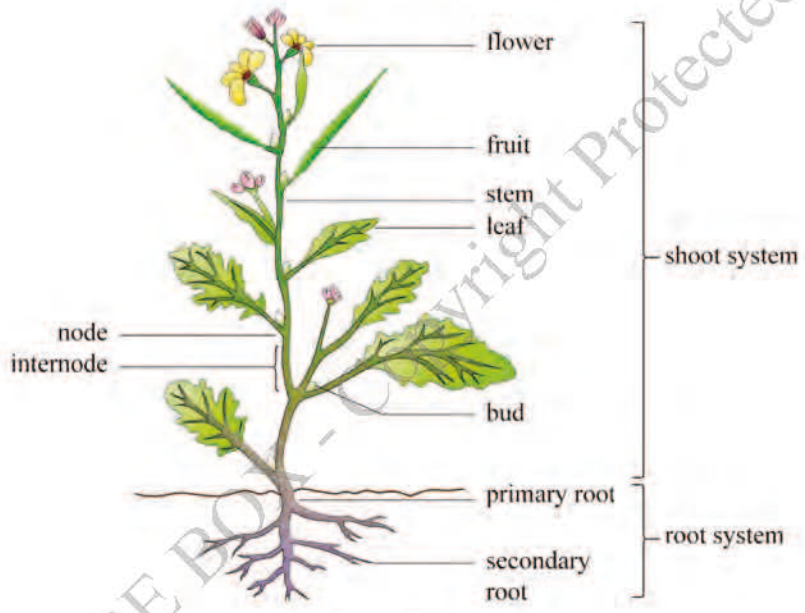
Teacher should ask the questions related to the previous lessons to the students. For example: Which type of tissues transport water and dissolved salt? What is phloem tissue? Where can xylem be found? Teacher should give guidance for the correct answers.

Teaching

Teacher should explain the level of organization in plant from the Textbook with available plant specimens. In the previous lessons, students have already learned about the cells and tissues. Therefore, teacher continues to explain that each plant tissue can be combined with other tissues to create organs such as leaves, flowers, stems and roots.

In addition, organs are further arranged or combined into organ systems that carry out life functions of the organism. During explanation, teacher should use the available teaching aids such as vinyl or chart.





A flowering plant

Practice

After teaching, teacher should ask the following questions:

1. Which one has less organs either in plant or in animal?
2. What are the functions of the stem?
3. Which part performs the reproductive system in plant?

Review and assessment

1. State how many systems are present in plant.

   The two systems are present in plant. They are the root system and the shoot system.

2. State the functions of the root system.

   Absorb water and mineral salts from the soil . Anchor the plant in the soil and give support to the plant.

3. What are the parts of the shoot system?
   The parts of the shoot system are stems, leaves, buds, flowers and fruits.

(B) Animal Tissues **Periods (16, 17)**

Lesson objective

- To gain knowledge about the animal tissues

Preparation for lesson

Teacher should prepare the teaching aids (vinyl, chart, etc.) showing animal tissues from the Textbook Figure 2.5.

Introduction

Teacher starts with explanation of tissue that is a cellular organizational level between cells and a complete organ. A tissue is an assemble of similar cells and their extracellular matrix from the same origin that together carry out a specific function. Organs are then formed together by the functional group of multiple tissues.

Teaching

Teacher should explain that the animal tissues consist of four basic groups; namely (1) epithelial or covering (2) connective or supporting (3) muscle or contractile and (4) nervous tissues. The epithelial tissues can be divided into two groups, simple and stratified. Connective tissues consist of loose connective, dense connective, cartilage, bone and blood tissues. The muscles are smooth muscles, skeletal muscles and cardiac muscles. Lastly the nervous tissue is made up of sensory, motor and relay neurons.

Practice

After teaching, teacher should ask the following questions:

1. What is tissue?
2. Name some types of tissues that you know.
3. Classify the basic groups of animal tissues.
4. Name the types of connective tissues.
5. List the types of muscle tissues.

Review and assessment

1. How are cells organized to form an organism?
   Similar cells are grouped into tissues, groups of tissues make up organs, and organs with a similar function are grouped into an organ system. Organ systems form an organism.
2. Identify the basic groups of tissue found in a higher animal.
   Animal tissues can be classified into four basic groups: (1) epithelial or covering (2) connective or supporting (3) muscle or contractile and (4) nervous tissues.

Organ systems **Periods (18, 19)**

Lesson objective

- To know and understand about the development of cell to organ systems

Preparation for lesson

Teacher needs to prepare charts as teaching aid showing the types of organ systems in the heading of organ systems from the Textbook.

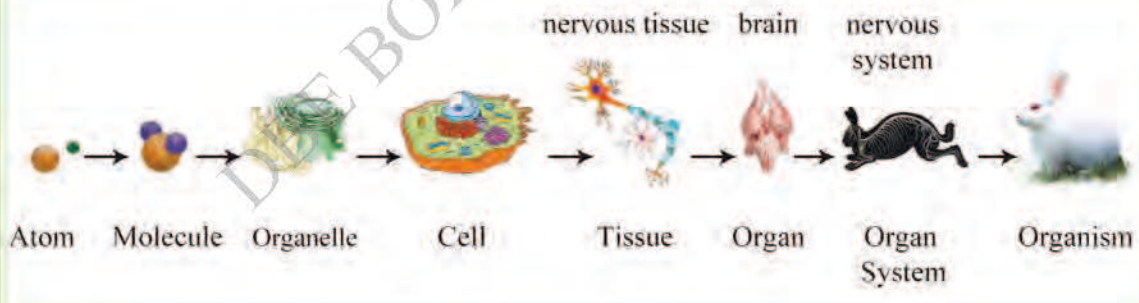
Introduction

Teacher begins by asking students whether they know that atoms are organized into molecules, molecules into organelles and organelles into cells, and that cells are the simplest level of organization in animals. Also explains that specialized cells show division of labour by being grouped into **tissues** and that the tissues may be further grouped into **organs** and the **organs** into **organ systems**.

Teaching

Teacher should explain that a living organism could be a unicellular or a multicellular organism and their living processes. In unicellular organisms, the single cell performs all the life functions, such as nutrition, respiration, excretion and reproduction. In multicellular organisms, different cells from various parts of the body perform different functions. More over, multicellular organisms have various levels of organization in their bodies. An organ system is a collection of two or more organs, which together perform some complex body functions. During explanation, teacher should use the available teaching aids such as vinyl or chart.

More information for teacher



Organization in living things

Practice

After explanation, teacher should ask the following questions:

1. List the levels of organization in the human body.
2. What is the digestive system?
3. What is the gas exchange system?
4. What is the reproductive system?
5. What is the circulatory system?

Review and assessment

1. Define the term organ and list the seven groups of organ systems.
   Textbook Page 29,30 [Organ are ..... functional unit.(1) Digestive system ..... (7) Reproductive system]
2. What do you understand the organ systems and explain any two of these systems?
   Textbook Page 30 [An organ system ..... of the body. Answer any two of the seven main systems in the human body.]
3. What are the different levels of organization?
   The levels, from smallest to largest, are: atom, molecule, cell, tissue, organ, organ system and organism.

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK
1. Page 12, No. 2.1.1 The Cell Theory
2. Page 15, No. 2.2 [Plants ..... cytoplasm.]
3. Page 15, Table 2.1 [Single copy ..... mitochondria.]
4. Page 15, Table 2.1
5. Page 16, Table 2.2 Plant cell wall (Function)
6. Page 17, Table 2.2 (mitochondrion)
7. Page 22, No. 2.2.3 There are five levels of organization in multicellular organisms: cells, tissues, organs, organ systems and organisms.
8. Page 17, Table 2.2 Nucleus (Functions)
9. Page 22, No. 2.2.3 [Cells are ..... that function.]
10. Page 23, Figure.2.4
11. Page 24, [Animal tissues ..... cells together.]
12. Page 25, No.(2), (4) and (5)

SUMMARY

Cells are the basic structure and functional unit of all living organisms. Cells are made of a number of different subunits called organelles which are microscopically small. Cells and organelles are observed by a microscope with a high magnification and resolution. The basic principles of the cell theory are also described in this chapter. Cells are of two types; prokaryotic and eukaryotic cells. In order to distinguish these two types of cells, explanation on their common characteristics and differences are provided with diagrams and tables. The components found in plant and animal cells are given in summarized form for easy understanding and learning. It explains how the cells are organized into tissues and organs. Simple explanations of plant and animal tissues supported by associate diagrams can easily be understood. Providing with examples, explanation on how tissues are organized into organs which in turn are organized into organ systems are also included in this chapter.

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