Supplement to the Science Education Key Learning Area Curriculum Guide

Science (Secondary 1-3)

Prepared by
The Curriculum Development Council

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This supplement was prepared by the Curriculum Development Council (CDC) for use in Secondary One to Three. Schools may pilot the curriculum in the 2016/17 and 2017/18 school years.

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Contents

Chapter 1 Introduction

Science (Secondary 1-3) is a core subject under the Science Education Key Learning Area (SE KLA) at junior secondary level. This document is a supplement to the S*cience Education Key Learning Area Curriculum Guide (Primary 1 - Secondary 6) (SE KLACG)(2017)*, in which the rationale, aims and learning targets and the curriculum framework for the Science (S1-3) curriculum are provided. Other suggestions on curriculum planning, learning and teaching, assessment and resources should be referred to the *SE KLACG (P1-S6)*.

1.1 Background

The aim of science education at the junior secondary level is to lay down a firm foundation in students for further developing the necessary scientific and technological knowledge and skills to live and work in the 21st century. In response to the changing needs of society and the rapid development of science and technology in the world, an ad hoc committee was set up by the Curriculum Development Council Committee on Science Education to review the Science (S1-3) curriculum. Taking consideration of the views of stakeholders collected through surveys and engagement activities, the committee had revised and updated the recommendations provided in the *Syllabuses for Secondary Schools Science (Secondary 1-3) (1998)*.

The Science (S1-3) curriculum was updated along the following directions:

- To fine-tune and update the curriculum content
- To nurture students' interest in science
- To help students build a solid and balanced foundation in science
- To strengthen the bridging between junior and senior secondary science curricula

1.2 Rationale

The Science (S1-3) curriculum adopts a thematic approach to provide broad and balanced learning experiences for students to extend their learning of the science elements in General Studies at primary level. The curriculum is designed for the development of scientific literacy, the associated science process skills, together with the awareness of the impact that science has on our lives and environment for students at junior secondary level. This helps students to deal with the opportunities and challenges in a wide variety of personal and social contexts in such an era of rapid scientific and technological change.

The Science (S1-3) curriculum follows the curriculum framework of the SE KLA which is depicted in Figure 1 on the next page.

Science Education

Science education provides learning experiences for students to develop scientific literacy with a firm foundation on science, realise the relationship between science, technology, engineering and mathematics, master the integration and application of knowledge and skills within and across KLAs, and develop positive values and attitudes for personal development and for contributing to a scientific and technological world.

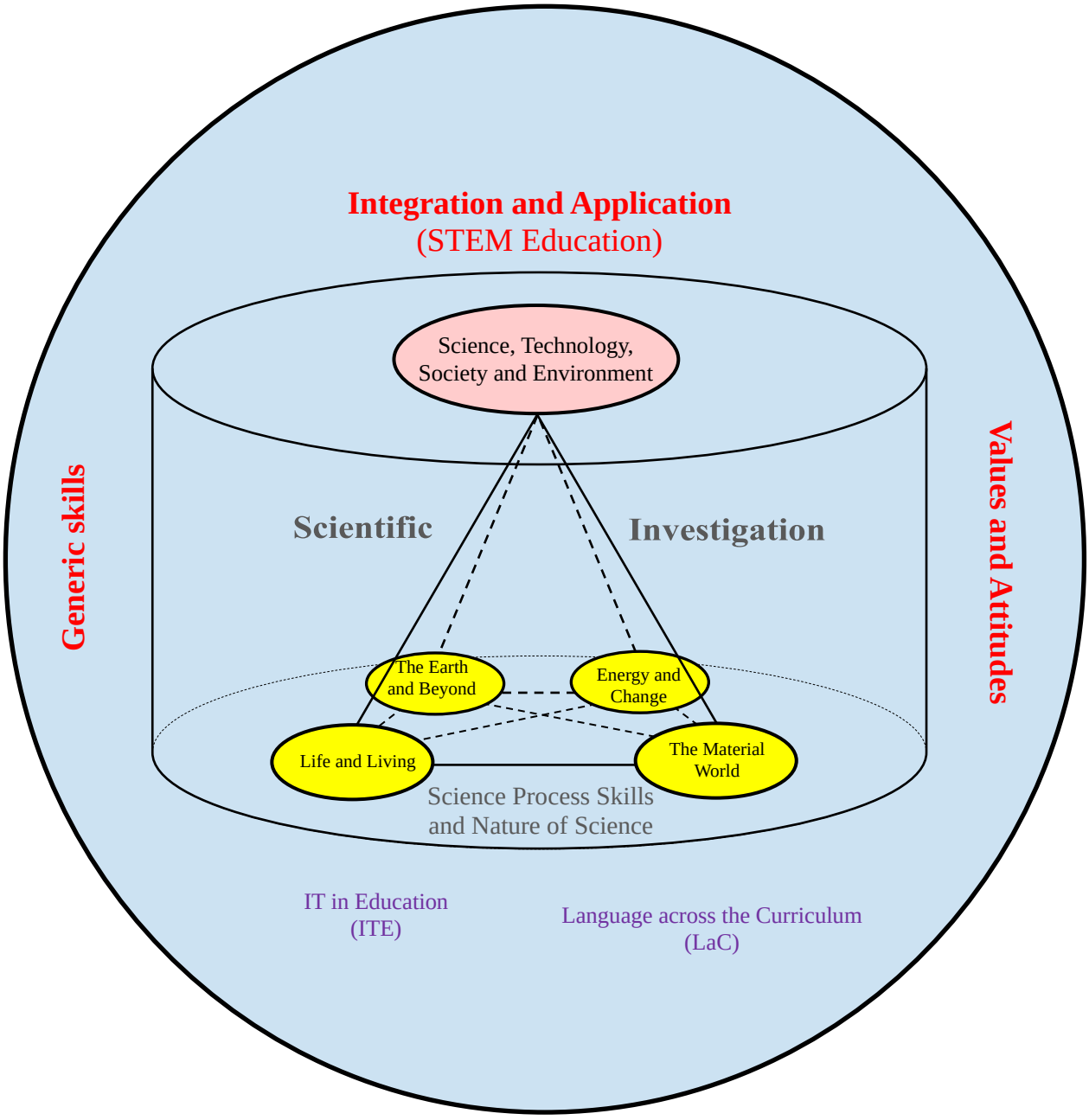

Figure 1 Diagrammatic Representation of the Science Education KLA Curriculum Framework

The content area of the Science (S1-3) curriculum covers the four interconnected strands of **Life and Living**, **The Material World**, **Energy and Change**, and **The Earth and Beyond** of the SE KLA so as to develop students' understanding of relevant scientific concepts and ideas. Besides, the importance of scientific knowledge towards scientific and technological developments and their implications to society and the environment is also highlighted in the curriculum to cover the strand of **Science, Technology, Society and Environment**. It also provides contexts for enhancing students' awareness of the relationship of science with other **STEM** [1] -related disciplines. The strand of **Scientific Investigation** is infused whenever appropriate into the Science (S1-3) curriculum, to facilitate students' understanding of the *nature of science* and acquisition of *science process skills*. The nature of science includes the belief and attitudes towards the knowledge about the natural world, the methods and processes through which scientific knowledge is acquired, and the socio-cultural and historical influences involved. The study of the nature of science could increase students' interests, enhance their understanding of scientific knowledge, and facilitate them to make informed decisions about science-related issues in their daily life. In addition to the brief introduction of the nature of science in Unit 1, teachers can select suitable topics in other Units as the context for developing students' understanding of the nature of science.

[1] STEM is an acronym that refers collectively to the academic disciplines of Science, Technology, Engineering and Mathematics. In the Hong Kong Curriculum Context, STEM education is promoted through the Science, Technology and Mathematics Education KLAs.

1.3 Curriculum Aims

The Science (S1-3) curriculum provides science-related learning experiences that develop students' interest in science and to lay a foundation for their studies of various science curricula at the senior secondary level. It also focuses on the development of scientific literacy for living in and contributing towards a scientific and technological world.

The broad aims of the Science (S1-3) curriculum are to enable students to:

- develop curiosity and interest in science;
- acquire fundamental scientific knowledge and skills, and appreciate the relationship between science and other disciplines;
- develop the ability to make scientific investigation and solve problems;
- use the language of science to communicate science-related ideas;
- develop a basic understanding of the nature of science;
- develop the ability to integrate and apply scientific knowledge and skills with other related disciplines;
- recognise the social, ethical, economic, environmental and technological implications of science, and develop an attitude of responsible citizenship and a commitment to promote personal and community health;
- be prepared for further studies in STEM-related disciplines; and
- become lifelong learners in science for personal development.

Chapter 2 Curriculum Structure and Organisation

The Science (S1-3) curriculum is designed to ensure continuity and progression of science education across primary and senior secondary levels. The curriculum framework comprises three interconnected components: Learning Targets, Curriculum Emphases, and the Units for the curriculum. The following figure represents the relationships between the various components.

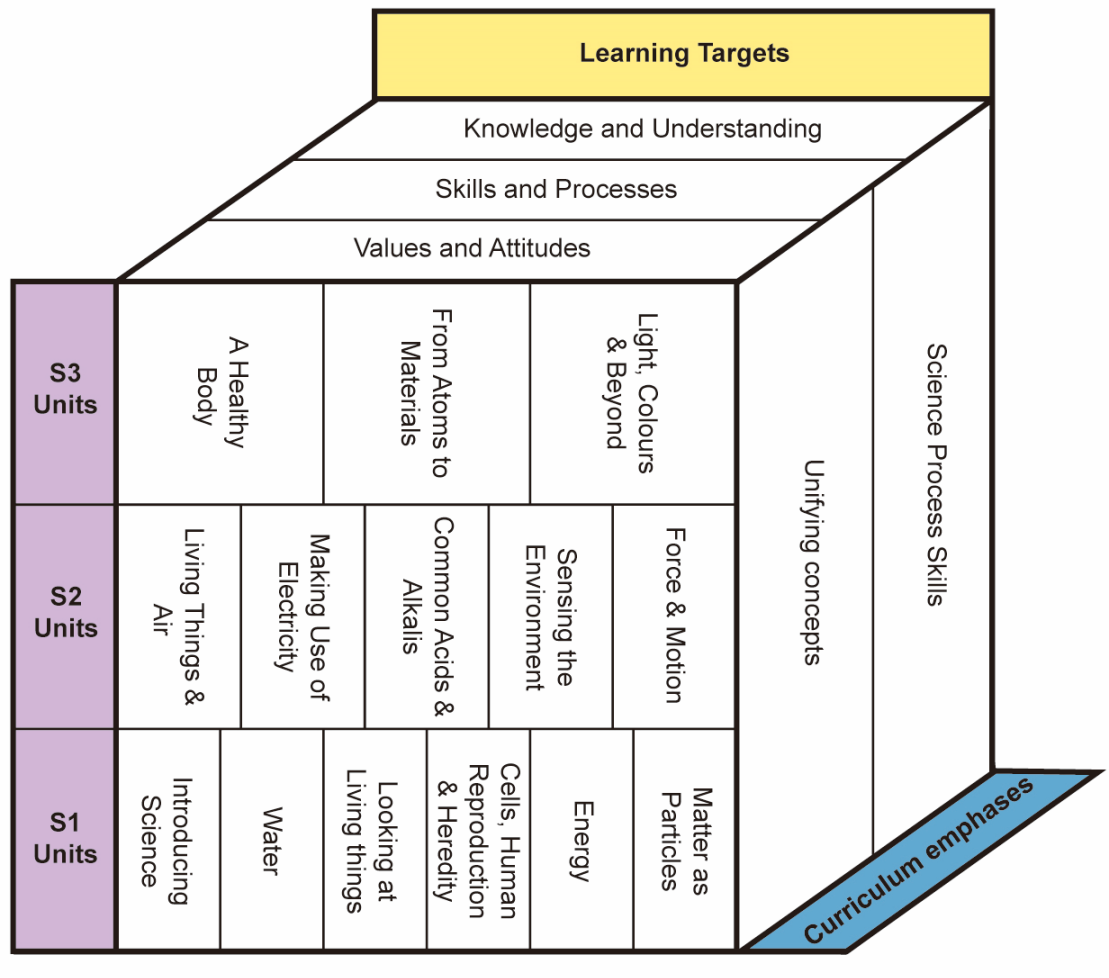

Figure 2 Diagrammatic Representation of the Science (S1-3) Curriculum Framework

2.1 Learning Targets

2.1.1 Knowledge and Understanding

Students should

- acquire basic scientific knowledge and understand some phenomena, facts, concepts and basic principles in science;
- recognise the connections and overarching coherence across different disciplines of science with unifying concepts;
- learn the vocabulary, terminology and convention used in science;
- apply scientific knowledge and skills to solve simple daily life problems.

2.1.2 Skills and Processes

Students should

- make observations, ask relevant questions, identify and define problems;
- use apparatus and equipment properly for conducting practical work;
- formulate hypothesis for investigation; control variables; plan and conduct investigation;
- make accurate measurement; use diagrams and graphs to present experimental results; collect and analyse data for making conclusion;
- use basic science language to communicate ideas;
- be able to think scientifically, critically and creatively;
- be able to integrate and apply knowledge and skills to solve problems collaboratively in real-life contexts;
- participate actively in group discussion and work effectively with other members in group;
- develop the ability to distinguish between fact, myth and belief, and make informed decision.

2.1.3 Values and Attitudes

Students should

- develop curiosity and interest in science and appreciate the wonder of the Nature and the development of the technological world;
- show respect to life and the environment;
- develop positive values and attitudes towards adopting healthy lifestyles;
- recognise the usefulness and limitations of science and the evolutionary nature of scientific knowledge;
- be aware of the relationship between science, technology, society and environment, and develop an attitude of responsible citizenship;
- develop an awareness of safety issues in everyday life, understand the reasons behind, and take proper actions to avoid accidents and reduce risks; and
- recognise the effects of human activities on the environment and act sensibly for sustainable development of the environment.

2.2 Curriculum Emphases

Two Curriculum Emphases, Unifying Concepts and Science Process Skills, are important components of the Science (S1-3) curriculum. They enhance students' understanding of the connections and overarching coherence across different science disciplines, and of the process of scientific investigations and related skills.

2.2.1 Unifying concepts

The unifying concepts are sets of ideas that pervade and transcend the boundaries of different disciplines of science. These are conceptual tools that help students understand the connections and overarching coherence across different science disciplines. The unifying concepts covered in this curriculum includes:

- Systems and organisation
- Evidence and models
- Change and constancy
- Form and function

A brief note on each of the above unifying concepts is given in the table below:

Unifying concepts	Notes
Systems and organisation	These are ways of observing and describing phenomena that are related to each other and/or work together as a whole. • A system is an organised group of related objects or components that form a whole. • Organisation is the act or process of putting things into a structural framework according to a particular hierarchy.
Evidence and models	Scientists use evidence and models to understand, explain and/or predict scientific phenomena. • Evidence consists of observations and data on which scientific explanations can be constructed and predictions can be made. • Models are representations that are taken to illustrate real systems, objects, concepts or events. They can be used to explain, predict and study how real objects work. Models can be physical, conceptual, or mathematical.
Change and constancy	Change and constancy describe the states of being of a scientific phenomenon. • Change is a process resulting in alteration. • Constancy is the state of being unchanged or some aspects of systems that have the remarkable property of always being conserved.
Form and function	Form and function are usually interrelated. The form of an object explains its function and its function explains the form. • Form is the shape and structure of an object. • Function is the role that an object, activity or job has, or the purpose for which it is used.

2.2.2 Science Process Skills

The essential science process skills that students are expected to master include:

- Observing
- Classifying
- Designing investigations
- Conducting practicals
- Inferring
- Communicating

A brief note on each of the above science process skills is given in the table below:

Science process skills	Notes
Observing	• Stating characteristics • Measuring sensibly and accurately • Recording data
Classifying	• Comparing similarities and differences • Grouping and ordering • Constructing keys • Stating relationship (includes identifying cause and effect)
Designing investigations	• Asking questions • Predicting results • Making hypothesis • Identifying variables • Suggesting operational procedures with consideration of fair testing
Conducting practicals	Hands-on practice which includes: • Choosing apparatus • Handling apparatus • Taking precautions

Inferring	• Analysing and interpreting data • Evaluating data • Estimating errors • Constructing explanations • Drawing conclusion
Communicating	• Using multiple representations to present information and ideas • Putting forward logical scientific argument

2.3 The Units for the Curriculum

The curriculum content is organised into 14 Units. It is designed to cover the key ideas of science, as well as the social and technological implications of science. Each Unit allows students to explore and investigate a specific theme in Science. The Units for S1, S2 and S3 are listed below:

S1	Unit 1: Introducing Science
	Unit 2: Water
	Unit 3: Looking at Living Things
	Unit 4: Cells, Human Reproduction and Heredity
	Unit 5: Energy
	Unit 6: Matter as Particles
S2	Unit 7: Living Things and Air
	Unit 8: Making Use of Electricity
	Unit 9: Common Acids and Alkalis
	Unit 10: Sensing the Environment
	Unit 11: Force and Motion
S3	Unit 12: A Healthy Body
	Unit 13: From Atoms to Materials
	Unit 14: Light, Colours and Beyond

2.3.1 Organisation of each Unit

The content of each Unit is organised into the following parts:

Overview

This part outlines the context and the focuses of each Unit. It also highlights the science process skills that students can practise and the unifying concepts that students may appreciate in the Unit.

Students should learn

This column lists the major content areas of each Unit. It indicates the knowledge and concepts that students should learn.

Students should be able to

This column lists the learning outcomes that students should achieve. These learning outcomes depict the cognitive level of the curriculum content that students should grasp. Whenever learning outcomes which draw on higher cognitive ability (e.g. relate) are applicable, other learning outcomes drawing on lower cognitive ability (e.g. state, describe) are not listed. Teachers can use these learning outcomes to set appropriate assessment tasks for monitoring the progress of learning and teaching.

Suggested learning and teaching activities

This column suggests activities through which students may achieve the learning outcomes. The list includes a wide range of activities, such as discussion, practical work, investigations, information search and projects. They are for teachers' reference only and are by no means an exhaustive or mandatory list. Teachers should exercise their professional judgment in selecting activities to cater for the interests and abilities of their students. Where possible, the activities should be designed with students' daily relevancy, allowing them to relate scientific knowledge to society and the environment around them. It is hoped that students will then be equipped with scientific concepts, theories and process skills to investigate and solve everyday problems, and develop positive values and attitudes.

2.3.2 Core and Extension

The curriculum content of each Unit is designed with *Core* and *Extension* to cater for students of different abilities and needs. The *Core* covers the basic science ideas that all students should learn, which help develop their scientific literacy. By concentrating on the *Core*, it is hoped that more time is available for students to master the basic concepts and skills in science. The *Extension* constitutes additional learning of science knowledge in wider or deeper scope. Some topics in the *Extension* are more demanding and more suitable for students aiming to pursue further study in senior secondary science curricula. Teachers should note that the level of attainment for each topic within the *Extension* could vary from school to school and from class to class. There are flexibility for teachers to choose topics from the *Extension* to suit the needs and abilities of their students, hence providing challenges for more able students or students

with strong interest in science to further develop their potential.

2.4 Time Allocation

The total lesson time for the junior secondary level should be around 918 hours per school year. The suggested time allocation for Science Education KLA should be 10-15% of the total lesson time, that is, about 92-138 hours per school year.

Below is the estimated lesson time for each Unit of Science (S1-3) curriculum:

S1 Units	Estimated lesson time (hours)		
	Core	Extension	Total
Unit 1: Introducing Science	12	0	12
Unit 2: Water	16	5	21
Unit 3: Looking at Living Things	18	0	18
Unit 4: Cells, Human Reproduction and Heredity	17	6	23
Unit 5: Energy	12	7	19
Unit 6: Matter as Particles	17	5	22
Total:	92	23	115

S2 Units	Estimated lesson time (hours)		
	Core	Extension	Total
Unit 7: Living Things and Air	24	2	26
Unit 8: Making Use of Electricity	20	7	27
Unit 9: Common Acids and Alkalis	15	2	17
Unit 10: Sensing the Environment	14	7	21
Unit 11: Force and Motion	19	5	24
Total:	92	23	115

S3 Units	Estimated lesson time (hours)		
	Core	Extension	Total
Unit 12: A Healthy Body	33	6	39
Unit 13: From Atoms to Materials	31	7	38
Unit 14: Light, Colours and Beyond	28	10	38
Total:	92	23	115

The sequence of presentation of topics in the curriculum framework should not be regarded as a fixed order of learning and teaching. Teachers should have the autonomy to decide on the learning and teaching arrangement that suits their students and the school context. Furthermore, schools are encouraged to deploy the school lesson time flexibly for arranging additional learning and teaching activities, such as scientific investigations, project learning, design and make activities, so that students could have more opportunities to integrate and apply scientific knowledge and skills with other related disciplines.

Unit 1 Introducing Science

Overview

Science is the study of phenomena and events around us through systematic observation and experimentation. It involves observing, investigating, understanding, and explaining the world. It is a human endeavor and is dynamic in nature. It is derived from systematic observation, experimentation and analysis, and requires imagination and creativity. Scientific knowledge is subject to change upon the emergence of new evidence, it should not be regarded merely as a body of facts to memorise. Science can be used in many different ways to bring us technological advances and better ways of living. However, we should be aware that improper uses of science would bring harmful impacts on humans and the world.

This Unit will introduce the scope, applications, impacts and the practice of science. Students will get a glimpse of the nature of science, and will appreciate the fun of learning and doing science. They will be introduced to the major steps of scientific investigations and some basic practical skills. Besides, students will learn about the apparatus, equipment for conducting experiments and the safety equipment in the science laboratory, and understand the importance of laboratory safety.

Students will develop some science process skills such as observing and conducting practicals, through practising some basic techniques for handling apparatus and making measurement. Students will appreciate the unifying concepts “evidence and models” through the sub-topic “Practice of science”.

Students should learn	Students should be able to	Suggested learning and teaching activities
1.1 Learning about science		
• Scope of science	• Recognise that science is a study of the Nature • Be aware that scientific knowledge is subject to change as new evidence becomes available • Be aware of the limitations of scientific knowledge	• Read about examples in which scientific knowledge has changed after the emergence of new evidence
• Application and impact of science	• Appreciate that some scientific discoveries have enhanced our understanding of the world and some inventions have improved our quality of life • Be aware of the impact of scientific knowledge on natural resource management and the development of technology • Give examples of the benefits brought about by the applications of science and the possible harms from the misuse of science • Be aware of the need to integrate and apply knowledge and skills of various	• Read about the contributions of some famous scientists (e.g. Louis Pasteur, Marie Curie, Youyou Tu, Charles Kao, Daniel Tsui and Lap-Chee Tsui) • Design a poster to show some applications of science • Search information on the impact of scientific knowledge on natural resource management and the development of technology • Search information on some misuse of science which may bring harms to humans

Students should learn	Students should be able to	Suggested learning and teaching activities
	science disciplines, mathematics and technology in solving daily life problems	
1.2 Practice of science	• Recognise that scientific knowledge is derived from systematic observation, experimentation and analysis, through which imagination and creativity is required • Recognise the steps in scientific investigation • Recognise the different types of scientific investigations (e.g. fair testing, classifying and pattern seeking)	• Watch video clips on the work of some famous scientists and identify the various steps of scientific investigation
1.3 Safety in the laboratory	• Be aware that a laboratory is a suitable place for conducting scientific investigation • Understand and observe the laboratory safety rules • Recognise the fire triangle and the various ways of putting out a fire • Identify some safety equipment in school laboratories	• Label the layout of a laboratory • Perform practical work with burning candles to demonstrate the necessary conditions for fire • Demonstrate the use of fire-fighting

Students should learn	Students should be able to	Suggested learning and teaching activities
	• Identify some common hazard warning symbols • Describe how to handle some common laboratory accidents	equipment (e.g. fire extinguishers) • Identify potential hazards shown in pictures of laboratories and suggest necessary precautions • Discuss the proper ways to cope with some laboratory accidents (e.g. a fire or acid spills)
1.4 Laboratory equipment and basic practical skills • Laboratory apparatus • Basic practical skills - Measurement and recording	• Identify and properly handle some common laboratory apparatus • Use appropriate instruments for measuring temperature, mass, length, volume and time • Use appropriate units in recording measurement data • Read the scales on the measuring instruments accurately • Be aware that there are errors in measurement • Be aware of the use of electronic instruments for precise measurement	• Practise the use of some common laboratory apparatus properly • Measure temperature, mass, length, volume and time using appropriate instruments • Record and present measurement data appropriately • Watch a video clip about the scale of the length of different things in the Universe

Students should learn	Students should be able to	Suggested learning and teaching activities
- Transferring and mixing solution	• Use appropriate apparatus to transfer and mix solution properly	• Perform practical work to transfer and mix different solutions
- Heating	• Use appropriate apparatus for heating solid and liquid safely	• Perform practical work on heating solid and liquid

Unit 2 Water

Overview

Water exists on Earth in three physical states. In the water cycle, water changes from one physical state to another through processes like evaporation and condensation. Substances which are soluble can dissolve in water to form solutions, whereas substances which are insoluble cannot. Water exists in natural form contain impurities and microorganisms, and requires purification and proper treatment before it could be consumed as drinking water. Water is a precious natural resource, therefore we should conserve water.

In this Unit, students will learn about the above aspects of water, and perform practical works and investigations, e.g. observing the change in state of substance, investigating the factors affecting the rate of dissolving, designing and making a filtration column. These would help students develop some science process skills as well as the ability to integrate and apply knowledge and skills of different disciplines.

Learning about the processes in the water cycle will help students appreciate the unifying concepts “change and constancy”. While investigating how some factors affect the rate of evaporation and the rate of dissolving of substances in water, students will recognise the unifying concepts “evidence and models”.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
2.1 The water cycle		
• The change in the physical states of water	• Recognise that water exists on Earth in three physical states (ice, water and water vapour) • Describe some processes (e.g. melting, freezing and boiling) of the change in states of water • Be aware that energy is released or absorbed when the physical state of water changes • Recognise that temperature of water remains unchanged during the change in states	• Give daily examples of change in states of water in which energy is released or absorbed • Perform practical work to heat pieces of ice to steam, and plot a temperature-time graph to show the temperature change during the process
• The processes in the water cycle	• Understand the processes (evaporation and condensation) in the water cycle	• Perform practical work to simulate the formation of rain
• *Rate of evaporation*	• *Describe the factors affecting the rate of evaporation*	• *Design and perform fair tests to investigate the factors affecting the rate of evaporation*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
2.2 Dissolving		
• Soluble and insoluble substances in water	• Give some examples of soluble and insoluble substances in water	• Classify household substances as soluble or insoluble substances in water
• Solvent, solute and solution	• Recognise that a solution is formed when a solute is dissolved in a solvent	
• Rate of dissolving	• Describe the factors affecting the rate of dissolving in water	• Perform fair tests to investigate the factors affecting the rate of dissolving
• *Solubility*	• *Recognise that the solubility of a substance in water changes with temperatures*	• *Perform fair tests to find out the solubility of a substance at different temperatures*
2.3 Water purification		
• Impurities in water from natural sources	• State some impurities in natural water	• Read articles on impurities present in water and discuss the possible impacts on our health
	• State the needs for pure water	• Observe unpurified and purified water samples under a microscope

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Methods of water purification	• Understand the processes involved in different methods of water purification (sedimentation, filtration and distillation)	• Design and make a filtration column to purify muddy water • Perform practical work to purify sea water • View animations on how impurities of various sizes can be separated using different methods of water purification
	• *Recognise the sedimentation and filtration processes in a water treatment plant*	• *Visit water treatment works*
2.4 Further treatment of drinking water • Microorganisms present in water	• State some harmful effects on our health caused by the microorganisms present in water	
• Methods to kill microorganisms in water	• State some methods to kill microorganisms in water including the use of chlorine, ozone or ultraviolet light	• Observe the effect of chlorine bleach or water purification tablets on microorganisms in water under a microscope
• Fluoridation	• Be aware of the importance of the addition of fluoride to drinking water in preventing tooth decay	

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
2.5 Water conservation and pollution • Conservation of water	• Recognise the importance of water conservation and the ways to conserve water	• Perform a survey in class to find out students' daily water consumptions at home and suggest ways to reduce the wastage of water • Design and make a water-saving device to be fixed on water tap for daily use
• Water pollution	• State some causes of water pollution and methods to control water pollution • Be aware of our responsibility to minimise water pollution	• Construct a concept map to show the relationship between the causes and the harmful effects of water pollution on humans and the environment • Design a poster or make a video clip to arouse the public awareness on minimising water pollution
• *The importance of treating waste water*	• *Recognise the importance of treating waste water before discharging it into the sea*	

Unit 3 Looking at Living Things

Overview

All living things share some common vital functions for sustaining life. There is a wide variety of living things on Earth. Scientists study living things by putting them into different groups according to some key features. These key features are related to the adaptation of living things to their living environments. The diversity of living things is important for sustaining the natural environment and we have to try our best to conserve the biodiversity.

Through the study of living things in this Unit, students will develop some science process skills such as observing and classifying. Learning about the grouping of living things helps students appreciate the unifying concepts “systems and organisation”, while relating the key features of different groups of living things to their functions helps students recognise the unifying concepts “form and function”. Through the study of the importance of biodiversity and the effects of human activities, students’ attention is also drawn to the need of conservation of both living things and their environments. This helps illustrate the unifying concepts “change and constancy”.

Student should learn	Student should be able to	Suggested learning and teaching activities
3.1 Living things • Vital functions of living things	• Identify the vital functions of living things • Distinguish between living things and non-living things • Recognise the importance of reproduction to living things	• Watch video clips showing the vital functions of living things • Discuss whether a robot or a coral is a living thing
• Wide variety of living things	• Recognise that there are a wide variety of living things, including various types of mircoorganisms, plants and animals • Be aware of the wide range of body size of different living things	• Watch video clips or pictures to observe the diversity of forms of living things • Search information on the body sizes of different living things
3.2 Grouping of living things • Grouping of living things and identification key	• Recognise the need of grouping living things • Understand that scientists put living things into different groups according to their key features • Construct a simple key for identification of living things	• Put living things into different groups according to their key features • Identify given specimens or pictures of living things with a given simple key • Construct a simple identification key for a variety of things e.g. seeds, vegetables and fruits; living things in an aquarium

Student should learn	Student should be able to	Suggested learning and teaching activities
• Key features of different groups of living things	• Identify the key feature for distinguishing between invertebrates and vertebrates • Identify the key features for distinguishing between fish, amphibians, reptiles, birds and mammals • Identify the key features for distinguishing between non-vascular plants and vascular plants, seedless plants and seed plants, non-flowering plants and flowering plants • Relate the key features of different groups of living things to their functions and adaptations to different habitats	• Identify the key features of different groups of animals and plants from given specimens or pictures • Examine a fish, a frog, a tortoise, a bird and a rabbit to observe the key features of different groups of animals • Identify the vascular tissues by observing the uptake of dye solution in vegetables • Dissect some fruits and vegetables (e.g. a pear, a snow pea pod and a peanut) to observe the different kinds of seeds • Identify different groups of plants in the school campus or a park • Conduct a project on how the body parts of different animals are adapted for moving in different habitats
3.3 Biodiversity • Importance of biodiversity	• Recognise the importance of biodiversity to the sustainable development of the natural environment, and its benefits to humans (e.g. provision of resources such	• Search information on the importance of biodiversity to the sustainable development of the natural environment, and its benefits to humans

Student should learn	Student should be able to	Suggested learning and teaching activities
	as food, medicine, raw materials)	
• Effects of human activities on biodiversity	• Give examples of human activities leading to the reduction in biodiversity • Understand that some human activities (e.g. hunting, destruction of habitat) may threaten the survival of some species • Give examples of some endangered species	• Visit the Endangered Species Resources Centre • Design a poster or make a video clip to introduce an endangered species, and the causes for its depletion and possible ways of its conservation
• Conservation	• Be aware of the importance of environmental conservation and the protection of wild life	• Visit some country parks and marine parks; and join the education programmes or conservation programmes run by the Agriculture, Fisheries and Conservation Department, non-governmental organisations or local tertiary institutions • Conduct a project on the conservation of marine animals in Hong Kong (e.g. corals, sharks, Green Turtle and Chinese White Dolphin) • Search information on the ways of the conservation of species (e.g. artificial reef, artificial fertilisation and cloning)

Unit 4 Cells, Human Reproduction and Heredity

Overview

Cells are the basic unit of living things. Each cell has some common basic structures. Within every cell, there are genetic materials, DNA, which carry the instructions for defining the different traits of a living thing. Reproduction is the essential life process that leads to the formation of a new life. There are specialised cells and organs responsible for reproduction in living things. Through reproduction, new individuals with some traits looking very alike to their parents will be formed. The passing of traits from generation to generation is called heredity.

In this Unit, students will learn about cells, human reproduction and heredity. Through preparing slides of live specimens for observation of different cells, students practice the science process skills of using a microscope, observing and making biological drawing. The study of the basic structure of cells and the level of organisation highlights the unifying concepts “systems and organisation”. The concept “constancy” can be illustrated by the fixed number of 46 chromosomes found in every body cell of humans. The unifying concepts “change and constancy” can be further exemplified in the process involved in heredity.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
4.1 Cells - the basic units of living things		
• Basic structure of a cell	• Recognise cells as the basic unit of living things • Distinguish between plant cells and animal cells	
	• Use a microscope to examine prepared slides of plant and animal tissues • Identify the basic structures of cells, including cell wall (in plant cells), cell membrane, cytoplasm, nucleus, vacuole, chloroplasts (in plant cells) • State the functions of the basic structures of cells	• Examine photomicrographs or prepared slides of various types of plant and animal cells • Prepare slides of plant and animal tissues (e.g. onion and ox eye cells), examine these slides under a microscope and draw diagrams of the observed cells
• DNA as the genetic materials and the book of life	• Recognise that the chromosomes found in the nucleus of each cell contain the genetic materials, DNA • State that there are 46 chromosomes in a human body cell • Recognise that human male and female cells have different sex chromosomes • State that DNA encodes the instructions that determine our different traits	• View animation of the structural relationship between chromosomes and DNA found in the nucleus • Examine photomicrographs of the set of chromosomes found in a male and a female human cell

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Cells can divide, grow and differentiate	• Recognise that cells can divide, grow and differentiate into different types of cells	• View animations or video clips about cell division
• *Level of organisation of living things*	• *State that the level of organisation in most living things is cells, tissues, organs and systems* • *Recognise that organs in different systems are specialised for carrying out different functions in living things*	• *Examine a human torso to identify the organs in different systems* • *Observe pig's liver and lungs for the various kind of tissues in different organs* • *Observe the different organs (e.g. flowers, leaves, stems and roots) of a potted plant*
4.2 Human reproduction • Reproduction	• State that reproduction is an essential life process to ensure the continuity of humans	
• Sexual maturity and secondary sexual characteristics	• Recognise the signs of maturation of the reproductive system during puberty • Describe the secondary sexual characteristics appear during puberty	• Watch video clips about puberty

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Reproductive systems	• Identify the different structures of the male and female reproductive systems and recognise the functions of these structures	• Examine a human torso to identify the different structures of human male and female reproductive systems
• Sex cells: sperm and ovum	• Identify sperms and ova as the male and female sex cells respectively • State that a sperm and an ovum each carry one set of chromosomes (23 chromosomes) in humans	• Examine prepared slides of sperms and ova • Examine photomicrographs of the set of chromosomes found in human sex cells
• Fertilisation and implantation	• Recognise that fertilisation occurs when a sperm fuses with an ovum • State that the zygote formed from fertilisation carries two sets of chromosomes (46 chromosomes) • State that development of the embryo begins from the implantation in the uterus • Recognise the development of the embryo inside the mother's body and the birth of a baby	• Watch a video clip on the development of embryo from the fertilisation of sperm and ovum • Watch a video clip on foetal development and the birth giving process

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Pregnancy and parenting	• State the signs and the length of pregnancy • Be aware that parenting is essential for the growth of infants	• Search information on some health advices during pregnancy (e.g. no smoking) • Search information on the length of pregnancy and the needs of parenting in other mammals
• Family planning and birth control	• Be aware of the need of family planning • Understand that prevention of the fusion of ovum and sperm is one of the basic principles of birth control • *Recognise the various methods of birth control* • *Recognise that some birth control methods can help prevent the transmission of sexually transmitted diseases*	• *Watch video clips on various methods of birth control*
4.3 Heredity and variation • Heredity	• State that heredity is the passing of traits from one generation to the next as a result of the transmission of genetic information	• Construct a "genetic traits tree" to analyse the passing of a trait in a family

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Variation	• Recognise that variations are determined by heredity and the environment • Give examples of continuous variation and discontinuous variation in humans • Construct and interpret bar charts and histograms showing the distribution of variations in a group	• Search information on some continuous and discontinuous variations in humans • Conduct a survey about a discontinuous variation in the class and present the data in a table and in a bar chart • Conduct a survey about a continuous variation in the class and present the data in a table and in a histogram
• Identical and non-identical twins	• Distinguish between the occurrence of identical and non-identical twins • Recognise that variations between identical twins are due to differences in their experiences and the environment	• View animations about the formation of identical twins and non-identical twins • Discuss about the factors affecting the differences between a pair of identical twins
• *DNA and heredity*	• *State that there are only four different kinds of bases, A, T, C and G on the DNA* • *State that the double helix structure of DNA is based on the base pairing of A with T and C with G* • *Recognise that the instructions encoded in DNA depend on the sequence of bases on the DNA*	• *Construct an origami model of DNA, or a candy DNA model to demonstrate the double helix structure as well as the base pairing* • *Design a coding system for the 26 alphabets using DNA bases and write the message in a string of DNA bases to a friend for decoding*

Unit 5 Energy

Overview

Energy exists in different forms. Common energy forms include chemical energy, electrical energy, kinetic energy, light energy and potential energy, etc. By the law of conservation of energy, energy can neither be created nor destroyed; it can only be changed from one form to another. With different energy converters, various forms of energy can be converted to other forms of useful energy at different efficiencies. Energy can also be transferred due to temperature difference by conduction, convection or radiation. A study of the factors affecting these energy transfer processes can enhance our understanding of their daily applications. Today, the world's primary energy sources are fossil fuels. However, there are concerns about their limited supply and the related pollution problems. There is a need to reduce our energy consumption and develop alternative sources of energy, like nuclear energy, solar energy and wind power, etc.

In this Unit, students will learn the different forms of energy, energy conversion, energy transfer processes and the various kinds of energy sources. Through performing fair tests, and design and make activities, students can develop some science process skills such as designing investigations. By constructing Sankey diagrams, students learn to communicate scientific ideas through graphical representations. Students will realise the unifying concept "change and constancy" through the learning of energy conversion and conservation of energy.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
5.1 Energy changes		
• Forms of energy	• Recognise that energy exists in different forms (chemical energy, electrical energy, kinetic energy, light energy, potential energy, sound energy and thermal energy) • State that joule (J) and kilocalorie (kcal) are units of energy	• Identify different forms of energy from daily life examples
• Energy conversion	• Recognise that different forms of energy can be converted from one form to another • Recognise some common energy conversion processes (e.g. burning, photosynthesis and generation of electricity)	• Perform practical work to demonstrate examples of energy conversion • Generate electricity using a steam engine model, a hydro-electric power model or a solar cell • Design and make a chemical cell using fruits • Perform a fair test to compare the energy stored in different stretched elastic bands
• Conservation of energy	• Recognise that energy is conserved • Use graphical representation to illustrate that energy is conserved in an energy conversion process	• Use Sankey diagram to show that energy is conserved in different energy conversion process

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• *Energy conversion efficiency*	• *Recognise efficiency of energy conversion as the ratio of useful energy output to total energy input,* $(Efficiency = \frac{Useful\ energy\ output}{Total\ energy\ input} x\ 100\%)$	• *Calculate and compare the efficiency of different energy converters (e.g. filament light bulbs and energy-efficient light bulbs)*
5.2 Heat transfer	• Identify different heat transfer processes: conduction, convection and radiation • Recognise the factors affecting conduction, convection and radiation • Give examples of the applications of conduction, convection and radiation	• Perform practical work to demonstrate the phenomena of conduction, convection and radiation • Conduct investigations on factors affecting conduction, convection and radiation • Design and make a container that can keep the temperature constant
5.3 Energy sources • *Fossil fuels*	• *Recognise that fossil fuels are non-renewable energy sources* • *Be aware of the concerns about using fossil fuels (e.g. limited supply and pollution problem)*	• *Compare the present lifestyle with that of 50 years ago and list instances to show the increasing need for energy* • *Inspect data on the amount of available fossil fuels and predict the world trend in energy usage*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• *Alternative energy sources*	• *Recognise the need for developing alternative energy sources (e.g. solar energy, biomass energy, nuclear power, wind power and hydroelectric power)* • *Be aware of the concerns arising from the use of different energy sources (e.g. nuclear power and wind power)*	• *Visit the Education Path at the Electrical and Mechanical Services Department Headquarters* • *Visit a wind power station* • *Search information on problems arising from the use of different energy sources* • *Debate on whether we should use nuclear power*
• *Saving energy*	• *Recognise the need for saving energy in daily life*	• *Propose ways to reduce energy consumption in daily life*

Unit 6 Matter as Particles

Overview

Matter is a physical substance that occupies space and has mass. According to the particle theory, all matter is made up of particles. The particle model is proposed to describe the arrangement of particles in the three states of matter. The particle theory can be used to explain the properties of matter in different states, and some physical phenomena like thermal expansion and contraction, the existence of gas pressure, dissolving and whether an object floats or sinks.

In this Unit, students will be introduced to some basic ideas of particle theory and learn to use it to explain some physical phenomena. Through performing different practical works, e.g. observing the movement of particles in a smoke cell under a microscope and measuring the change in volume and mass when salt is dissolved in water, students will practise different science process skills like observing and inferring. Learning about the particle theory and using the theory to explain physical phenomena helps students realise the unifying concept “evidence and models”.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
6.1 Particle theory		
• Basic ideas of the particle theory	• State that all matter is made up of particles	
	• Recognise that particles are in random motion	• Watch video clips showing the motion of fat globules in diluted milk viewed under a microscope • Observe the movement of particles in a smoke cell under a microscope
	• Recognise that there are empty spaces between particles	• Illustrate that there are empty spaces between particles using a model (e.g. beans contained in a bottle) • Measure the volume change when water is mixed with alcohol
• Different types of particles	• Give examples of atoms and simple molecules	
	• Recognise that different particles have different sizes and masses	• Show that different particles (atoms and molecules) have different sizes using computer simulation • Search information on the particle size and mass of some atoms

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
6.2 Particle model for the three states of matter • Arrangement of particles in the three states of matter	• Recognise the arrangement of particles in the three states of matter	• Demonstrate the movement and arrangement of particles in the three states of matter using a kinetic theory model • Draw diagrams to represent the arrangement of particles in the three states of matter
• Properties of matter in the three states	• Compare the properties of matter in different states	
6.3 Dissolving	• Describe the process of dissolving using the particle theory	• Observe the changes in the solution when a crystal of potassium permanganate is dissolved in water
	• Recognise that mass is conserved when a solid is dissolved in water • Explain the change in volume when a solid is dissolved in water using the particle theory	• Measure the change in volume and mass when a small amount of table salt is dissolved in water

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
6.4 Thermal expansion and contraction	• State the effect of temperature change on the movement of particles • Explain thermal expansion and contraction using the particle theory • Give examples of daily applications of thermal expansion and contraction	• Study the effect of temperature change on the movement of particles using computer simulation • Perform practical work to show thermal expansion and contraction • Measure the change in volume of a coloured liquid under heating or cooling • Search information on some daily applications of thermal expansion and contraction
6.5 Gas pressure	• *Recognise that the existence of gas pressure is due to gas particles hitting against the walls of a container* • *Explain the change in gas pressure at different temperatures using the particle theory* • *Appreciate the existence of atmospheric pressure*	• *Study the change in gas pressure by changing the temperature or the volume of a container using computer simulation* • *Perform practical work to experience the existence of atmospheric pressure using Magdeburg hemispheres*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
6.6 Density	• Recognise that density of a substance is the relationship between its mass and its volume • Calculate the density of a substance using the formula ($\text{Density} = \frac{\text{Mass}}{\text{Volume}}$) • Determine whether an object will sink or float by comparing its density with that of its surrounding medium • *Explain the effect of temperature change on the density of a substance using the particle theory*	• Compare the mass of different objects of the same volume (e.g. iron block and aluminium block) • Perform practical work to find out the densities of iron, copper and lead of given sample blocks • Find out the densities of some objects in irregular shapes • Perform practical work to test whether plasticine objects in various shapes float or sink in water • Make a density column using different liquids (e.g. oil, water, sugar syrup) • *Perform practical work to compare the density of cold and hot water* • *Perform practical work to show how a hot-air balloon works* • *Study the effect of temperature change on the density of a substance using computer simulation*

Unit 7 Living Things and Air

Overview

Air can be found everywhere on Earth and it is essential for living things to survive. Among the components of air, oxygen and carbon dioxide are both involved in three of the essential life processes of living things, including photosynthesis, respiration and gas exchange. Through these life processes, the proportions of oxygen and carbon dioxide in the atmosphere is balanced. However, some human activities may disrupt such balance in Nature and living things may be adversely affected. Hence, it is essential to maintain the air quality in the environment.

In this Unit, students will learn about the different components of air, the above mentioned essential life processes as well as the importance of the natural balance of oxygen and carbon dioxide in the atmosphere. Through performing different practical works and investigations, e.g. testing for oxygen and carbon dioxide, testing for the presence of starch in green leaves, burning of food to release energy for heating water and investigating the factors necessary for photosynthesis, students will practise different science process skills, like handling apparatus, observing, designing investigation and inferring.

Students will realise the unifying concept “change and constancy” through the learning of photosynthesis, respiration and the balance of carbon dioxide and oxygen in Nature. Simple molecules like carbon dioxide and water are converted into food in photosynthesis while these food can be converted back into carbon dioxide and water in respiration. On the other hand, light energy is changed to chemical energy in food by photosynthesis in green plants while the chemical energy stored in food is changed to other useful forms of energy for living things in respiration. Through learning the balance of carbon dioxide and oxygen in Nature, students will realise the “constancy” of the composition of different gases in air.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
7.1 Air • Major components of air	• Recognise that air is a mixture of gases • State the percentage of main gases in air	
• Properties of oxygen, carbon dioxide and nitrogen	• State the main properties of oxygen, carbon dioxide and nitrogen • Describe the tests for oxygen, carbon dioxide and water • Give examples of the daily applications of oxygen, carbon dioxide and nitrogen	• Read the story about the discovery of oxygen • Perform practical works to test for oxygen, carbon dioxide and water • Search information on the daily applications of oxygen, carbon dioxide and nitrogen
7.2 Photosynthesis	• Recognise that photosynthesis is the process that plants make their own food • State that light energy is converted to chemical energy in food during photosynthesis in plants • Write the word equation of photosynthesis • *Write the chemical equation of photosynthesis*	• Perform practical work to test for starch in green leaves • Perform practical work to show that oxygen is produced during photosynthesis

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• Understand that light, chlorophyll, carbon dioxide and water are the necessary factors for photosynthesis • Recognise that the carbohydrates (glucose) produced in plants can be used immediately or stored as starch for later use • Recognise the significance of photosynthesis of plants to other living things • *Recognise that plants are the producers and animals are the consumers in most food chains*	• Plan and conduct investigations to find out the necessary factors for photosynthesis • *Construct food chains to show the feeding relationship between different living things*
7.3 Respiration	• State that food (e.g. carbohydrates) is the source of energy for all living things • Recognise that the chemical energy stored in food can be changed by our body into other useful forms of energy to support body activities • Describe respiration as a process in which food is broken down in cells to release	• Perform practical work to heat a small amount of water by burning food

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	energy in usable form for cells • Write the word equation of respiration • *Write the chemical equation of respiration*	
7.4 Gas exchange in plants and animals • Gas exchange in plants	• Understand that the net gas exchange in plants depends on the relative rate of photosynthesis and respiration taken place • *Recognise that gas exchange in plants is carried out through the stomata*	• Perform practical work to find out the change in carbon dioxide content in a boiling tube with a leave under light and dark conditions respectively • *Examine a prepared slide of leaf epidermis to observe the stomata under a microscope*
• Gas exchange in animals	• Compare the temperature and the composition of gases (oxygen, carbon dioxide and water vapour) between inhaled and exhaled air	• Perform practical work to compare oxygen, carbon dioxide and water vapour content of inhaled and exhaled air • Perform practical work to find out the change in carbon dioxide content in a boiling tube with an animal (e.g. mealworm, grasshopper)

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• Identify the main parts of the breathing system in humans • State that gas exchange in humans takes place at the air sacs • State the significance of gas exchange to body cells • *Describe the exchange of gases between air sacs and the surrounding blood capillaries* • *Describe how smoking affects gas exchange in humans* • Recognise that smoking is harmful to health (e.g. causing lung cancer and heart diseases)	• Examine a human torso to identify the main parts of the breathing system • Dissect pig lungs to observe the structure of the lungs • *View animation about the gas exchange process at air sacs* • *Perform a demonstration to show how smoking affects a pair of pig's lungs* • Search information on the long term effects of smoking on health • Design a poster or make a video clip to persuade smokers to quit smoking • Search information about electronic cigarette and its health effect, and discuss whether its sale should be regulated by the government

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
7.5 Balance of carbon dioxide and oxygen in Nature	• Understand that there is a natural balance of carbon dioxide and oxygen in the atmosphere • Recognise some human activities are disrupting the balance of carbon dioxide in Nature • State carbon dioxide as one of the greenhouse gases • Describe the effects of the increasing amount of carbon dioxide in the atmosphere on the environment	• Watch a video clip about the relationship between the trend of carbon dioxide content in the atmosphere and global warming, and the climate change that result • Design a poster or make a video clip to promote low carbon living • Visit the Zero Carbon Building
7.6 Air quality	• Be aware of the effect of air quality on our health • Give examples of common air pollutants • Recognise the health advice related to the Air Quality Health Index (AQHI)	• Search information on some diseases related to poor air quality • Conduct a project to investigate the AQHI of the district where your school is located for a particular period of time and give appropriate health advice to students in your school

Unit 8 Making Use of Electricity

Overview

Electricity is the most common source of energy used at home. In making use of electricity, various kinds of electrical components are connected in different types of circuits to achieve different purposes. The concepts of current, voltage and resistance are essential for understanding the practical use of electricity in households. As there may be potential hazards in using electricity, particular attention should be paid to the safety aspects of domestic electricity.

In this Unit, students will learn about the different aspects of electricity through connecting circuits, drawing and interpreting circuit diagrams, and conducting a series of practical works and investigations. In the process, the science process skills of choosing and handling apparatus, measuring and recording data, inferring, communicating and identifying variables will be developed. Furthermore, designing circuits and making electrical devices, can also help foster students' creativity and innovative mind. The study of the patterns of changes in currents and voltages in series and parallel circuits helps students recognise the unifying concepts "change and constancy".

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
8.1 Simple circuit		
• Closed circuit	• Understand that a cell and a closed circuit are required for lighting up a bulb • Recognise that cell is the energy source in a circuit	• Use a cell and some wires to make a bulb light up in a circuit
• Electrical conductors and insulators	• Identify electrical conductors and insulators	• Design a circuit to test for electrical conductors and insulators
• Switch	• Understand switch as a device to open or close a circuit	• Observe different kinds of switches
• Circuit symbols and circuit diagrams	• Recognise the circuit symbols (cell, battery, light bulb, switch, ammeter, voltmeter, resistor and rheostat) • Draw and interpret simple circuit diagrams	• Set up electrical circuits based on given circuit diagrams • Draw circuit diagrams of circuits using circuit symbols
8.2 Current, voltage and resistance		
• Current	• Use an ammeter to measure current • State that ampere (A) is a unit of current • Recognise electric current as a flow of charges	• Measure the current in a circuit with an ammeter

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• Recognise the heating effect and magnetic effect of current	• Perform practical work to demonstrate the heating effect and magnetic effect of an electric current
• Voltage	• Use a voltmeter to measure voltage • State that volt (V) is a unit of voltage • Recognise that battery with greater voltage will cause greater current to flow in a circuit	• Measure the voltage of some common cells and batteries with a voltmeter • Measure the voltage across different number of cells • Perform practical work to investigate the relationship between the current and voltage in a simple circuit
• Resistance	• Recognise the differences in resistance between electrical conductors and insulators • State that ohm (Ω) is a unit of resistance • Understand that a greater resistance will result in a smaller current to flow in a circuit • Recognise the use of resistors in a circuit • *Understand the effect of length, thickness and the material of the wire on the resistance of a circuit*	• *Perform practical work to investigate the current in a simple circuit with different resistances and analyse the results by plotting graph* • *Design and conduct investigation to find out factors affecting the resistance of a wire*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• *Understand how a rheostat works* • *Give examples of common applications of rheostats (e.g. dimmer switch, volume control)*	• *Analyse the relationship between the length of a metal wire and the current flowing through it by plotting a graph* • *Connect a circuit to control the brightness of a light bulb with a rheostat*
8.3 Electrical circuits • Series circuit	• Identify series circuits • Recognise that the current is the same at all points in a series circuit	• Set up series circuits • Measure the current and voltage in series circuits
• Parallel circuit	• Identify parallel circuits • Recognise that the current in the main loop is the sum of that in the branches and that a larger current flows in the branch with a lower resistance • Recognise that the voltage across the branches of a parallel circuit is the same	• Set up parallel circuits • Measure the current and voltage in parallel circuits • Design and construct simple circuits for specified purposes

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
8.4 Household electricity		
• Household electrical appliances	• Recognise that electrical appliances are energy converters • Be aware that many household electrical appliances (e.g. hair dryer and fan) are making use of the heating effect and magnetic effect of current	• Design and make devices making use of the effects of electric current
• Mains voltage and domestic circuits	• State the mains voltage in Hong Kong	• Search information about the mains voltage in other countries
	• Explain why parallel circuits are preferred to series circuits in domestic circuits	• Connect a circuit to simulate how different electrical appliances can work independently
	• Understand the wiring of a 3-pin plug and identify the colour coding of wires	• Wire a 3-pin plug
• Potential hazards in using electricity	• Understand the danger of overloading in the use of universal adaptors • Understand the condition leading to short circuits and its danger	• Search newspaper articles on accidents related to using electricity • Perform demonstrate to show the condition leading to short circuits

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Safety precautions in using electricity	• Recognise the importance of the use of earth wire • Recognise fuses and circuit breakers as devices in protecting circuits • State safety precautions in using electricity	• Perform practical work to demonstrate the use of fuses to protect electrical appliances (e.g. light bulbs) • Design a poster or make a video clip on safety in using electricity
• *Power and efficiency of an electrical appliance*	• *Understand power as the electrical energy transferred to an appliance per second, ($Power = \frac{Energy}{Time}$)* • *State that watt (W) is a unit of power* • *Recognise the efficiency of an electrical appliance as the ratio of useful power output to power input, ($Efficiency = \frac{Useful\ power\ output}{Power\ input}$ x 100%)*	• *List the power rating of some common electrical appliances* • *Calculate the energy consumed by some common electrical appliances using the equation, $Power = \frac{Energy}{Time}$* • *Perform practical work to measure the power of different electrical appliances* • *Study and compare the energy labels of electrical appliances of different models*
• *Cost of electricity*	• *Recognise that kilowatt-hour meter and joulemeter are used to measure the electrical energy consumed*	

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• *State that kilowatt-hour (kWh) is a unit of electrical energy for calculating the cost of electricity* • *Understand the inter-conversion between joule and kilowatt-hour* • *Calculate the cost of electricity from the amount of electrical energy consumed*	• *Perform practical work to measure the electrical energy consumed by an electrical appliance and calculate the cost of electricity* • *Discuss ways to reduce electrical energy consumption*

Unit 9 Common Acids and Alkalis

Overview

Acids and alkalis are commonly found in our homes and school laboratories. They can be identified using indicators. We may use the pH scale to describe the relative acidity and alkalinity of substances. When acids are mixed with alkalis, neutralisation occurs and gives salts and water. Acids and alkalis are corrosive. We should be aware of the potential hazards associated when using them. Besides, the acidic air pollutants resulted from human activities may lead to the formation of acid rain, and adversely affect the environment and living things.

Through performing different practical works, e.g. classifying substances into acids and alkalis, measuring the pH of substances and obtaining salts from neutralisation, students will practise some science process skills, like observing, classifying, presenting data in graphical presentation for effective communication. Through the study of neutralisation, students learn that salt and water is formed when acids are mixed with alkalis, and that the mass of reactants and products is conserved in the reaction. This will help students realise the unifying concept “change and constancy”.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
9.1 Common acids and alkalis	• Give examples of common acids and alkalis found at home and in laboratory • State the properties of acids and alkalis	• Search information on the uses of some common acidic and alkaline substances
9.2 Measuring pH for acids and alkalis		
• Acid-alkali indicator	• Be aware that some natural pigments give different colours in acidic and alkaline solutions • Recognise that acid-alkali indicators are used to classify solutions as being acidic or alkaline	• Perform practical work to find out the colour of some plant extracts in acidic and alkaline solutions • Use acid-alkali indicators or natural indicators to classify solutions as being acidic or alkaline
• pH scale	• Recognise that the pH scale is used to describe the relative acidity and alkalinity of substances • Describe how pH paper, universal indicator and electronic instruments can be used to measure the pH of solutions • Compare the advantages and disadvantages of using universal indicator and electronic instruments in measuring the pH of solutions	• Use pH paper, universal indicator, pH meter and data logger system to find the pH values of common household products • Discuss the advantages and disadvantages of using universal indicator, pH meter and data logger system in measuring the pH of solutions

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
9.3 Neutralisation	• Understand that salt and water will be formed when an acid is mixed with alkali	• Perform practical work to obtain salts by mixing dilute acids and dilute alkaline solution
	• Recognise that the mass of reactants and products is conserved in neutralisation reaction	• Perform practical work to show that mass is conserved in neutralisation reaction between sulphuric acid and barium hydroxide solution
	• *State the chemical names of salts formed by the neutralisation of common acids and alkalis*	• *Identify the pattern in word equations of neutralisation reactions through a card game activity*
	• *Write word equations to describe the neutralisation reactions between common acids and alkalis*	
	• Present the change in pH in a neutralisation reaction with a pH curve	• Perform practical work to study the change in pH during a neutralisation reaction
	• Give examples of applications of neutralisation	• Search information on some applications of neutralisation in our daily life
9.4 Corrosive nature of acids	• Recognise that dilute acids can attack metals and some building materials (e.g. limestone, marble) to produce hydrogen	• Perform practical work to test the gases produced when a dilute acid is reacted with metals (e.g. magnesium, iron) and

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	and carbon dioxide respectively • *Write word equations to describe the reactions between dilute acids and metals, and reactions between dilute acids and carbonates* • Understand the causes of acid rain and its effects on the environment and living things	building materials (e.g. limestone, marble) respectively • Perform practical work to study the effect of acid rain on the growth of seedlings
9.5 Potential hazards related to the use of acids and alkalis	• Recognise that acids and alkalis can be irritating or corrosive and may cause injuries to our bodies • Recognise that mixing common cleansing products may be hazardous • Describe the emergency treatment for accidents involving acids or alkalis	• Perform demonstration to show the corrosive effect of alkalis on a chicken foot or on hair by putting it into a concentrated sodium hydroxide solution • Study the safety instructions of common chemical cleansing products • Study cases of accidents involving acids or alkalis and discuss the proper ways of emergency treatment

Unit 10 Sensing the Environment

Overview

Detecting changes in the environment is a vital function of all living things for survival. This helps living things escape from danger as well as look for food and mates. Living things perceives environmental stimuli through various sense organs. The information collected by the sense organs will be sent to the brain. As a central coordinator, the brain integrates and interprets all sensory signals to give a comprehensive perception of the environment so that appropriate responses can be made.

In this Unit, students will learn about how sight and hearing are produced and the structures of corresponding sense organs. They will then learn about other senses and the role of the brain in detecting the environment. Students will also study the effects of alcohols, solvents and drugs on our judgements and responses, enabling them to make informed decision and refuse to take these substances.

Through performing practical works, e.g. dissecting an ox eye and finding out the reaction time of different persons, students will practise some science process skills like observing and conducting practicals. The study of topics on eyes and ears will also help them realise the unifying concepts “form and function”.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
10.1 Senses and sense organs	• Recognise the need for living things to respond to the environment • Recognise that there are specialised sensory cells in different sense organs for detecting different stimuli • Relate our sense organs to the types of stimuli and the senses produced	• Search information on how different animals sense the environment
10.2 Sight • The eye	• Identify the main parts of an eye • State the functions of the main parts of an eye • Be aware that there are light-sensitive cells on the retina • Describe briefly how an image is formed on the retina • *Compare the shapes of the lens when seeing near objects and distant objects* • *State that rod cells and cone cells are the light sensitive cells* • Recognise the limitations of our eyes and the various ways for extending our vision	• Examine a human eye model to identify the main parts of the eye • Dissect an ox eye to identify the main parts of the eye • *Perform practical work to show the shapes of the lens when seeing near objects and distant objects* • Perform practical work to show the presence of blind spot

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• *Defects of the eye*	• Describe the ways of protecting our eyes • *Understand the causes and correction method of long sight and short sight* • *Give examples of defects or diseases of the eye (e.g. colour blindness, astigmatism, cataract)*	• Search information on the development of telescope, hand lens and microscope • Design a poster or make a video clip to show the various ways of protecting our eyes when using electronic screen products • *Simulate long sight and short sight, and the corresponding correction methods using an eye model* • *Search information about the causes of eye defects (e.g. colour blindness) other than long sight and short sight and some eye diseases, like cataract* • *Test colour-blindness using charts*
10.3 Hearing • Sound	• Understand that sound is produced by vibrations and its transmission requires a medium • Recognise that hertz (Hz) is a unit of frequency of sound and decibel (dB) is a unit of loudness of sound	• Observe how sound is produced in different musical instruments • Observe the wave pattern when a vibrating tuning fork is placed in water • Perform practical work to study the transmission of sound in solids, liquids, air and vacuum

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• The ear	• Identify the main parts of an ear • State the functions of the main parts of an ear • Be aware that there are specialised sensory cells in the cochlea for detecting vibrations • Be aware that the range of frequencies audible to humans is different from other animals • Recognise the harmful effects of noise pollution on our health • Describe the ways of protecting our sense of hearing	• Examine a human ear model to identify the main parts of the ear • Find out the range of frequencies audible to the class using a signal generator • Measure the environmental sound level in different locations using a decibel meter • Design a poster or make a video clip to show the various ways of protecting our sense of hearing, e.g. the precautions for using earphones
10.4 Smell and taste	• *Recognise that the specialised sensory cells in our nose and in the taste buds on our tongue detect chemicals to produce the senses of smell and taste respectively* • *Be aware that our sense of smell affects our sense of taste*	• *Search information about the types of primary tastes* • *Perform practical work to show that smell affects our sense of taste*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
10.5 Other senses	• *Recognise that skin is a sense organ with specialised sensory cells for detecting touch, pressure, pain and temperature* • *Be aware that our skin is not reliable in detecting hot and cold* • *Be aware that the sense of balance relies on the sensory signals from the eyes, muscles and joints, and the inner ear*	• *Perform practical work to show that different parts of our limbs are not equally sensitive to touch* • *Perform practical work to show the unreliability of our skin in detecting hot and cold* • *Perform a test to assess students' ability to maintain good balance* • *Search information on ways to improve one's balance*
10.6 The brain and our senses	• Recognise that the brain integrates and interprets information from different sense organs and acts as coordinator for making appropriate responses • Identify the cerebrum of the brain and state its function • Be aware that our senses are not always reliable and there may be illusions • Recognise the effects of taking or inhaling drugs on our judgements, responses and our health	• Observe some human behaviours in daily scenarios to identify the stimuli and the related responses made by humans • Perform practical work to find out one's reaction time • Examine a model of the human brain • Experience illusions through different activities • Search information on the effects of drinking alcohol, inhaling organic solvents and taking drugs on our judgements, responses and our health

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
		• Design a poster or make a video clip to persuade young people to stay away from drugs

Unit 11 Force and Motion

Overview

Force affects our daily life in many ways. Force can change the motion of an object but it is not required in maintaining a motion. An object will stay at rest or in uniform motion when the forces acting on it are balanced. Gravity and friction are examples of forces and their effects on motion are commonly found in everyday experience. Forces are always working in action and reaction pairs. When an object is being pushed, the object pushes back with a force of equal magnitude and in an opposite direction. The scenario of space flight provides an interesting context for us to appreciate how the understanding of forces and motion is put into application.

This Unit introduces the basic concepts about force and motion. Through drawing distance-time graph and performing practical work to observe the phenomena of action and reaction, students develop some science process skills such as observing, inferring and communicating using graphical representation. The design and make activities provide opportunities to foster students' creativity and innovation, and develop their abilities to integrate and apply knowledge and skills of science and other disciplines. Through learning about the effects of forces on the motion of an object, students will recognise the unifying concepts "change and constancy".

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
11.1 Motion • Speed, distance and time	• Recognise the relationship between average speed, distance and time • State that metre per second (ms^{-1}) is a unit of speed	• Calculate the average speed of a moving object by the equation: $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$
• Distance-time graph	• Represent a motion using a distance-time graph • Interpret a distance-time graph	• Draw a distance-time graph and describe the motion of an object
• Uniform motion and non-uniform motion	• Identify uniform motion and non-uniform motion	• Demonstrate uniform motion by using an air track/ air cushion and a sensor (e.g. a motion sensor) • Describe the motion of a moving object (e.g. a train) in terms of uniform and non-uniform motion
11.2 Force • Effect of force	• Describe the effect of force on changing the speed and direction of motion of an object	• Demonstrate the effect of forces on motion by practical work, video clips or animations

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Measuring forces	• State that newton (N) is a unit of force • Use a spring balance to measure forces	• Investigate the relationship between the strength of a force acting on a spring and the extension of the spring
• Contact forces and non-contact forces	• State that forces can act at a distance • Give examples of contact forces and non-contact forces	• Demonstrate non-contact forces using magnets
• Balanced forces and unbalanced forces	• Recognise that an object will stay at rest or in uniform motion when the forces acting on it are balanced • Use free-body diagram to show the direction of forces acting on an object	• Demonstrate that a stationary object, or a moving object with constant motion, has balanced forces acting on it (e.g. to pull an object with two spring balances in opposite directions) • Give examples of common situations where forces are unbalanced

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
11.3 Gravity		
• Gravity and its effect	• State that gravity is the force that causes two objects to attract each other • Be aware that gravity exerted by Earth on an object pulls it towards the centre of the Earth • Recognise that the force of gravity experienced by an object increases with its mass	• Study the motion of a free-falling object using a sensor (e.g. a motion sensor)
• Weight and mass	• Recognise weight as a measure of the force of gravity on an object • Distinguish between weight and mass • *Recognise the relationship between weight and mass*	• Find the weights of some objects with a spring balance • Search information to find out the weight of a 1 kg object on the Moon and on different planets • *Perform practical work to find out the relationship between weight and mass with a spring balance*
11.4 Friction and air resistance	• Recognise that friction and air resistance are forces that oppose the motion between contact surfaces • Describe ways for reducing friction and	• Demonstrate the effects of friction and air resistance on the motion of an object • Perform practical work to show that friction can be reduced by lubricants, air

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	air resistance • Give examples of situations where friction or air resistance are useful	cushions and ball bearings, and that air resistance can be reduced by stream-lining the shape of an object • Name daily life examples in which friction is reduced and examples in which friction is applied • Design and conduct an investigation to find out factors affecting the speed of a falling parachute • Use 3D printer to make some objects with different shapes, and compare the effect of air resistance on the movement of objects of different shapes • Design and make a toy car which can roll fast down an inclined plane
11.5 Action and reaction	• Recognise that forces always work in action and reaction pairs • Understand that action and reaction pairs are equal in magnitude, opposite in direction and act on different objects • Identify some action and reaction pairs of	• Perform demonstrations on action and reaction pairs • Identify and indicate action and reaction pairs in diagram by arrows • Design and make a water rocket or a

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	forces in daily examples	balloon car
11.6 Space flight	• *Be aware that rockets have to escape from gravity when launched to outer space* • *Be aware that rockets are pushed upwards because exhaust gases are pushed downwards* • *Recognise the stream-lined shape of rocket minimise air resistance when launching* • *Recognise the frictionless motion and micro-gravity motion of spacecrafts in space* • *Be aware of the design of spacecrafts for returning to Earth safely (e.g. heat insulation, reducing speed)*	• *Watch video clips on the use of rocket engines during space journey for change of direction and speed* • *Watch video clips about the experiments performed in space* • *Design an experiment to be carried out under the micro-gravity condition in space* • *Watch video clips on spacecrafts returning to Earth*

Unit 12 A Healthy Body

Overview

Healthy lifestyles are essential for keeping ourselves healthy. A balanced diet is crucial to our health. Appropriate amount of different kinds of food helps provide energy, support growth and maintain proper functioning of our bodies. The food we ingested has to be digested and absorbed before it can be used by our body cells and finally contributing towards our health. If our diet is not balanced, health problems may result. On the other hand, we may fall sick due to diseases caused by viruses and microorganisms, and we have to protect our bodies from them.

In this Unit, the various aspects of nutrition and health are introduced. These include the different types of food substances, how food can be digested and absorbed by our bodies and the idea of a balanced diet. Ways of preventing infectious diseases and the importance of healthy lifestyles for reducing the risks of developing certain non-infectious diseases are also highlighted.

Through performing practical works, for instance, food tests, and chemical digestion by enzymes, students practise science process skills, like handling apparatus, observing and inferring. Students will also carry out investigations to find out the food substances in different food samples, compare the amount of vitamin C in fruits and vegetables, and to compare the energy values of snacks, etc. Students will practise the science process skills such as designing investigations and inferring. Upon completion of the Unit, students should understand that maintaining the internal balance of our body is essential for staying healthy. Any changes that disturb the balance may result in health problems or diseases, and students may then realise the unifying concept “change and constancy”. In addition, students will also realise the unifying concept “systems and organisation” from the study of the digestive system.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
12.1 Keeping our bodies healthy	• Recognise that healthy lifestyles (e.g. balanced diet, appropriate amount of physical activities, enough rest) and prevention of diseases are required for keeping our bodies healthy • Be aware of the harmful effects of abuse of alcohol and drugs, and smoking on our health	• Discuss how to develop a healthy lifestyle • Search information on the appropriate amount and intensity of physical activities for people of different age groups • Search information on the types of exercises that can train up one's strength, endurance and body suppleness • Search information on the effects of abuse of alcohol and drugs, and smoking on our health
12.2 Nutrition and health • Food substances	• Describe the key functions of the six main types of food substances, including carbohydrates, lipids, proteins, vitamins, minerals and dietary fibre • *Be aware of the building blocks of carbohydrates, lipids and proteins* • State the importance of water to the human body	• Perform practical works to test for glucose, starch, lipids, proteins and vitamin C • Conduct investigations to find out the food substances in food samples • Conduct investigations to compare the amount of vitamin C in different fruits and vegetables

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Digestion and absorption of food	• Identify the main parts of the digestive system in humans • State the functions of the main parts of the digestive system in humans • Understand that food has to be digested into simple and soluble substances before it can be absorbed and used by body cells • Recognise that there are mechanical digestion and chemical digestion • Recognise the role of teeth in mechanical digestion • Recognise the types and functions of teeth in humans	• Examine a human torso to identify the main parts of the digestive system • Watch a video clip about a tour inside the digestive system
	• *Recognise the structure of teeth*	• *Examine a tooth model to identify its structure*
	• *Understand the causes of tooth decay and periodontal diseases, and the ways of protecting our teeth and gum*	• *Perform practical work to find out the effect of soft drinks on a pig tooth* • *Search information on oral diseases and oral care*
	• Recognise that different digestive juices contain enzymes for chemical digestion	• Perform practical work to show chemical digestion by enzymes

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• State that most digested food substances are absorbed in the small intestine and carried to all parts of the body via the transport system	
• Balanced diet	• Understand that a balanced diet involves the intake of different food substances in the right proportion and quantities	• Conduct an investigation to compare the energy value of some snacks
	• Recognise the energy value of different foods	• Inspect food labels to find out the nutritional value and energy value of the food
	• Recognise the energy requirement for people of different age, sex and occupation	• Design a one-day menu of balanced diet for people of designated age, sex and occupation
• Unbalanced diet	• State the effect of insufficient intake of food substances on health, including proteins, dietary fibre, some vitamins (vitamin A, C and D) and minerals (calcium, iron and iodine)	• Search information on iodine deficiency in the diets of people in some parts of the Mainland in the 1990s and its impacts on society
	• Recognise that unbalanced diet will increase the risk of certain health	• Search information on common health problems related to diet, like high blood

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	problems, such as cardiovascular diseases, diabetes and hypertension • Describe the effects of under-eating and over-eating on weight and health	lipids, high blood glucose and high blood pressure • Calculate your Body Mass Index (BMI) to see if you are within the healthy weight range • Search information on the causes of obesity and anorexia and their health effects
12.3 Health and diseases • Infectious diseases	• Recognise that most infectious diseases are caused by infection of microorganisms • State that some common infectious diseases are caused by viruses (e.g. cold and influenza) • Recognise some ways for preventing infectious diseases (e.g. personal hygiene and vaccination)	• Conduct an investigation to compare the amount of germs before and after washing hands • View an animation about how a vaccine works • Search information on the Hong Kong Childhood Immunisation Programme and

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
		the government vaccination programme • Search information on the importance of vaccination programme on the eradication of smallpox
• Non-infectious diseases	• Recognise that some non-infectious diseases are related to unhealthy lifestyles • Recognise the importance of healthy lifestyles to the prevention of certain non-infectious diseases (cardiovascular diseases, lung cancer, colorectal cancer and diabetes) • *Recognise some risk factors for cancers (e.g. chemicals, radiations, viral infections, genetic factors)* • *Recognise diabetes as a disorder related to a hormone (insulin) for regulating blood glucose level*	• Construct a model to simulate the blood flow in a cholesterol-clogged vessel • Design a poster or make a video clip to illustrate how non-infectious diseases can be prevented by healthy lifestyles • *Search information about some common cancers and their causes* • *Read about the story of the discovery of diabetes*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• Biotechnology and health	• Be aware of the health-related applications of biotechnology (e.g. manufacturing of drugs, genetic testing for diseases, identification of infectious virus and microorganisms)	• Search information on the newborn screening services provided by the Department of Health • Search information on the development of production of drugs (e.g. insulin) • Search information about the application of biotechnology in the identification of the infectious agents of some common diseases (e.g. influenza)

Unit 13 From Atoms to Materials

Overview

All matter is composed of small particles called atoms. Different elements, consisted of different atoms, have unique properties. Based on the chemical properties and the atomic number of different elements, scientists developed a systematic way to organise elements in the Periodic Table. Elements can generally be classified as metals, semi-metals and non-metals. Different elements may react with each other and form new substances through chemical change. Balanced chemical equations of simple reactions can be used to represent the chemical changes in the reactions. Through different chemical reactions, humans extract metals from metal ores to develop tools for different uses. Besides metals, alloys and plastics are also widely used in the modern world to improve our quality of life. However, we should be aware of the environmental problems associated with the improper use and disposal of these materials.

Through performing different practical work, for example, the electrolysis of water, distinguishing samples into metals and non-metals, and extracting metals from their ores using carbon, students will practise different science process skills such as observing, classifying and handling apparatus.

Through the learning of the development of the Periodic Table of elements, students will realise the unifying concept “systems and organisation”. The simple model of atom will foster students’ understanding of the unifying concept “evidence and models”. After learning about materials of the modern world, students will recognise that different types of plastics have different properties and usages and hence realise the unifying concept “form and function”.

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
13.1 Atoms and elements • Elements	• Recognise that all matter is composed of small particles called atoms • Be aware of the relationship between elements and atoms • State the names and symbols for some common elements • Identify elements of metals, non-metals and semi-metals based on their physical properties	• Perform practical work to classify samples of elements into metals and non-metals
• Simple model of atom	• Describe the structure of an atom in terms of protons, neutrons and electrons • State some characteristics of protons, neutrons and electrons • Be aware that atomic number represents the number of protons in the nucleus of an atom • Recognise that the mass number of an atom is the sum of the number of protons and the number of neutrons	• Watch video clips about the development of atomic model

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
• *Ions*	• *Recognise that ions carry charges as they have different number of protons and electrons* • *State the chemical symbols of simple ions*	
13.2 Periodic Table • The development of Periodic Table	• Recognise that Periodic Table is a way to organise elements in a systematic order • Be aware that scientists in the past organise elements according to the mass of atoms and their chemical properties • Recognise that the modern Periodic Table lists elements in order of increasing atomic number	• Read stories about how scientists developed the Periodic Table
• Groups in the Periodic Table	• Recognise that elements in the same group of the Periodic Table exhibit some common properties • Give examples of some elements in different groups and their daily applications	• Perform practical works by putting magnesium, calcium and carbon into dilute hydrochloric acid respectively to identify the elements which have similar chemical properties • Search information on the properties and applications of elements using an interactive Periodic Table

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• *Be aware that the chemical properties among elements in the same group are similar but with different reactivity*	• *Perform practical work to compare the rate of production of hydrogen in the reactions of very dilute acids with magnesium and calcium respectively.*
13.3 Mixtures and compounds	• Recognise that mixtures are formed when two or more substances mix with each other without the formation of a new substance • Be aware that compounds are formed by elements joining together chemically • Recognise that chemical change is a process in which new substances are formed in reactions • Be aware that physical change does not involve a change in chemical composition • *Write balanced chemical equations for the reactions between elements to form compounds (sodium chloride, hydrogen chloride, water and carbon dioxide)* • Distinguish between elements, compounds and mixtures	• Watch a video clip of the separation of substances in milk by centrifugation • Perform practical work to obtain hydrogen gas and oxygen gas by the electrolysis of water • Perform practical work to compare the properties between a compound and its constituent elements (e.g. iron(II) sulphide, iron and sulphur) • Illustrate elements, compounds and mixture using interlocking bricks

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
		• Classify different samples into elements, compounds and mixtures (e.g. sea water, air, sand, dry ice)
13.4 Metals • History of the use of metals	• Relate the use of metals to their ease of extraction and availability	• Conduct a project to study the history of discovery and use of metals
• Obtaining metals	• Recognise that some metals occur in their elemental forms in Nature while most exist as compounds • *Outline the method of metal extraction using carbon*	• Search information on how to obtain metals from ores • *Perform practical work to extract iron and copper from their ores using carbon* • *Perform practical work to distinguish a metal from its ore*
• Properties and uses of metals	• Relate the properties of metals to their uses	• Perform practical work to compare the physical properties (e.g. strength, malleability, ductility, electrical conductivity and thermal conductivity) of some metals

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
13.5 Materials of the modern world		
• Alloys	• Recognise that alloys are made by adding other elements into metals for the improvement of the properties of the metals	
	• Give examples of alloys and their common uses	• Search information about the invention of new alloys and their uses
• Useful materials from crude oil	• Recognise crude oil as a mixture of hydrocarbon molecules of different sizes	
	• *Relate the physical properties of the hydrocarbons to their sizes*	
	• Recognise that fractional distillation is the method for separating crude oil into different fractions	• Perform a demonstration on the fractional distillation of crude oil
	• State some major uses (e.g. fuels, solvents and raw materials for making plastics) of the different fractions	• Perform a fair test to find out the best solvents for removing oil stain on a cloth
	• Recognise that plastics are macromolecules made by joining up many hydrocarbon molecules	• Design and make a paper weight using epoxy resin or polystyrene

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
	• Give examples of plastics (e.g. PE and PVC) and their usage • Be aware that new plastics are invented based on the emerging needs in our society	• Search information on examples of plastics and the advancement in new plastics invention
• Environmental problems associated with the use of materials	• Describe some environmental problems associated with the use of materials (e.g. plastics, metals) • State some solutions to the problems of using materials (e.g. plastics, metals)	• Search information on the environmental problems associated with the use of plastics and metals • Watch video clips on the recycling of plastics and metals • Propose a feasible plan to reduce the use of plastics or metals in daily life

Unit 14 Light, Colours and Beyond

Overview

An object can be seen when it gives out light or reflects light from a luminous object. Reflection, refraction and total internal reflection of light are common phenomena and they have many applications in our daily life. Visible light is part of the electromagnetic spectrum consisting of lights of different colours. Besides visible light, there are also other radiations in the electromagnetic spectrum that is widely used in the modern world. We should be aware of the effects of electromagnetic radiations on our health, and assess the risks and benefits of using them.

In this Unit, students will learn about the above aspects of light and the electromagnetic spectrum. They will also study the formation of images by mirrors and lenses, and understand the application of these optical devices in daily life. Through investigating the paths of light rays in different optical devices or mediums and drawing ray diagrams, students will practise science process skills, like handling apparatus, observing and inferring, and communicating by graphical representation. The design and make activities help arouse students' interests in learning and provide opportunities to foster their creativity and innovative mind. Learning about the reflection and refraction of light helps students recognise the unifying concepts "change and constancy". By studying the bending of light rays using optical devices of different shapes (e.g. prisms, convex and concave lenses), students will recognise the unifying concepts "form and function".

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
14.1 Light rays from an object • Luminous objects and non-luminous objects • Light rays	• Distinguish between luminous and non-luminous objects • Recognise that light travels in a straight line • Represent light rays by straight lines and arrows	• Perform practical work to show that light travels in a straight line • Draw ray diagram to show the path of light ray from a near object and a distant object to our eyes respectively • Search information on the daily life applications of the property that light travels in a straight line • Design and make a pin-hole camera
14.2 Reflection	• State the laws of reflection • Describe the nature of images formed by plane mirror • Give examples of daily applications of reflection of light	• Perform practical work to find the relationship between the incident angle and the reflected angle of light • Draw ray diagram to construct the image formed by a plane mirror • Design and make a device applying the reflection of light (e.g. periscope, kaleidoscope) • Design and make a game for school fun fair that applies the reflection of light

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
14.3 Refraction	• Recognise that light is refracted at the boundary between air and any transparent material (e.g. glass, perspex, water) • Recognise that materials with different refractive index leads to different degree of bending of light from air to the materials • Use ray diagram to illustrate some phenomena due to light refraction	• Perform practical work to demonstrate refraction of light (e.g. bending of chopsticks in water; apparent depth of a trough of water) • Perform practical work to observe the refraction of light in different materials
14.4 Total internal reflection	• *State the conditions for total internal reflection* • *Give daily examples of total internal reflection*	• *Perform practical work to demonstrate the conditions for total internal reflection using a semi-circular glass block and a ray box* • *Make a periscope using prisms* • *Perform practical work to demonstrate total internal reflection* • *Search information on the uses of optical fibres in telecommunication and medicine (e.g. endoscopy)*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
14.5 Images formed by convex lenses	• Recognise that light rays converge after passing through a convex lens • *Construct the images formed by convex lenses using ray diagrams* • *Describe the nature of images formed by convex lenses* • *Find out the magnification of images formed by convex lenses* • Give examples of the daily applications of convex lenses	• Perform practical work to observe the paths of light rays through convex lenses • *Perform practical work to find out the nature of images formed by convex lenses* • *Perform practical work to find out the magnification of images formed by convex lenses* • *Design and make an optical instrument (e.g. telescope)*
14.6 Images formed by concave lenses	• Recognise that light rays diverge after passing through a concave lens • *Construct the images formed by concave lenses using ray diagrams* • *Describe the nature of the images formed by concave lenses* • *Find out the magnification of the images formed by concave lenses* • Give examples of the daily applications of concave lenses	• Perform practical work to observe the paths of light rays through concave lenses • *Perform practical work to observe the images formed by concave lenses*

(Extension parts are highlighted in blue italics.)

Students should learn	Students should be able to	Suggested learning and teaching activities
14.7 Electromagnetic spectrum		
• Visible spectrum	• Recognise that visible light is part of the electromagnetic spectrum	
	• Describe the visible spectrum	• Perform practical work to produce a colour spectrum of white light
	• Be aware that different colour light has different wavelength	
	• *State the three primary colours of light*	
	• *Recognise that primary colour of light can be combined to produce different colours*	• *Perform practical work to mix the three primary colours of light*
	• *Understand how coloured objects appear in white light and in different colour lights*	• *Perform practical work to find out how objects look in different colour light*
• Beyond the visible spectrum	• Describe the invisible parts of the electromagnetic spectrum	• Perform practical work to demonstrate the existence of invisible electromagnetic radiations
	• Give examples of the applications of electromagnetic spectrum	• Search information on the use of electromagnetic radiations and the related potential hazards
	• Recognise the potential hazards of using electromagnetic radiations	

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