SYLLABUSES
FOR
SECONDARY SCHOOLS

SCIENCE

(SECONDARY 1-3)

PREPARED BY
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PREAMBLE

This syllabus is one of a series prepared for use in secondary schools by the Curriculum Development Council, Hong Kong. The Curriculum Development Council, together with its co-ordinating committees and subject committees, is widely representative of the local educational community, membership including heads of schools and practising teachers from government and non-government schools, lecturers from tertiary institutions, officers of the Hong Kong Examinations Authority and those of the Curriculum Development Institute, the Advisory Inspectorate and other divisions of the Education Department. The membership of the Council also includes parents and employers.

This syllabus is recommended for use in Secondary 1 to 3 by the Education Department. Once the syllabus has been implemented, progress will be monitored by the Advisory Inspectorate and the Curriculum Development Institute of the Education Department. This will enable the Science Subject Committee (Secondary) of the Curriculum Development Council to review the syllabus from time to time in the light of teaching and learning experiences.

All comments and suggestions on the syllabus may be sent to:

Principal Curriculum Planning Officer (Secondary and Prevocational),
Curriculum Development Institute,
Education Department,
Wu Chung House, 13/F,
213, Queen's Road East,
Wan Chai,
Hong Kong.

INTRODUCTION

Science education has to prepare students to cope with the rapid advancement in science and technology. The primary aim of science education at the junior secondary level is to ensure that students develop the necessary scientific and technological knowledge and skills to live and work in the 21st century.

This syllabus emphasises a balanced approach towards the acquisition of scientific knowledge, attitudes and skills through carefully organised activities. The **investigative approach**, which involves students in defining problems, designing experiments to find solutions, carrying out practical work and interpreting the results, should be employed. Such investigations would enhance the acquisition of knowledge and skills as well as contribute towards other educational goals such as cultivation of citizenship, development of appropriate social and personal values and appreciation and respect for life. To achieve these ends, it is necessary to link science education to technological applications, social issues, and the daily experiences of students. Learning science in these contexts will be more interesting and effective.

The content of this syllabus has been carefully chosen to ensure continuity and progression of science education across the primary and secondary levels. Students are presented with aspects of science that are interesting and best contribute to their general education. It is expected that upon completion of the course students shall acquire the basic foundation for more academic pursuit in the discipline of science in senior secondary education. To help students keep up with advances in science and technology, teachers should feel free to incorporate current issues that are relevant and interesting into their lessons. For example, the use of modern technology in measurement and control should be introduced where appropriate.

It is important to note that the sequencing of topics in this syllabus does not suggest a teaching order. Schemes of work and assessment should be drawn up by teachers in a manner commensurate with the needs, interest and abilities of their students. Teachers are advised to adopt a variety of approaches in their teaching and incorporate ideas as well as materials from the everyday experiences of their students.

AIMS

The broad aims of this syllabus are that students should:

1. acquire the basic scientific knowledge and concepts for living in and contributing to a scientific and technological world;

2. develop the ability to enquire and to solve problems;

3. be acquainted with the language of science and be equipped with the skills in communicating ideas in science related contexts;

4. develop curiosity and interest in science;

5. recognise the usefulness and limitations of science and the interactions between science, technology and society and develop an attitude of responsible citizenship, including respect for the environment and commitment to the wise use of resources;

6. be able to appreciate and understand the evolutionary nature of scientific knowledge.

OBJECTIVES

Based on the broad aims, it is possible to identify the general objectives for the syllabus as follows:

A. Knowledge and understanding

Students should be able to demonstrate knowledge and understanding in relation to

1. some phenomena, facts and concepts in science
2. some scientific vocabulary and terminology
3. some applications of science in society and students' everyday life

B. Scientific method and problem solving skills

Students should be able to

1. ask relevant questions, suggest ideas and make predictions
2. select and apply facts and concepts learnt to solve problems
3. propose hypotheses and devise methods for testing them
4. analyse data, draw conclusions and make further predictions

C. Laboratory techniques

Students should be able to

1. handle apparatus and chemicals safely and properly
2. carry out instructions for experiments
3. observe and describe objects and experimental results accurately
4. select appropriate apparatus and suggest experimental procedures

D. Communication skills

Students should be able to

1. extract relevant information from a variety of sources
2. manipulate simple numerical and other data
3. interpret scientific information from data presented in diagrammatic, numerical, tabular and graphical forms
4. organise and present information in a clear and orderly manner
5. argue for or against the use of science in technological situations based on scientific, ethical, economic, political and social considerations
6. communicate scientific ideas and values with one another

E. Decision making skills

Students should be able to

1. make objective judgements based on data and arguments presented with scientific, ethical, economic, political and social considerations
2. support value judgement using appropriate and relevant scientific facts and knowledge

F. Attitude

Students should

1. develop curiosity and interest in science
2. be aware of the importance of the safety of oneself and others in the laboratory and be committed to safe practices in daily life
3. develop personal integrity through honest recording of experimental data
4. develop an awareness of scientific advancement and its social, economic, environmental and technological implications
5. be willing to communicate and comment on issues related to science and respect the decisions of others
6. develop a positive attitude in enhancing personal and community health
7. show concern for the care of the environment and a willingness to contribute to it

CONCEPTUAL FRAMEWORK

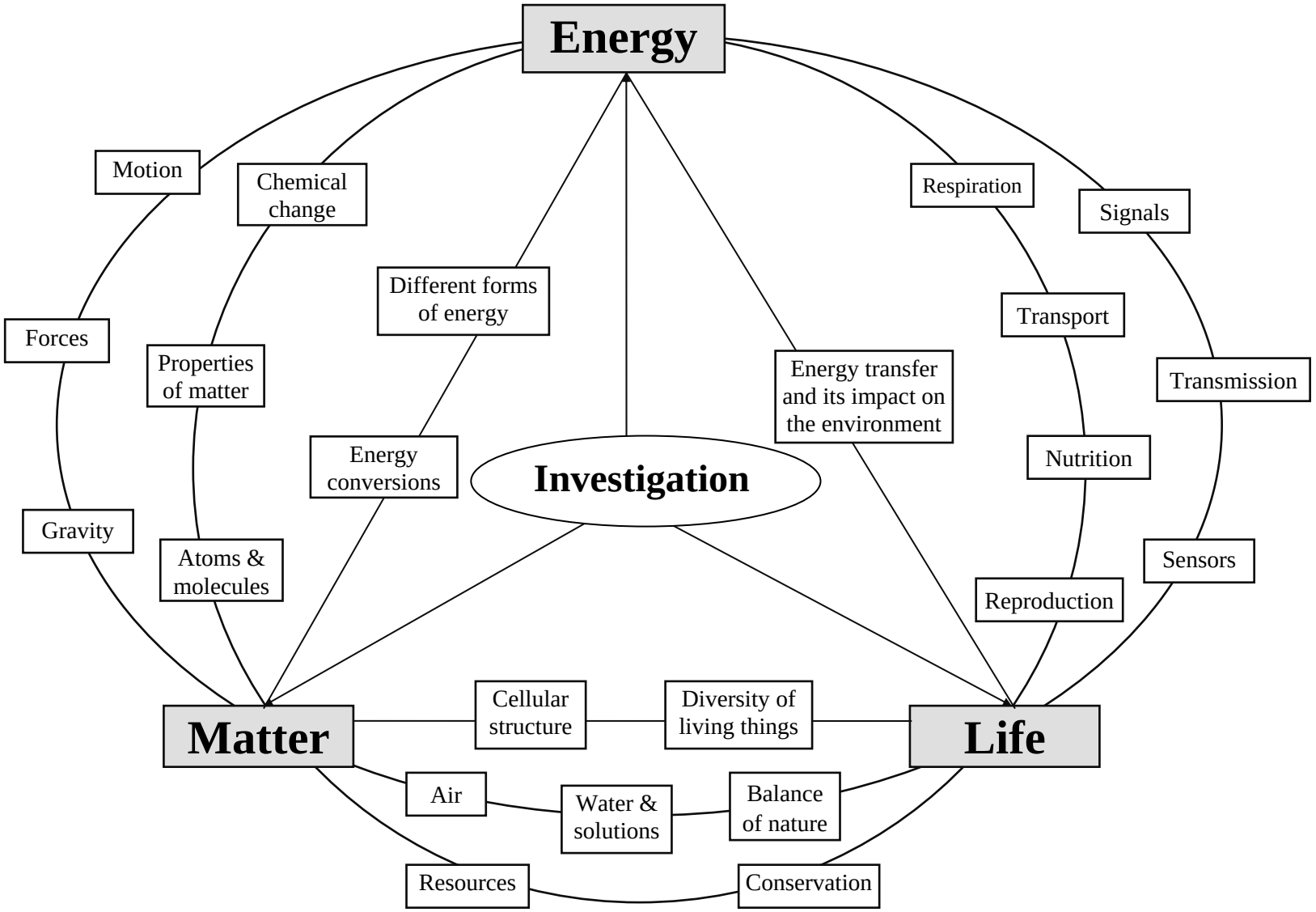
The content of this syllabus is organised into 15 units, yet the topics should not be viewed as compartmentalised blocks of knowledge. In order that students can have a coherent understanding of the world around them, the diversity and multiplicity of scientific facts and concepts should be learned as inter-related "bigger ideas" in a conceptual scheme. The framework given on the next page illustrates how the content is organised and linked into a unifying conceptual whole. The syllabus is intended to encourage students to integrate concepts and skills acquired to enquire into the environment, hence the central theme '**Investigation**'. The conceptual framework is built around the 3 interrelated areas of **matter**, **energy** and **life**.

Matter and **energy** are components of the environment and are in constant interaction. At the microscopic level, students are introduced to the fact that matter is made up of different atoms and molecules, that is why different substances have different properties. These properties in turn determine the type of chemical changes that could take place which always involve a change of energy. At the macroscopic level, the interconvertibility of different forms of energy and the storage of energy in matter are discussed. Students' attention is also drawn to the fact that the extensive use of energy as a result of modernisation has brought about negative impact on the environment and threatened the substainability of life.

Living things (**life**) need **energy** to stay alive. Food relationships and energy transfer processes in the living world are important areas covered at this level. Besides, how living things respond to stimuli and react to signals are included as they are also examples of energy transfer processes. Students are also made aware of the contribution of the safe and quick long-distance transmission of signals to the advancement of our society.

In the study of **life** and **matter**, students are first introduced to cells, which are the basic unit of living things, and the great diversity of life on earth. They are then led to examine mixtures such as air and solutions, and compounds such as water, and their importance to everyday life and to industries. In particular, social issues related to maintaining air and water quality, and the need for conservation of natural resources are also dealt with.

Conceptual Framework of the CDC Syllabus for Science (S1-3)



SYLLABUS CONTENT

Unit	Content
1. Introducing Science	What is science: application of science in everyday life Safety in the laboratory Using some common laboratory equipment Conducting a simple scientific investigation; concept of a fair test
2. Looking at Living Things	Living things: characteristics of living things Observing an animal: observing carefully over a long period of time and drawing conclusions Diversity of plant and animal life: wide variety of living things and the variation within the same kind of living things Sorting things into groups: using and constructing simple keys for identification Endangered species: wild life, man's impact on the environment and conservation
3. Cells and Human Reproduction	The basic unit of living things: cell A new life is born: fertilisation, implantation, development of the embryo inside the mother's body Puberty: sexual characteristics, male and female reproductive systems, signs of maturation of the reproductive systems Pregnancy: signs and length of pregnancy, preparation for parenthood and family planning Sexually transmitted diseases: spread, consequences and attitude
4. Energy	Different forms of energy: heat, light, sound, kinetic, potential, chemical and electrical energy Simple energy changes: energy converters, controlled and uncontrolled energy conversion Fuels: common fuels and safety in using fuels Generating electricity: related pollution problems and other ways to generate electricity Energy sources and we: limited supply of fossil fuels and our increasing need for energy
5. The Wonderful Solvent - Water	Our heavy demand for clean water supply Water purification: sedimentation, filtration, distillation, killing micro-organisms using chlorine and ozone The water cycle Water conservation and pollution Dissolving: idea of saturated solution and factors affecting the rate of dissolving Growing crystals Solvents other than water

Unit	Content
6. Matter as Particles	States of matter and change of states Evidences of particle nature: particles are small and invisible, there are spaces between particles, particles are moving A simple particle model for the three states of matter; atom is the smallest unit of matter Considering gas pressure, density, thermal expansion and contraction from the particle point of view
7. Living Things and Air	What is air made up of; tests for oxygen, carbon dioxide and water Oxygen supports burning; the fire triangle How does man obtain energy How do green plants obtain energy: photosynthesis Idea of food chain Gaseous exchange in animals and plants: respiration and the release of chemical energy from food Balance of carbon dioxide and oxygen in nature Effects of smoking and polluted air on our respiratory system
8. Making Use of Electricity	Idea of a closed circuit Electrical conductors and insulators Current: measurement and its unit Voltage: measurement and its unit Resistance: rheostat and factors affecting the resistance of a wire Circuit symbols: simple circuit diagrams Series and parallel circuits The heating effect of current and the use of fuses Household electricity: mains voltage, ring circuits, earth, overloading and short circuits Power of an electrical appliance Cost of electricity Working principles of some common electrical appliances
9. Space Travel	Forces: measurement and unit Friction: reducing friction; making use of friction Force of gravity: mass and weight A space journey: launching of a rocket, fuel, shape of rocket, action and reaction forces; frictionless and gravity-free motion in space; return of spacecraft Life of an astronaut in space: problems faced by astronauts living in space Space exploration: the impact of space programmes on man

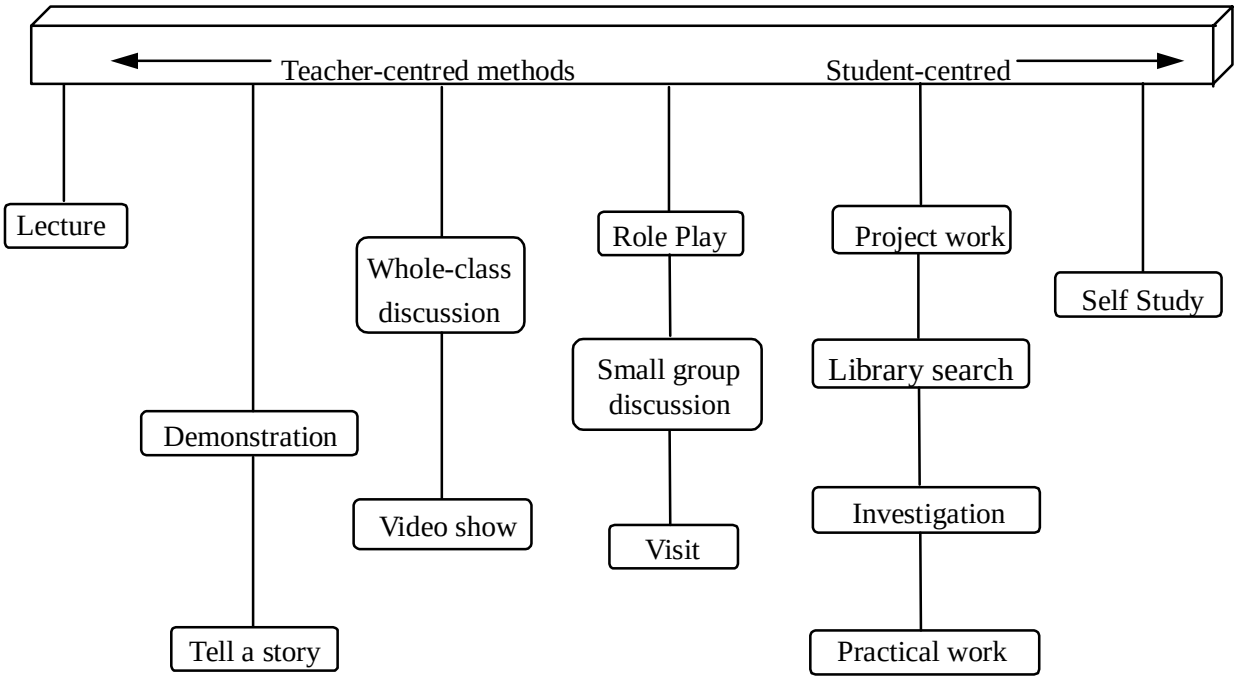
Unit	Content
10. Common Acids and Alkalis	Common acids and alkalis Indicators for testing acids and alkalis: common indicators and pH value Acids and corrosion: action of acids on metals and building materials; safety in handling acids Acid rain: causes and its effects on the environment Neutralisation: neutralisation of acids and alkalis to get salts Everyday uses of acids, alkalis and neutralisation: food preservation, cleansing, treating stomach-ache and insect stings, treating industrial waste Potential hazards related to the use of acids and alkalis: proper procedures in diluting concentrated acids and alkalis
11. Sensing the Environment	Sensing the environment: types of stimuli and corresponding sense organs How we see: functions of main parts of the eye Limitations of our eyes Eye defects: causes of long and short sight and their correction How we hear: the production and transmission of sound; functions of main parts of the ear Limitations of our ears: audible range and sound level Effects of noise pollution: protection of our ears Senses of smell, taste and touch: reliability of our senses The brain and our senses: interpretation of sense signals Response to stimuli Effects of drugs and solvents on our senses: drugs and solvents affect our judgements and responses

Unit	Content
12. A Healthy Body	Keeping our body healthy: appropriate food, enough exercise and rest Food substances: main types of food substances and their functions Balanced diet: energy value of food; food pyramid and the importance of dietary fibre; over-eating and under-eating Natural food and processed food How food is digested and absorbed in our body: structure of teeth and prevention of tooth decay ; the digestive system; the absorption of digested food The fate of digested food: transportation of digested food; exchange of materials between blood and body cells Our circulatory system: blood vessels and the heart, the structure of the heart and its pumping action How fatty food affects our circulatory system: adverse effects of too much cholesterol in the blood Exercise and health: strength, suppleness and stamina Need for rest
13. Metals	History of the use of metals How to obtain metals: extraction of metals using carbon; elements and compounds; physical changes and chemical changes Properties and uses of metals: choice of metals in relation to their particular properties Making metals more useful: alloys and their uses Environmental problems associated with the disposal of used metals
14. Materials of the Modern World	Making plastics from crude oil: fractional distillation; different uses of fractions; plastics produced by joining small hydrocarbon molecules; some examples of common plastics and their useful properties Environmental problems associated with the disposal of plastics Composite materials: characteristics of composite materials, some examples of common composite materials
15. Light, Colours and Beyond	How we see an object Reflection at plane surfaces: law of reflection, plane mirror images and applications of the reflection of light Colour: spectrum of light; mixing coloured lights and the 3 primary colours; colour as a human sensation; colour of an object and colour filters Beyond the visible: detection and applications of infra-red and

Unit	Content
	ultra-violet radiation Beyond infra-red and ultra-violet: the other parts of the EM spectrum and their applications; radio waves as carriers of information - transmission and detection; increasing use of radio waves and their influences; the controversial issue of whether EM radiation affects our health Refraction and its practical uses: bending of light through lenses; images formed by convex lenses and applications Optical fibres and total internal reflection: light can travel along a curved path in an optical fibre

NOTES ON TEACHING STRATEGIES

In science, practical work is essential for students to gain personal experience of science through doing and finding out. Another important objective of science teaching is to develop students' thinking. Teachers are encouraged to design their lessons in such a way that suitable questions and activities are incorporated in order to develop various types and levels of thinking in students, including analysis, evaluation, critical thinking and creative thinking. Generally speaking, student-centred and interactive approaches are useful in providing suitable learning experiences for stimulating and developing higher level thinking and are highly recommended. Teachers may consider to adopt a variety of strategies from the following spectrum which ranges from very teacher-centred methods to very student-centred methods.



Spectrum of Teaching Methods

Teachers should choose appropriate teaching methods in accordance with the topic/skill to be taught as well as the interest and abilities of their students. The following are some factors to be considered when deciding on the teaching method for a particular topic:

- learning objectives to be achieved;
- ability of students;
- subject matter;
- availability of resources; and
- amount of time available.

PLANNING TEACHING & LEARNING ACTIVITIES

This syllabus emphasises a balanced approach towards the acquisition of scientific knowledge, attitudes and skills through carefully organised learning activities. It is important that students progressing through the junior secondary level should acquire and continually develop the skills which will enable them to solve problems in a logical way and to make sense of the environment. These skills include:

a) the ability to **observe** closely and carefully
b) the ability to **classify**
c) the ability to **measure** accurately
d) the ability to **handle equipment and apparatus** properly and safely
e) the ability to **communicate**
f) the ability to **infer** from observations and experimental data
g) the ability to **predict**
h) the ability to **propose hypotheses**
i) the ability to **interpret data**
j) the ability to **control variables**

Some of the skills listed above are cognitive in nature - for example, learning how to control variables in an experiment and proposing hypothesis. Some are very practical - for example handling equipment and apparatus properly. Throughout the course students should be exposed to various learning opportunities to develop their proficiencies in these skills. A brief explanatory note on each of the skills emphasised in the course, which might be useful to teachers in planning their lessons, is given below:

a) <u>Observing closely and carefully</u>

This is the skill of using our senses, (including the use of instruments to extend the range of our senses) to gather qualitative as well as quantitative information about a particular object, event or phenomenon. Careful observation of details and of the order of events are important aspects of observation. The different facets of observation include:

- making use of several senses
- noticing relevant details of the object and its surroundings
- identifying similarities and differences
- discerning the order in which events take place
- using instruments to aid the senses for studying details

b) Classifying

This is the skill of grouping objects or events according to common attributes or properties. Scientific classification involves the learning of the particular classifications which scientists employ and which are established as productive for pursuing scientific ends. For example, in Unit 6 there is practice in shifting from classifying by actual observed properties (solids have fixed shapes and size whereas ....) to classifying by inferred properties (in solids the particles are .. whereas ....). Such shifts from concrete / actual to abstract / inferred (from macroscopic to microscopic in this case) must be carefully taught.

c) Measuring

Measuring sensibly and accurately includes making decisions about what instruments to choose, over what range and interval, when and how often to measure, ways to improve accuracy and the need to repeat measurements. The concept of appropriate accuracy for a reading is also fundamental. There is, for instance, rarely a need to measure time to three decimal places, although students with digital watches often do so.

d) Handling equipment and apparatus properly

This includes simple practical skills, the use of various equipment and apparatus and safe handling of chemicals and live specimens needed for simple scientific investigations. For example, preparing a microscopic slide in Unit 3, dissecting an ox eye in Unit 11, distilling water in Unit 5, etc.

e) Communicating

Communication in science involves using various conventions of representation which help in organising information and conveying it efficiently. Symbols, tables, graphs, charts, etc. can serve this purpose and they have to be chosen to suit the particular kind of information to be handled. Communication also involves the ability to take information from written sources, to use information presented in graphical or tabular form. The different facets of communicating include:

- talking, listening or writing to sort out ideas and clarify meaning
- making notes of observations in the course of an investigation
- using drawings, graphs, charts and tables to convey information
- choosing an appropriate means of communication to suit the purpose
- recording of activities carried out

f) Inferring

This is the skill of interpreting or explaining observations or pieces of data. In this connection, students should be taught to respect evidence, and not to push one's conclusions beyond the available information.

g) Predicting

Predictions clearly require careful inferences which in turn require careful observation first. For much of the course content the shift is slight; nonetheless training in the systematic way - (observations → inferences → predictions) - is invaluable. The behaviour which indicate that predicting is in action includes:

- making use of evidence from past or present experience in stating what may happen
- explicitly using patterns in evidence to interpolate or extrapolate
- justify a statement about what will happen or be found in terms of present evidence or past experience
- showing caution in making assumptions about a pattern applying beyond the range of evidence
- distinguishing a prediction from a guess

h) Proposing hypotheses

This is the skill of making a general explanation for a related set of observations or events. It is an extension of inferring. When hypothesising, the suggested explanation need not be correct, but it should be reasonable in terms of the evidence available and possible in terms of scientific concepts or principles. So proposing hypotheses includes:

- suggesting an explanation which is consistent with the evidence
- suggesting an explanation which is consistent with some scientific principle or concept
- applying previous knowledge in attempting to give an explanation
- realising that there can be more than one possible explanation of an event or phenomenon
- realising the tentative nature of any explanation

i) Interpreting data

Interpreting the data produced in the course of the activities is part-and-parcel of the whole process of science. There is little in the course which requires mathematical skills of any complexity, graph interpretation being probably the most frequent. It is important that all evidence available is considered rather than using only preconceived ideas based on experience. Thus the skill of interpreting includes:

- making interpretations related to data (rather than to preconceived ideas) even if only loosely
- making interpretations based on all available data
- checking interpretations against new data
- interpreting explicitly based on patterns or relationships

j) Controlling variables

This skill involves keeping all-but-one variable constant so as to 'make experiments fair'. In the early units, the emphasis is on experiments where a single variable is prominent (e.g. with the living things in Unit 2 -' What happens when we do this ...?'). Later on, problems involving several variables are examined (e.g. evaporation experiments in Unit 5).

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In the teaching and learning of the above skills, efforts should initially be directed at teaching explicitly each of the skills through the use of appropriate activities, and then finally helping students integrate some or all of these skills in experimenting and carrying out investigations.

When selecting investigations for teaching purposes it is useful to have a clear understanding of the demands of different investigations. The investigations chosen should neither be too simple nor too complex for students, while the learning objectives embedded within the tasks should be easily identifiable. Some of the points to be considered in choosing an investigative activity are as follows:

a) The context in which the investigation is set

Investigations should, initially, be set in familiar contexts within the everyday experience of the students. Gradual diversification into wider and more abstract contexts follow.

b) Match prior knowledge of students

Investigations should use concepts which are familiar by their everyday use or by previous learning. The conceptual demands will therefore increase as students grow older.

c) The complexity of the variables involved

Early investigations require a systematic approach, involving simple variables in the design of a 'fair test'. In later years, investigations should involve the use of more variables. Here, decisions will need to be taken regarding the number, range and values of the data to be collected.

d) Skills of reporting and recording the results of investigations

As the complexity of investigations progress in the manner outlined above, the need for more complex reporting skills becomes apparent. Students must be encouraged to appreciate the most appropriate form of representation in graphs, charts and tables - bearing in mind the nature of the investigation they have carried out. They should also make use of, and develop, their technical vocabulary in reporting.

e) Interpreting data obtained by investigations

Initially, interpretation of data requires the understanding and evaluating of data in relation to the original problem, and the sorting out of simple patterns. Further progress would be indicated by the identification of mathematical relationships.

LABORATORY SAFETY

A safe working environment is essential for pleasant and effective learning. For guidance, teachers are advised to study the pamphlets *Safety in Science Laboratories*, and the *School Science Newsletter* as well as the school circular *Safety in School Laboratories* issued by the Education Department.

In essence, clear instructions, good laboratory discipline, close supervision, correct techniques and proper use of safety devices contribute to laboratory safety. Teachers should always take special care to ensure safety in the laboratory and remind students to take appropriate safety measures while doing experiments.

The *Chemical Safety Teaching Kit* produced by the Occupational Safety & Health Council and the Education Department has provided some teaching strategies and resources related to the safe use of chemicals and should be useful to teachers in the planning of activities for promoting chemical safety among students. The attention of teachers is specially drawn to the following points:

- A lesson should be reserved at the beginning of each school year to discuss safety aspects in the laboratory. Activities such as safety quizzes, case studies on laboratory accidents and video shows may be employed to arouse students' awareness of the importance of the safety of oneself and others in the laboratory so that they would be committed to safe practices in the laboratory.

- Experiments which are dangerous should NOT be attempted in schools. Those which involve the taking of human blood and cell samples should also be avoided, since they carry a risk of transmitting blood-borne diseases.

- Safer alternatives to potentially hazardous chemicals and procedures should be used whenever possible.

CURRICULUM GUIDE

NOTES ON THE TEACHING SYLLABUS

The teaching syllabus is organised into 15 units. It is designed to cover the major aspects of science, as well as the social and technological implications of science. Each Unit allows students to investigate and examine a specific theme in science.

The introduction of each Unit outlines the context and the philosophy behind the organisation of the Unit. Instructional objectives were also listed to illustrate the level of achievement that is expected of the students on completing the Unit. It aims at assisting teachers in their selection of course materials, learning activities and instructional methods. It can also serve as the learning guidelines for the students and the basis of an evaluation program.

The key concepts, skills and values/attitudes to be developed by students are given for each Unit in tabular form. The major topics of the syllabus are indicated in the first column. Column two highlights the key points for the topics. Experienced teachers will find the information in these two columns sufficient to plan their teaching and to design appropriate teaching/learning activities according to the needs and interest of their students. Columns three and four indicate the materials that could be included at the core and extension levels and provide guidance as to how the topics can be treated at the respective levels. Column five lists suggested teaching and learning activities. Attempt has been made to cover a variety of activities which are coded to indicate the skills emphasised. Activities suggested here are by no means exhaustive nor meant to be prescriptive. It is hoped that teachers will find them useful as resources to choose from and, preferably, to further develop teaching and learning activities that best suit their students. It is expected that through conducting the suggested activities, students would demonstrate increasing competencies in the skills emphasised in the syllabus and would eventually attain the objectives stated in the syllabus. The extent to which students should have developed in the different areas after completing each Unit have been delineated for teachers' reference. *The key points and activities for the extension materials are indicated in blue italics*.

In drafting this teaching syllabus, careful consideration has been given to the sequencing of the topics but they are not the only way nor the best way in which the topics can be organised. Teachers need not adhere strictly to the suggested sequence and are encouraged to exercise their discretion in modifying the recommendations given in this guide taking into account the interest, needs and abilities of their students and other social or environmental factors. Teachers are also encouraged to adopt a variety of approaches in their teaching and incorporate ideas as well as materials from social issues and everyday experiences of students.

Listed below is the synopsis of the teaching syllabus, in terms of titles of the various units and subunits.

Unit 1 Introducing Science

1.1 What is science
1.2 Safety in the laboratory
1.3 Using common laboratory equipment
1.4 Conducting a simple scientific investigation

Unit 2 Looking at Living Things

2.1 Living things
2.2 Observing an animal
2.3 Diversity of plant and animal life
2.4 Sorting things into groups
2.5 Endangered species

Unit 3 Cells and Human Reproduction

3.1 The basic units of living things
3.2 A new life is born
3.3 Puberty
3.4 Pregnancy
3.5 Sexually transmitted diseases

Unit 4 Energy

4.1 Forms of energy
4.2 Energy changes
4.3 Fuels
4.4 Generating electricity
4.5 Energy sources and we

Unit 5 The Wonderful Solvent - Water

5.1 Water purification
5.2 Further treatment of water
5.3 The water cycle
5.4 Water conservation and pollution
5.5 Dissolving
5.6 Growing crystals
5.7 Solvents other than water

Unit 6 Matter as Particles

6.1 States of matter
6.2 Illustrations for the support of the claims of the particle theory
6.3 Particle model for the three states of matter
6.4 Gas pressure
6.5 Density
6.6 Thermal expansion and contraction

Unit 7 Living Things and Air

7.1 What is air made up of
7.2 Burning
7.3 How does man obtain energy
7.4 How do green plants obtain energy
7.5 Gaseous exchange in animals and plants
7.6 Balance of carbon dioxide and oxygen in nature
7.7 Effects of smoking and polluted air on our respiratory system

Unit 8 Making Use of Electricity

8.1 Closed circuit
8.2 Electrical conductors and insulators
8.3 Current
8.4 Voltage
8.5 Resistance
8.6 Circuit symbols
8.7 Electrical circuits
8.8 Fuses
8.9 Household electricity
8.10 Power of an electrical appliance
8.11 Cost of electricity
8.12 Electrical appliances

Unit 9 Space Travel

9.1 Forces
9.2 Friction
9.3 Force of gravity
9.4 A space journey
9.5 Life of an astronaut in space
9.6 Space exploration

Unit 10 Common Acids and Alkalis

10.1 Common acids and alkalis
10.2 Indicators for testing acids and alkalis

10.3 Acids and corrosion
10.4 Acid rain
10.5 Neutralisation
10.6 Every day uses of acids, alkalis and neutralisation
10.7 Potential hazards related to the use of acids and alkalis

Unit 11 Sensing the Environment

11.1 Sensing the environment
11.2 How we see
11.3 Limitations of our eyes
11.4 Defects of the eye
11.5 How we hear
11.6 Limitations of our ears
11.7 Effects of noise pollution
11.8 Senses of smell, taste and touch
11.9 The brain and our senses
11.10 Responses to stimuli
11.11 Effects of drugs and solvents on our senses

Unit 12 A Healthy Body

12.1 Keeping our bodies healthy
12.2 Food substances
12.3 Balanced diet
12.4 Natural food and processed food
12.5 How food is digested and absorbed in our body
12.6 The fate of the digested food
12.7 Our circulatory system
12.8 How fatty food affects our circulatory system
12.9 Exercise and health
12.10 Need for rest

Unit 13 Metals

13.1 History of the use of metals
13.2 How to obtain metals
13.3 Properties and uses of metals
13.4 Making metals more useful
13.5 Environmental problems associated with the disposal of used metals

Unit 14 Materials of the Modern World

14.1 Making plastics from crude oil
14.2 Environmental problems associated with the disposal of plastics
14.3 Composite materials

Unit 15 Light, Colours and Beyond

15.1 How we see an object
15.2 Reflection at plane surfaces
15.3 Colour
15.4 Beyond the visible spectrum
15.5 Beyond infra-red and ultra-violet
15.6 Refraction and its practical uses
15.7 Optical fibres and total internal reflection

SUGGESTED TEACHING & LEARNING ACTIVITIES

Rapid scientific and technological advances has made it impossible to teach all the latest knowledge and to ensure that the knowledge taught will still be useful or relevant a decade or two later. So it is important for students to learn how to seek information effectively, to make sensible judgement from data and to obtain answers for themselves. This means that they need to acquire and continually develop the skills which will enable them to solve problems in a logical way during their school years.

The suggested activities in column five of the teaching syllabus aim at helping students cultivate these skills. In fact, the content of some units lends itself to the practice of certain skills better than others, the table below gives a preliminary idea on how these skills are emphasised in the different units. Some of the activities in these units are coded to facilitate teachers in identifying appropriate learning opportunities for the students. It is expected that students should demonstrate increasing competencies in the skills emphasised in the syllabus through conducting these suggested activities. The extent to which a student should have developed in the different areas is clearly delineated at the end of each Unit. Where higher order learning outcomes are listed, the lower orders are obviously subsumed and are not repeated. The activities suggested are by no means exhaustive nor meant to be prescriptive. It is hoped that teachers will find them useful to choose from. They should also feel free to include any activities in all units to help students develop these skills.

Skills[⚐] \ Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a. Observing (OB)	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓
b. Classifying (CS)		✓				✓				✓		✓		✓	
c. Measuring (MS)	✓	✓		✓		✓		✓	✓		✓				✓
d. Handling apparatus (EA)	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
e. Communicating (CM)	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
f. Inferring (IF)	✓					✓	✓	✓	✓	✓	✓			✓	✓
g. Predicting (PD)				✓		✓	✓	✓	✓		✓				✓
h. Proposing hypotheses (HP)						✓			✓						✓
i. Interpreting data (ID)		✓		✓	✓			✓			✓	✓	✓		✓
j. Controlling variables (CV)		✓		✓			✓								

[⚐] For an explanatory note on each of the skills, please refer to p.13 to p.17

In recent years, there has been a shift in emphasis in practical work to include more investigative work in the science curriculum. This move reflects a shift in emphasis in both views about students' learning, and ideas about school science. There is a growing belief that students construct their own knowledge and that students learn more effectively through investigations. Investigative work not only gives students opportunities to bring together and express their understanding of scientific concepts and skills - often in a practical context - but it also provides concrete situations in which students' existing understanding of scientific knowledge can be challenged and hence, new learning can occur.

In drawing up the teaching syllabus, an attempt has been made to include a variety of investigations which are indicated by the code [IN]. These activities should involve a fairly genuine form of 'experimenting', including proposing questions or hypotheses for investigating, and devising ways to find answers. It also involves deciding on the type of equipment required, and measurements to be made, as well as identifying the variables involved and manipulating the variables so that the effect of only one variable can be observed in any one experiment. However, it should be noted that these coded activities are examples only and they do not form a complete set. Teachers may, however, find them a useful starting point for their own ideas.

ESTIMATED TIME ALLOCATION

The teaching syllabus is compiled on the assumption that schools will devote **at least 4 periods per week** to the teaching of Science in Secondary One to Three. As there is on average 28 teaching weeks in a school year, a total of 112 periods should be available in each school year.

As our student population shows a wide range of abilities, the course should be adapted to suit the interests and abilities of the students. The Core represents the basic components of science that all students should learn. By concentrating on a smaller number of content areas in the Core, it is hoped that most students will be able to master the basic concepts and principles in science. The Extension constitutes additional learning, the level of attainment for each topic within the Extension would vary from school to school and from class to class. Apart from the Core, teachers would need to select materials from the Extension to suit the needs, interests and abilities of the students. **It must be emphasised that an average student is not expected to learn all the materials in the Extension**.

Below is an estimation of the number of periods required to cover the individual units:

S1 Topics	**Estimated no. of periods**		
	Core	**Extensio**	**Total**
Unit 1 : Introducing Science	14	4	18
Unit 2 : Looking at Living Things	12	5	17
Unit 3 : Cells and Human Reproduction	13	7	20
Unit 4 : Energy	20	6	26
Unit 5 : The Wonderful Solvent - Water	14	14	28
Unit 6 : Matter as particles	15	12	27
Total:	88	48	136

S2 Topics	**Estimated no. of periods**		
	Core	**Extensio**	**Total**
Unit 7 : Living Things and Air	20	12	32
Unit 8 : Making Use of Electricity	17	8	25
Unit 9 : Space Travel	17	10	27
Unit 10: Common Acids and Alkalis	16	8	24
Unit 11: Sensing the Environment	18	10	28
Total:	88	48	136

S3 Topics	**Estimated no. of periods**		
	Core	**Extensio**	**Total**
Unit 12: Healthy Body	30	17	47
Unit 13: Metals	10	5	15
Unit 14: Materials of the Modern World	22	7	29
Unit 15: Light, Colours and Beyond	26	19	45
Total:	88	48	136

As it is very important that students be provided with the opportunity to learn through their own experience and at a level appropriate to their own achievement, the course should be adapted to suit the interests and abilities of the students.

The Core represents the basic components of science that all students should learn. By concentrating on a smaller number of content areas in the Core, it is hoped that most students will be able to master the basic concepts and principles in science. The Extension constitutes additional learning, the level of attainment for each topic within the Extension would vary from school to school and from class to class. Apart from the Core, teachers would need to select materials from the Extension to suit the needs, interests and abilities of the students.

An above average student would take a shorter time to cover each topic area, teachers should judiciously re-assign the time saved to cover more of the Extension topics to make the course more challenging for the students.

TEACHING SYLLABUS

Unit 1 - Introducing Science

Introduction

This Unit aims at arousing students' interest and curiosity in science and to open up their awareness to the different aspects of science, including the way that scientific knowledge is obtained. To this end, students are introduced to techniques and apparatus commonly used in a science laboratory as well as some of the fundamental ideas and skills useful in the processes of scientific investigations. As these ideas and skills are employed in investigations throughout the course, the treatment here should be kept simple. Students should also be guided to plan and carry out their first scientific investigation in the laboratory.

Unit objectives

All students should

1. develop interest and enthusiasm in science
2. gain some ideas of the skills and methods used by scientists
3. follow safety rules in carrying out experiments
4. develop skills in the safe handling of chemicals, apparatus and equipment
5. demonstrate commitment to safe practices in the laboratory
6. be able to take appropriate safety measures in case of emergency in the laboratory
7. practise cooperation in group activities
8. be able to observe, record and present simple experimental results
9. develop personal integrity through honest recording of experimental results
10. be able to use appropriate units in the measurement of physical quantities
11. gain some ideas and skills related to scientific investigation
12. identify the variables involved in an investigation
13. recognise the importance of measuring physical quantities accurately

The more able students should

1. be able to design and carry out a simple scientific investigation

Unit 1 - Introducing Science

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
1.1 What is science	Scope of science Limitations of scientific knowledge	What is science? The work of a scientist Realising the limitations of scientific knowledge		S. Collect newspaper cuttings related to science for board display and then discuss 'what is science?'(CM) T. Video on work of scientists. S. Library search on discoveries / inventions of famous scientists and discussion of their contributions to society (CM)
1.2 Safety in the laboratory	Laboratory safety	Knowing your laboratory Laboratory safety rules Safety measures to be observed in the science laboratory Coping with common laboratory accidents		S. From pictures identify potential hazards in the laboratory and suggest necessary precautions(OB) S. Decision making exercises on the right things to do in the laboratory in the case of accident or emergency, e.g. in case of a fire or acid spills T. Demonstrate the use of fire extinguishers (EA)
1.3 Using common laboratory equipment	Measuring temperature, weight, length, volume and time	Proper handling of simple apparatus, e.g. test-tube, dropper, Bunsen burner Proper use of measuring instruments, e.g. measuring cylinder, thermometer, half-metre rule, stop-		S. Familiarize with the safe handling of some common laboratory apparatus (EA, MS)

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
	Reading scales Accuracy in measurement Units Skills in using instruments	watch and balance Skills in transferring solution; mixing solution; measuring length, weight, time, temperature and volume Use of appropriate units in the measurement of physical quantities		
1.4 Conducting a simple scientific investigation	Fair test Control of variables Predictions Hypothesis Inferences Conclusion	Carry out a simple scientific investigation • carrying out an experiment • observing and recording the results • thinking about the results • drawing conclusion	*Design and carry out a simple scientific investigation, which may consists of some or all of the following steps:* • *identifying the problem to be investigated* • *identifying factors involved* • *proposing hypothesis* • *designing the investigation* • *choosing appropriate*	S. Video on the use of scientific methods S. Design and carry out a fair test [IN]

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
			instruments • *carrying out the investigation* • *collecting data* • *Interpreting data* • *drawing conclusion* *Making predictions and formulating hypotheses despite incompleteness of scientific knowledge*	*S. Read detective stories to appreciate how scientists look for evidences and make intelligent guesses (IF)* *S. Read stories of how scientists made inventions or discoveries*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. observing objectively and carefully
2. handling apparatus and instruments properly
3. measuring accurately
4. recording data honestly
5. data handling
6. handling chemicals and equipment safely
7. extracting relevant information from various sources and suitably organising them
8. communicating effectively during discussion
9. planning and carrying out a simple scientific investigation

Unit 2 - Looking at Living Things

Introduction

The emphasis of this Unit is to help students to develop some science related skills such as observation, classifying, recording of data and communication, through the study of living things. Through observations and discussions, students are introduced to the fact that living things have some features in common. They are also introduced to the wide variety of forms of living things and the need for classification.

Individual differences within and among different species are stressed. These aim at encouraging students to develop a more accepting attitude towards oneself and others. Students' attention is also drawn to man's impact on the environment and the need to protect the environment and endangered species.

Unit objectives

All students should

1. be able to distinguish between living and non-living things
2. be able to classify living things into animals and plants
3. be able to identify some of the characteristics of living things through the observation of an animal
4. be able to present data collected in a table form
5. appreciate variations among members of the same species and develop a more accepting attitude towards oneself and others
6. be able to use and construct a simple key to classify a given set of living things
7. be able to classify animals into those with and without backbones
8. be able to classify plants into flowering and non-flowering plants
9. show concern for the extinction of a variety of life forms
10. be aware of the effects of man's activities on the environment
11. be willing to contribute to the protection of our environment and endangered species
12. appreciate the wonder of nature and show respect and care for all forms of life

The more able students should

1. *be able to derive from observations some characteristics of living things*
2. *be able to construct and interpret a bar chart*
3. *be able to classify animals with backbones into fish, amphibians, reptiles, birds and mammals*

Unit 2 - Looking at Living Things

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
2.1 Living things	Characteristics of living things	Living and non-living things Plants and animals		S. Watch video or study pictures showing the characteristics of living things (OB)
2.2 Observing an animal	Observation Habitat	Observing an animal (a pet, a grasshopper, a snail, etc) in terms of its external features, feeding, movement, reaction to stimuli and habitat		S. Observe the external features, feeding, movement, habitat, etc. of an animal (e.g. a pet), discuss their observations (OB, CM) S. Find out how animals react to stimuli (CV)
2.3 Diversity of plant and animal life	Wide variety of living things Variation within the same kind of living things *Bar chart*	Observing the diversity of forms among living things Observing and comparing variation within the same kind of living things, e.g. variation of length of hand spans or size of leaves from the same tree	*Constructing and interpreting bar charts; variation from norm*	S. Collect pictures or photos of living things and present them in a wallchart to show the diversity of forms of living things (CM) S. Find out differences within a species (e.g. height or length of hand span) and present the data in table form (MS, ID) *S. Present the data obtained from the above activity in a bar chart (ID)*
2.4 Sorting things into groups	Keys Classification Animals with and without	Use of simple keys for identification Classifying animals into those with and without backbones Classifying plants into flowering and		S. Identify given specimens or diagrams of animals/plants by means of a given simple key (CS) S. Classify animals into those with or

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
	backbones Flowering and non-flowering plants	non-flowering plants		without backbones & plants into flowering and non-flowering plants from given pictures (CS)
			Constructing simple keys for identification	S. Construct a simple key to identify given living things (CS)
			Classifying animals with backbones into fish, amphibians, reptiles, birds & mammals	*S. Classify animals into fish, amphibians, reptiles, birds or mammals from given pictures of animals with backbones (CS)*
2.5 Endangered species	Endangered species Wild life Effects of man's activities on the environment Conservation	Awareness of the decreasing number and species of plants and animals on earth and the implication for man Inter-dependence of life, e.g. predation Effects of man's activities on wild life Importance of protecting wild life		S. Library search on the issue of endangered species (CM) S. Carry out activities in relation to conservation, e.g. visits to country parks

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. observing (an animal) over a period of time, noticing relevant details
2. making notes of observations
3. making generalisation from observations
4. identifying similarities and differences
5. classifying according to external features
6. controlling a single variable (finding out how animals react to stimulus)
7. data recording
8. using tables and graphs to present information
9. consulting different sources of information
10. extracting relevant information from a text and recording it
11. evaluating human activities with respect to environmental cost

Unit 3 - Cells and Human Reproduction

Introduction

In this Unit students are introduced to the cell as the basic unit of life and the fact that a new life begins from a cell. In man, when a sperm fuses with an ovum it may develop into an embryo. The development of a new life from embryo to baby to adolescent is followed. Then the focus of the students is drawn to the changes they expect to have at puberty and the maturation of the sex organs to be ready for reproduction. The stages from fertilisation to the development of the embryo are then studied. Signs and length of pregnancy and related health issues are also considered. The Unit ends with a discussion of other social issues like *in vitro* fertilisation and sexually transmitted diseases.

Much of the material in this Unit contributes towards 'sex education'. This is a cross-curricular issue where an agreed school policy is desirable. The content of the Unit should be evaluated in relation to the school policy. It is also important to liaise with staff of other departments in the school so that a more comprehensive programme may be offered. Sex education programmes should continue throughout the secondary school years.

Unit Objectives

All students should

1. understand that the cell is the basic unit of life
2. acquire some skills in using a microscope
3. appreciate and understand how a new life is born
4. be able to describe the various changes at puberty and the secondary sexual characteristics of the two sexes
5. be able to identify the different parts of the male and female reproductive systems
6. acquire some knowledge about the menstrual cycle
7. recognise nocturnal emission as a common phenomenon during adolescence
8. acquire some knowledge about pregnancy
9. recognise the responsibilities of parenthood
10. acquire some knowledge about the need for family planning and various methods of birth control
11. develop a positive attitude towards sex
12. recognise the responsibility within relationships and be able to make judgement on appropriate behaviour in relationships
13. appreciate the value of life and develop a positive attitude towards it

The more able students should

1. *acquire some knowledge about sexually transmitted diseases and develop a sense of obligation towards the prevention of their spread*
2. *be able to make judgements on social issues related to in vitro fertilisation*
3. *acquire some knowledge about heredity*

Unit 3 - Cells and Human Reproduction

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
3.1 The basic units of living things	Cells Basic structure of a cell Cells can divide and grow	Cells as basic units of living things which can divide and grow Basic structure of a cell: nucleus, cytoplasm, cell membrane, cell wall (in plants)		S. Through a video imaging device and microscope, examine the various types of cells in man (OB) S. Prepare slides of plant and animal cells (e.g. onion and ox eye cells) and observe under the microscope (OB,EA)
3.2 A new life is born	Reproduction Sex cells: sperm and ovum Fertilisation Implantation Birth Parental care *Heredity*	Perpetuation of human beings Fertilisation occurs when a sperm meets an ovum Implantation of the embryo in the uterus The development of the embryo inside the mother's body Birth of a baby Growth of a baby and parental care	*Various aspects of parental care in human beings* *Inheritance of characteristics* *Occurrence of identical and non-identical*	S. Watch video on how an embryo develops *S. Library search on parental care in other animals (CM)* *S. From a pool of photos, select and group the photos of the same family together*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			twins	
3.3 Puberty	Secondary sexual characteristics Reproductive systems Sexual maturity Menstrual cycle Nocturnal emission Positive attitude towards individual differences in physical appearance	Secondary sexual characteristics Male & female reproductive systems Signs of maturation of the reproductive system (menstrual cycle and nocturnal emission) We reach sexual maturity at different ages	***	S. With the help of a model examine the various stages of the menstrual cycle S. Watch video on the various changes at puberty School: Sex Education Week - board exhibition, film show, talk by Family Planning Association, seminar, and /or debate
3. 4 Pregnancy	Intercourse Pregnancy Parenthood Family planning Birth control *Abortion* *In vitro fertilisation*	Pregnancy: signs of pregnancy; length of pregnancy; related health issues Preparation for parenthood Family planning: the need for birth control, prevention of the fusion of ovum and sperm as the basic principle of birth control	*The various methods of birth control and how they work* *Abortion and its implications*	*S. Watch video on various methods of birth control*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			In vitro fertilisation: what it is and the related social issues	*S. Watch video on "test-tube" babies and debate on related issues such as selective breeding (CM)*
3.5 Sexually transmitted diseases	*Sexually transmitted diseases*		*Sexually transmitted diseases:* • *Examples of some sexually transmitted diseases* • *How do sexually transmitted diseases spread?* • *Consequences of contracting sexually transmitted diseases* • *Attitude towards AIDS patients*	*S. Quiz on the causes and prevention of sexually transmitted diseases* *S. Simulation game on the spread of sexually transmitted diseases* *School:* *Talk on HIV and AIDS held by a school counsellor or Family Planning Association /AIDS Foundation*

*** *In order to provide a comprehensive program of sex education, areas such as emotional development starting from puberty, sex role, identity, self-image and self-awareness should also be included in the school curriculum at the various levels. These themes could be dealt with through talks organised by social workers and moral/religious educational activities organised by various committees and school personnel for implementing sex education. Furthermore, the Guidelines on Sex Education in Schools should provide very useful resources as well as strategies that could be employed in organising sex education programmes.*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. preparing a microscope slide
2. observing biological specimens using a microscope
3. drawing and describing biological specimens
4. observing carefully to discern the order in which events take place
5. interpret information from data presented in diagrammatic form
6. extracting relevant information from various sources and suitably organising it
7. positioning oneself in a debate and expressing one's own opinion
8. debating to sort out ideas and clarify meaning
9. evaluating the impact of various application of scientific discoveries on society
10. making judgements on information obtained from the media based on scientific, ethical and social considerations

Unit 4 - Energy

Introduction

This Unit introduces students to the very important concept - energy. Students are first introduced to the different forms of energy and their interconvertibility through a series of activities. They are also presented with the energy conversion in a range of common devices. The importance of controlled energy conversion is brought out through a case study on a gas explosion. Safety in the transportation, storage and use of fuels is simultaneously highlighted.

A survey on the kind of fuels and energy sources used in Hong Kong is included in this Unit. Students should recognise that electricity is the most common source of energy used at home since it is a clean and convenient form of energy at the consumer end. The pollution problems arising from the generation of electricity should be discussed.

Through the analysis of data showing the world trend in energy usage and the amount of energy resources available on Earth, students should become aware that energy resources are limited and consider the possible long term implications. In this connection, they should be given opportunities to discuss how society might make decisions about energy issues.

Unit Objectives

All students should

1. be able to distinguish the different forms of energy
2. be able to identify the initial and final forms of energy in an energy change
3. be familiar with some common energy converters
4. be aware of the need to control energy conversions
5. be able to take appropriate safety precautions when using fuels
6. be able to explain why electricity is the most common energy source used at home
7. be able to state the energy changes in generating electricity from fuels
8. be able to state some examples of alternate energy resources
9. be aware of man's increasing need for energy and the finite energy source available to man
10. show concern for pollution problems arising from the generation of electricity
11. recognise the need to conserve energy in daily life and demonstrate commitment to it

The more able students should

1. *be aware of some of the safety problems associated with the storage and transportation of fuels*
2. *be aware of the pollution problems arising from the use of different energy sources*

Unit 4: Energy

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
4.1 Forms of energy	Heat energy Light energy Sound energy Kinetic energy Potential (gravitational) energy Chemical energy Electrical energy	Introducing the different forms of energy: heat, light, sound, kinetic, potential (gravitational), chemical and electrical energy		S. Identify the different forms of energy
4.2 Energy changes	Energy conversion Energy converters Controlled energy conversion Uncontrolled energy conversion	Simple energy changes; initial and final forms of energy in such processes Some common examples of energy converters including cells, motors and dynamos Controlled energy conversion Uncontrolled energy conversion is disastrous	*The intermediate forms of energy in some common energy changes*	S. Energy conversion experiments(OB) *S List the intermediate forms of energy in the course of energy changes* S. Perform a fair test to compare the energy stored in different stretched elastic bands (MS, CV) S. Watch video or read newspaper cuttings on gas explosions and then discuss the energy changes involved

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
4.3 Fuels	Fuels *Good fuels* Safety in using fuels	Common fuels, e.g. coal, petrol, kerosene, LPG (Liquefied petroleum gas), town gas Safety in using fuels	*What makes a good fuel* *Safety in the storage and transportation of fuels*	*S. Conduct a survey to find out the major fuels used in Hong Kong(ID)*
4.4 Generating electricity	Generation of electricity *Hydro-electric power* *Wind power* *Nuclear power*	Electricity is the most common energy source used at home Electricity is generated in power stations from coal, oil or natural gas in HK; pollution problems arising from the generation of electricity	*Other ways to generate electricity: e.g. hydro-electric power, wind power, nuclear power, chemical cell and solar cell*	T Generate electricity using a steam engine model *T. Generate electricity using a hydro-electric power model* *S. Generate electricity with a solar cell or home made chemical cells*
4.5 Energy sources and we	Fossil fuels and their limited supply Energy saving Efficient use of	Limited supply of fossil fuels and our increasing need for energy; the need for saving energy and the use of alternative energy sources		S. Inspect data on the amount of available fossil fuels and predict the world trend on energy usage (PD) S. Compare present life style with that

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
	energy Alternative energy sources Renewable and non-renewable sources of energy		*Pollution problems arising from the use of different energy sources*	of 50 years ago and list instances to show why there is an increasing need for energy S. Decision making exercise on ways to reduce energy consumption *S. Library search on pollution problems arising from the use of different energy sources (CM)*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. making notes of observations
2. observing carefully to discern the order in which events take place
3. making decision about what instruments to choose and what variables to measure
4. devising experimental tests which involve control of variables
5. data collection and interpretation
6. interpreting data explicitly based on patterns or relationships
7. consulting different sources of information
8. extracting relevant information from tables and graphs
9. suitably organising information extracted from different sources
10. using patterns in evidence to extrapolate
11. justifying a statement about what will happen in terms of present evidence
12. seeing the relationship between past and present events
13. evaluating the balance between comfort and environmental cost
14. evaluating the impact of scientific discoveries on our society

Unit 5 - The Wonderful Solvent - Water

Introduction

This Unit starts with the need to purify water for drinking, a need that students can easily perceive. The students are asked to design their own ways of making water clean. The teacher then leads students to consolidate the various means to make water drinkable. Through examination of the impurities under the microscope, students are introduced to the microscopic world of matter (seeing things that is normally invisible to them). The students are taken a step further, though not explicitly, into the microscopic world - the world of particles, when they consider the processes of boiling and evaporation. Through an experiment that simulates the formation of rain, students are helped to develop the 'particle' idea further by allowing them to see tiny 'particles' of water rising up inside the model.

The discussion of water consumption and pollution aims at arousing students' awareness of the need to conserve water and control water pollution.

The development of scientific investigation skills is given a prominent position in this Unit. As the investigations in this Unit are relatively safe, students should be encouraged to design the experiments on water purification in consultation with the teacher and then try them out. The skills in experimental design and the notion of a 'fair test' should be pursued further when comparing the rate of evaporation and the rate of dissolving using water as the solvent.

Unit Objectives

All students should

1. understand our heavy demand for clean water
2. be aware of the existence of soluble and insoluble substances as well as living organisms in water
3. be able to design and perform an experiment to purify water
4. understand how to evaluate their own experimental designs
5. acquire skills in filtration, distillation and evaporation
6. be able to distinguish between the purposes of filtration, distillation and evaporation
7. understand some of the ways of killing the micro-organisms present in water
8. be able to describe the water cycle
9. show concern for the water pollution problem and demonstrate commitment to the reduction of water pollution in daily life
10. acquire some knowledge about dissolving

The more able students should

1. *be able to design and carry out an investigation on the factors affecting the rate of evaporation*
2. *be aware of the need for sewage treatment before discharging*
3. *be able to design and carry out an investigation on the factors affecting the rate of dissolving*
4. *acquire some knowledge about crystals*
5. *be able to list some common solvents other than water*
6. *develop safety consciousness on the handling of solvents other than water*

Unit 5 - The Wonderful Solvent - Water

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
5.1 Water purification	Water purification Sedimentation Filtration Filtrate Residue Distillation Boiling Condensation	Heavy demand for clean water supply Impurities in natural water Various methods of water purification including sedimentation, filtration and distillation and their different capabilities	*Sedimentation and filtration processes in the water treatment plant*	S. Watch video on the lack of clean water supply in developing countries S. Read articles on impurities present in water and discuss their adverse effects on our health S. Design experiments to purify muddy water [IN] S. Perform purification experiments of students' own design [IN] S. With the help of a microscope, compare un-purified water with students' sample of 'purified' water (OB) S. Evaporate 'purified' samples to dryness (EA) S. Discuss the suitability of using the 'purified' samples collected as drinking water (CM) T. Distil muddy water using distillation apparatus (EA)
5.2 Further treatment of water	Micro-organisms Chlorination Fluoridation	Some micro-organisms present in water: Amoeba and *E. coli* and their possible effects on our health Methods to kill micro-organisms in water including the use of chlorine,		S. Under the microscope, observe micro-organisms in water and the effect of chlorine on them (OB)

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
		ozone or ultraviolet light Addition of fluoride to drinking water to prevent tooth decay		
5.3 The water cycle	The water cycle Evaporation Convention current *Rate of evaporation*	The water cycle - formation of clouds (evaporation & condensation), transportation by wind and rain	*Factors affecting the rate of evaporation*	S. Carry out an experiment to simulate the formation of rain in nature S. Watch video on where our drinking water comes from *S. Investigate the factors affecting the rate of evaporation [IN]*
5.4 Water conservation and pollution	Conservation of water Water pollution *Need to treat waste water*	Need to conserve water Common causes of water pollution Control of water pollution		S. Look at figures of water supply and consumption in HK and discuss ways to conserve water (CM, ID) S. Watch video on water pollution in HK S. Discuss methods of controlling water pollution (CM)
			Need to treat waste water before discharging it into the sea *Our responsibility towards minimising water pollution*	S. Suggest ways to reduce wasting water at home and in the community *S. Discuss on the issue of sewage treatment charges (CM)*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
5.5 Dissolving	Soluble Insoluble Dissolving Solvent Solute Solution *Saturated solution* *Rate of dissolving*	Water as a solvent for many substances	*Saturated solution* *Some substances can dissolve more and some less in the same amount of water* *Factors affecting the rate of dissolving*	*S. Investigate the factors affecting the rate of dissolving [IN]*
5.6 Growing crystals	*Crystals* *Crystallisation*		*Growing crystals* *Different crystals have different shapes*	*S. Grow crystals from a saturated solution (EA)* *S. Examine the shapes of different crystals (OB)*
5.7 Solvents other than water	*Solvents other than water*		*Examples of common solvents other than water: e.g. alcohol, thinner, nail varnish remover and dry-cleaning liquids; their uses and*	*S. Perform a fair test to find the best solvent for an oil stain on a cloth [IN]*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			potential hazards	

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. suggesting explanations for observations
2. inferring abstract concept through observing macroscopic phenomena (developing 'particle' idea from the experiment simulating the formation of rain)
3. checking interpretation against new findings
4. manipulative skills in filtering, distilling and evaporating
5. assembling apparatus for particular purposes
6. designing an experiment
7. evaluating experimental design based on stated purposes
8. devising and carrying out fair tests which involve control of variables
9. consulting different sources of information
10. identifying patterns and making predictions
11. interpreting data explicitly based on patterns of relationships
12. applying laboratory findings to large scale uses
13. evaluating the balance between modernization and environmental cost

Unit 6 - Matter as Particles

Introduction

Through classification of matter into solids, liquids and gases, students study the differences between matter in different states and then describe the properties of matter in the three states.

Students are then introduced to a simplified version of the particle theory. The approach taken is slightly different from the traditional approach. Instead of asking students to carry out experiments and then to use the results to 'reinvent' the particle theory, the students are first introduced to the ideas of the theory. After carrying out relevant experiments, students are asked to consider whether there is evidence to support the ideas. Students are then required to make use of the particle theory to explain some observed phenomena such as expansion, gas pressure and the density of matter.

Unit Objectives

All students should

1. know that there are three states of matter - solid, liquid and gas
2. be able to describe the macroscopic properties of matter in the three states
3. be able to classify matter into solids, liquids and gases
4. acquire awareness that the state of a substance depends on temperature, and a change in temperature can cause a substance to change state.
5. be able to find evidence to support the claims of the particle theory
6. be able to infer that all substances are made up of tiny particles
7. be able to infer that particles are moving
8. be able to infer that there are spaces between particles and the spaces between particles in a gas are relatively large while that in solids and liquids are relatively small
9. know that atom is the smallest unit of matter
10. know that a gas can be compressed and its pressure changes when it is compressed
11. acquire some knowledge of density
12. be familiar with the thermal expansion and contraction of solids, liquids and gases and some of their daily applications

The more able students should

1. *be able to explain the expansion and contraction of substances using the particle model*
2. *be able to explain the greater densities of solids when compared with liquids or gases using the particle model*
3. *be able to relate the different densities of hot and cold air to particle spacing*

Unit 6: Matter as Particles

Topics	Keys points	Content		Suggested activities
		Core	*Extension*	
6.1 States of matter	States of matter Solid Liquid Gas Change of state Melting Freezing Melting point Boiling point	States of matter: solid, liquid & gas Properties of solids, liquids & gases: • solids - have fixed volume & shape; • liquids - have fixed volume but no fixed shape; • gases - have no fixed shape & no fixed volume Change of state of matter takes place at a fixed temperature: melting, freezing and boiling		S. Classify matter into solids, liquids and gases (CS) S. Experiment to compare the change of volume of some solids, liquids and gases when compressed (PD) S. Experiment to find the melting and boiling point of water (EA) S. Find the melting point of a solid, e.g. stearic acid (MS, EA) S. Discuss how change of state can be put to use in everyday life
6.2 Illustrations for the support of the claims of the particle theory	Particles are small and invisible Particle spacing Particle movement	Particles are the fundamental building blocks of matter; they are small and invisible There are spaces between particles Particles are moving		S. Observe the growth of crystals under the microscope (OB, IF) S. Mix equal known volumes of alcohol with water and observe carefully (MS, IF) T. Diffusion experiment of nitrogen dioxide into air (IF) T. Diffusion experiment of perfume from within a balloon into air (IF)

Topics	Keys points	Content		Suggested activities
		Core	*Extension*	
				S. Experiment on the diffusion of potassium permanganate in water (IF) T. Through a video imaging device, show Brownian movement on a TV (IF)
6.3 Particle model for the three states of matter	Particle model Atom	Describing the three states of matter using the particle model Matters(e.g. Gold, Silver, Carbon) are made up of different particles Atom is the smallest unit of matter		S. Propose models for the three states of matter (HP) T. Demonstrate particle motion in the three states using the kinetic motion model
6.4 Gas pressure	Compressibility Gas Pressure	Gases are compressible due to the relatively larger spaces between the gas particles Pressure of gas due to the hitting of moving particles against container walls Measuring gas pressure using the pressure gauge		S. Compress air in a syringe and measure the pressure using a pressure gauge (EA, MS) T. Remove air directly with a vacuum pump from a metal can until it collapses / suck on a plastic bottle until it collapses
6.5 Density	Density	Objects with equal volume but different mass (weight) Floating and sinking Less dense substances float on denser liquids	*Density = $\frac{Mass(Weight)}{Volume}$*	S. Find the densities of some objects selected from the density kit (MS) *S. Find the densities of some liquids and some solids with regular shapes (MS)* S. Experiments on floating and sinking (PD)

Topics	Keys points	Content		Suggested activities
		Core	*Extension*	
			Using the particle model to explain • *The rising of a hot air balloon* • *The floating of a steel ship on water*	T. Carry out the hot air balloon experiment
6.6 Thermal expansion and contraction	Thermal expansion Thermal contraction	Substances expand when heated and contract when cooled Different expansion of solids, liquids and gases	*Using the particle model to explain the difference in the expansion of solids, liquids and gases*	T. Experiments on the thermal expansion and contraction of solids, liquids and gases (HP)
		Applications of thermal expansion & contraction in everyday life	*Explain the bending of the bimetallic strip when heated*	*T. Demonstrate the use of bimetallic strip in the construction of a fire alarm*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. observing objectively and carefully
2. interpreting observations
3. classifying from observed macroscopic properties
4. classifying from abstract and inferred properties
5. seeking empirical evidence for claims
6. measuring volume very accurately
7. explicitly using patterns in evidence to extrapolate
8. distinguishing a prediction from a guess
9. drawing conclusion from available data
10. checking interpretation against new findings
11. suggesting an explanation which is consistent with evidence
12. using models to explain phenomena and make predictions
13. distinguishing between fact, theory and model
14. applying science to solve problems

Unit 7 - Living Things and Air

Introduction

Students are first introduced to the gases present in the air. The experiment on the burning of food in air to release energy is used to illustrate that oxygen is required in our bodies to convert the chemical energy stored in food to other useful forms of energy.

How animals and plants obtain energy is taken as the thread to link respiration with photosynthesis. In both animals and plants, energy is released from food through respiration. In animals, the energy is obtained from the chemical energy of the food they consume. In green plants, the energy is obtained from the chemical energy of the food which they make for themselves through photosynthesis.

The gas exchange during respiration and photosynthesis is then employed to bring out the beauty of the carbon dioxide and oxygen balance in nature.

Unit Objectives

All students should

1. acquire some knowledge about the gases present in the air
2. be able to carry out tests for oxygen, carbon dioxide and water
3. be able to compare the composition of breathed and unbreathed air
4. be able to state the necessary conditions for burning
5. be able to set up control experiments to asses results of experiments
6. recognise that green plants make their own food through photosynthesis
7. be able to infer from experiments the necessary conditions for photosynthesis
8. be able to test for the presence of starch in green leaves
9. be able to infer that man and plants obtain their energy from the chemical energy stored in food
10. be able to infer from experiments that oxygen is used and carbon dioxide is produced by plants and animals during respiration
11. be able to control variables to make experiments valid
12. recognise respiration as the process during which the chemical energy in food is released
13. be able to distinguish between breathing and respiration
14. be able to generalise from the gas relationship between animals and plants that there exists a carbon dioxide - oxygen balance in nature
15. appreciate the interdependence between plants and animals
16. be able to evaluate the effects of smoking on health
17. be aware that air may contain substances which are irritating to our lungs

The more able students should

1. *be able to investigate the necessary conditions for photosynthesis*
2. *recognise green plants as the primary producers in food chains*
3. *be able to identify the main parts of our respiratory system*
4. *be able to describe the breathing mechanism in man*

Unit 7 - Living Things and Air

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
7.1 What is air made up of	Air as a mixture of gases Test for oxygen, carbon dioxide and water	Gases in the air: percentage of main gases in the air Test for oxygen using a glowing splint Test for carbon dioxide using lime water or hydrogen carbonate indicator Test for water using blue cobalt chloride paper Comparing the oxygen and carbon dioxide content and the temperature of breathed and unbreathed air	*Comparing the water vapour content in breathed air and unbreathed air*	S. Test for carbon dioxide, oxygen and water (EA) S. Experiments to compare the oxygen and carbon dioxide content of breathed and unbreathed air (IF)
7.2 Burning	Oxygen supports burning Fire triangle	Burning requires oxygen Energy is given out during burning Energy and carbon dioxide are given out when food is burnt The fire triangle - oxygen, fuel & temperature		T. Demonstrate the various methods of putting out a fire and discuss the reasons behind S. Quiz on fire prevention knowledge

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
				and survival skills in fire accidents
7.3 How does man obtain energy	Food as a source of energy	The chemical energy stored in food can be changed by our body into other useful forms of energy	*Examples of food with high energy content*	S. Experiment on burning of food to heat a small amount of water (PD) S. Fair tests to find out which brand of snacks contains the greatest amount of energy [IN]
7.4 How do green plants obtain energy	Photosynthesis Test for starch Conditions for photosynthesis Conversion of energy in sunlight to chemical energy in green plants *Food chain*	Green plants make food through photosynthesis Starch and oxygen are products of photosynthesis Test for starch in green leaves Conditions for photosynthesis	*Destarching in photosynthesis experiments* *Investigating the various conditions required for photosynthesis* *Green plants take in energy from sun and are producers of food, animals*	S. Test for starch in green leaves (EA) S. Show that oxygen is produced during photosynthesis (CV) *S. Investigate the necessary conditions for photosynthesis: carbon dioxide, light and chlorophyll [IN]*

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
			are consumers *Idea of food chain*	
7.5 Gaseous exchange in animals and plants	Gaseous exchange in animals Respiration *Respiratory system in man* *Breathing mechanism* Gaseous exchange in plants	Animals take in oxygen and give out carbon dioxide day and night Oxygen is needed to release the chemical energy from food Respiration is a process during which energy is given out from food to support body activities	*Main parts of respiratory system including nose, trachea, bronchi, lungs, ribs & diaphragm* *Other parts including the air sacs and intercostal muscles* *Breathing in and out in relation to the change of volume of lungs and position of ribs and diaphragm* *Breathing in and out in relation*	S. Find out which gas is consumed when animals breathe. (CV) *T. Use a model to illustrate the main parts of the respiratory system in man* *T. Demonstrate the breathing mechanism in man using a balloon-bell jar model* *T. Use a model to illustrate the action of the diaphragm and the intercostal muscles during breathing*

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
			to pressure difference	
		Distinguish between breathing and respiration Plants respire day and night Under sunlight, green plants carry out both respiration and photosynthesis.		T. Experiment to show the gaseous exchange in plants during photosynthesis and respiration (CV)
7.6 Balance of carbon dioxide and oxygen in nature	The carbon dioxide - oxygen balance	Balance of carbon dioxide and oxygen in nature	*The effect of the increasing amount of carbon dioxide in the atmosphere on us*	*S. Library search on the effect of the increasing amount of carbon dioxide in the atmosphere on us*
7.7 Effects of smoking and polluted air on our respiratory system	Smoking and health Air pollution *Air pollution index*	Smoking & health: passive smoking; diseases related to smoking, e.g. lung cancer and heart disease		T. Using a cigarette smoking model, show that tar is breathed in during smoking S. Discuss the issues related to passive smoking (CM)
		Air may contain substances which are irritating to our lungs; these substances may include small solid particles and a small quantity of poisonous gases	*Air pollution index (API) as an indicator for air quality*	

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
		Diseases of the respiratory system easily triggered by polluted air e.g. asthma and bronchitis		

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. interpreting and explaining observations
2. identifying cause-effect relations
3. making generalisations
4. survival skills in fire accidents
5. applying laboratory techniques in the tests for gases, water and starch
6. controlling variables to ensure the validity of experiments
7. devising and carrying out fair tests
8. distinguishing between valid and invalid conclusions
9. combining findings of different experiments in drawing conclusions
10. using models to explain phenomena
11. suitably organising relevant information extracted from different sources
12. managing natural resources wisely and responsibly

Unit 8 - Making Use of Electricity

Introduction

Electricity has become part of modern living. In this Unit, students are guided through a series of investigations to realise the necessary conditions for current flow. Series and parallel circuits will be introduced to pave the way for looking at the electricity supply used in the home.

The use of circuit symbols in representing circuit components is a relatively abstract idea. To begin with, students will be required to connect various parts of the circuit components according to pictures of real objects or block diagrams. Following the development in the Unit, circuit symbols are introduced and students are required to wire up electrical circuits according to circuit diagrams. Through practice they will appreciate the usefulness of using circuit diagrams in showing essential features of circuits.

The Unit ends with a discussion of electrical safety which serves to warn students of the dangers of mains electricity and encourages adoption of safe practices in their daily life. They also learn to calculate the cost of energy used by domestic appliances.

Unit Objectives

All students should

1. be able to illustrate with experiments that a source of electrical energy and a closed circuit are required for current flow
2. be able to design a simple circuit to test for insulators and conductors
3. be familiar with the structures of simple switches
4. be aware that chemical energy in a cell is converted to other forms in a closed circuit
5. be able to measure current and voltage with ammeters and voltmeters respectively
6. be able to describe the functions of resistors in a circuit and give examples of the common applications of rheostats
7. be able to use the units: ampere, volt, ohm appropriately
8. be able to use common circuit symbols in drawing circuit diagrams
9. acquire some skills in wiring simple circuits
10. recognise and describe patterns of changes in currents and voltages in electrical circuits
11. acquire some familiarity with series and parallel circuits
12. be able to interpret the heating effect of current as a kind of energy conversion
13. be able to choose correct fuses to protect appliances
14. be able to explain why parallel arrangement is preferred to series arrangement in domestic circuits
15. be aware of the danger of overloading in the use of universal adaptors
16. commit to practising safety precautions in using mains electricity

The more able students should

1. *be able to investigate and find out the factors affecting the resistance of a wire*
2. *be able to use the units: watt, kilowatt-hour appropriately*
3. *be able to calculate the cost of power consumption at home*
4. *be able to identify electrical appliances working with the magnetic effects of currents*

Unit 8 - Making Use of Electricity

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
8.1 Closed circuit	Closed circuit	Chemical energy is stored in a cell Need for a closed circuit and a cell to light up a bulb		S. Using a cell and some wires to make a bulb light up in a circuit (PD)
8.2 Electrical conductors and insulators	Electrical insulators Electrical conductors Switch	Classifying objects into electrical insulators and conductors Structure of simple switches		S. Design a circuit to test for insulators and conductors [IN] S. Observe the structure of different kinds of switches and connect each of them in a circuit to light up a bulb (OB, EA)
8.3 Current	Current ampere Ammeter	Current flows in a closed circuit to light up a bulb Electric current Chemical energy in a cell is converted into light and heat energy in a bulb when a current flows in a circuit Use of a suitable analogy to illustrate the concept of current Unit of current: ampere (Symbol, A) Ammeters are used to measure current		S. Measure the current in a circuit using an ammeter (MS, EA)
8.4 Voltage	Voltage volt Voltmeter	Voltage of a cell: the greater the voltage, the greater the current in a circuit Unit of voltage: volt (Symbol, V) Voltmeters are used to measure the voltage of a cell		S. Measure the voltage of some common cells and batteries using a voltmeter

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
				(MS, EA)
8.5 Resistance	Resistance Resistor ohm Rheostat	Resistance Resistor Unit of resistance: ohm (Symbol, Ω) How a rheostat works Applications of a rheostat, e.g. volume control	*Factors affecting the resistance of a wire*	S. Observe the brightness of the bulb as the resistance of the circuit is changed (IF) *S. Carry out fair tests to investigate factors affecting the resistance of a wire [IN]*
8.6 Circuit symbols	Circuit symbols Circuit diagrams	Circuit symbols including those for cell, battery, light bulb, resistor, rheostat, switch, voltmeter and ammeter Simple circuit diagrams		S. Set up electrical circuits from given circuit diagrams (EA) S. Draw diagrams of actual circuits using circuit symbols
8.7 Electrical circuits	Series circuit Parallel circuit	Series circuit: current is identical at all points in a series circuit Parallel circuit: current in the main loop is equal to the sum of the currents in the branches; a larger current flows in the branch with lower resistance		S. Measure currents in series and parallel circuits (EA)
8.8 Fuses	The heating effect of a current Fuses Fuse ratings Circuit breaker	Heating effect of current as a kind of energy conversion Heating effect increases as current increases Working principle of a fuse		S. Observe the heating effect when a current is passing through a nichrome wire (OB)

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
		Use of fuses for the protection of electrical appliances Fuse ratings Circuit breaker as an alternative device in protecting circuits (Working principle is NOT required)		T. Experiment on the use of fuses
8.9 Household electricity	Mains voltage Ring circuits Overloading Earthing Short circuits	Mains voltage in Hong Kong Wiring of a 3-pin plug Colour coding of wires Domestic circuits: advantages of a ring circuit Electrical adaptors: overloading and electrical fires Safety precautions in using electricity from the mains: • Use of an Earth wire • Avoid overloading of electrical adaptors • Avoid short circuiting		S. Wire a 3-pin plug (EA) S. Newspaper cuttings on accidents caused by electrical fires (CM)
8.10 Power of an electrical appliance	*Power* *watt*		*Power (wattage) as the electrical energy transferred to an appliance per second* *Unit of power:*	*S. List the power rating of some common electrical appliances* *S. Find the current drawn from the mains when using some common appliances (Using the relation: Current = Power / Voltage) (ID)*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			watt (Symbol, W) *The greater the power of an appliance, the larger the current flowing through it for the same applied voltage*	
8.11 Cost of electricity	*Kilowatt-hour* *Kilowatt hour meter*		*Practical unit of electrical energy: kilowatt-hour (Symbol: kW h)* *Kilowatt-hour meter* *Calculating the cost of electricity from an electricity bill*	*S. From meter readings, calculate the cost of electricity (ID)*
8.12 Electrical appliances	*The magnetic effect of a current*		*Working principle of common electrical appliances:*	*S. Observe the internal structure of electrical appliances which make use of the heating effect of a current (OB)* *S. Study the magnetic effect produced by*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			• *Heating effect, e.g. electric iron, rice-cooker, heater* • *Magnetic effect, e.g. motor, loudspeaker, door bells*	*a coil (IF)* *T. Demonstrate that a force can be produced by a magnet on a wire carrying an electric current. (OB)* *S. Observe the internal structure of electrical appliances which make use of the magnetic effect of a current (OB)*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. setting up electrical circuits
2. predicting based on present evidence
3. selecting appropriate apparatus and suggesting experimental procedures
4. drawing conclusion from evidence
5. classifying according to intrinsic properties
6. using a variety of measuring devices (ammeter, voltmeter)
7. reading scales of electrical meters
8. recording data and presenting them suitably
9. using symbols to convey information
10. making generalisation from data collected
11. distinguishing and co-relating different physical quantities (current, voltage, resistance)
12. conducting a fair test
13. suitably organising relevant information extracted from different sources
14. applying science to solve everyday problems
15. wiring plugs
16. handling electrical appliances safely
17. choosing suitable electrical appliances based on scientific considerations

Unit 9 - Space Travel

Introduction

The Unit introduces students to space travel - the idea that applications of science and technology have made it possible for man to send equipment and people beyond the limits of the earth.

Basic concepts about forces and their effects are first introduced to help students understand how a rocket is launched. The absence of gravity in space stations should help students appreciate the effects of forces on the motion of an object and this should provide a very good background for discussions of 'inertia' and 'Newton's first law of motion' at a later stage. The problems met by astronauts living in space should provide a very interesting context for students to explore conditions for life.

The 'spin-off' benefits from space research which influence our everyday lives and the financial implications of these space programmes are also discussed.

Unit Objectives

All students should

1. be able to describe some effects of forces
2. be able to use newton (N) as the unit of force
3. recognise friction as a resisting force to motion between surfaces
4. be able to demonstrate some ways to reduce friction
5. recognise weight as a measure of the force of gravity of the earth on an object
6. be able to infer from experiments that the upward motion of a rocket is due to the downward motion of the exhaust gas
7. be able to infer from experiments that forces always work in pairs and they are equal and opposite to each other
8. understand some basic conditions required for space travel
9. recognise that motion in space is frictionless and gravity-free
10. be able to describe the effects of gravity and frictional forces on the motion of an object on earth
11. understand some of the problems faced by astronauts living in space
12. develop an awareness that science is not confined to the laboratory
13. develop an interest and enjoyment in studying the marvels of science and technology
14. appreciate that the advances in science and technology have brought man beyond the limits of our planet

The more able students should

1. *recognise that the weight of an object on the moon is different from its weight on earth*
2. *be aware of the potential hazards in using hydrogen as a fuel*
3. *recognise the advantages of using space shuttles in space programs*
4. *be able to infer some of the basic conditions required to maintain life through the study of space suits*

Unit 9 - Space Travel

		Content		
Topics	Key points	Core	*Extension*	Suggested activities
9.1 Forces	Forces Measuring forces Newton	Using a newton balance to measure forces Unit of force: newton (Symbol, N) Examples of forces including non-contact forces (force of gravity, force exerted by a magnet) Effect of forces on the motion of an object		S. Using a newton balance to measure forces (MS) S. Investigate the effects of forces on the motion of an object (PD)
9.2 Friction	Friction Reducing friction	Friction as the force existing between two surfaces in relative motion Friction can be reduced by lubricants, air cushions etc Making use of friction		S. Experiments with 'frictionless motion', e.g. slide a balloon puck along a bench
9.3 Force of gravity	Force of gravity Weight *Mass*	Force of gravity is the force exerted by the earth on an object pulling it towards the centre of the earth Weight as a measure of the force of gravity of the earth on an object	*Weight of an object on the moon is different from its weight on earth*	S. Measuring weight using a newton balance

		Content		
Topics	Key points	Core	*Extension*	Suggested activities
			The relationship between mass and weight	
9.4 A space journey	Action and reaction Hydrogen as a fuel Air friction Stream-lining Frictionless motion Gravity-free motion Weightlessness Insulation of heat	a. Launching: • Escape from gravity • Rockets are pushed upwards because exhaust gases are pushed downwards • Forces are always working in pairs - action and reaction • Fuels for rockets - solid fuel and liquid hydrogen • Rockets carry their own supply of oxygen because of the absence of oxygen beyond the atmosphere	*Potential hazards in using hydrogen as a fuel*	S. List the conditions needed for space journeys S. Experiment with balloons, water rockets, etc. (IF) S. Trolley experiments on action and reaction (HP) S. Watch videos on the use of rocket motors during space journeys for change of direction and speed *S. Test for hydrogen (EA)*
		• Stream-lined shape of rocket (minimising air friction)		S. Make the fastest 'balloon rocket' [IN]
		b. In space • Frictionless motion • Gravity-free motion		S. Discuss how astronauts move in space S. Riding a roller coaster to experience some of the sensations felt by astronauts during space journeys, e.g. accelerated motion and weightlessness

		Content		
Topics	Key points	Core	*Extension*	Suggested activities
		c. Return of spacecraft • Gravity • Air friction (heat insulation, parachute)		S. Experience the heating effect of friction (PD) *S. Investigate the factors which affect the fall of a parachute [IN]* S. Obtain information concerning a manned spacecraft, including its design and re-entry (CM)
			Space shuttle	*S. Library search about the launching of a space shuttle and how it returns to earth (CM)*
9.5 Life of an astronaut in space	*Radiation* *Conduction of heat*	Some problems faced by astronauts living in space, e.g. weightlessness, energy sources, food & water, sanitation, communication, sleep etc.		S. Obtain and present information on life of an astronaut in space (CM)
			Space suits for astronauts working outside the spacecraft: • *Maintaining body temperature* • *Maintaining the pressure* • *Treating body waste* • *Oxygen supply*	*S. Study the design of a space suit (IF)* *S. Comparing the space suit with a vacuum flask.*

		Content		
Topics	Key points	Core	*Extension*	Suggested activities
9.6 Space Exploration			*The impact of space programmes on Man*	*S Debate on whether we should continue with space exploration (CM)* *S. Library search on achievements in space exploration programmes in our country (CM)* *S. Make a list of some space spin-off products.*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. inferring from observations
2. interpreting data
3. defining physical quantities operationally (e.g. forces are measured by the effects they produced)
4. using patterns in evidence to extrapolate
5. suggesting an explanation which is consistent with evidence
6. predicting based on present evidence
7. making generalisations
8. applying scientific concepts in explaining phenomena
9. applying imagination to visualise experience in space based on scientific information
10. distinguishing between facts and inferences
11. consulting different sources of information
12. extracting relevant information from a text and suitably organising it for presentation
13. carrying out and evaluating simple investigations
14. applying science to solve everyday problems
15. evaluating the impact of scientific development on society

Unit 10 - Common Acids and Alkalis

Introduction

This Unit introduces students to acids and alkalis using indicators. The pH value is then introduced as an indication of the relative acidity and alkalinity of a solution. The corrosive nature of acids and the effect of acid rain on the environment are explored. Neutralisation and uses of acids and alkalis in everyday life are also discussed. Students should be alerted to the potential hazards associated with the handling of acids and alkalis and they should develop safety consciousness in the handling of chemicals.

Unit objectives

All students should

1. be able to list some common acids and alkalis
2. be able to distinguish acidic and alkaline solutions using common indicators
3. acquire knowledge of pH scale as an indication of relative acidity
4. be able to use pH paper or universal indicator to indicate the degree of acidity and alkalinity of a substance
5. be able to describe some of the actions of dilute acids on metals and building materials
6. acquire some knowledge of the corrosive nature of acids
7. be aware of the potential hazards related to the use of acids and alkalis
8. acquire some knowledge of the causes of acid rain and its effects on the environment
9. acquire skills in preparing a salt by acid-alkali neutralisation
10. acquire some knowledge of the everyday uses of acids, alkalis and neutralisation
11. develop safety consciousness in the handling of chemicals

The more able students should

1. *be able to describe some of the measures to prevent the formation of acid rain*
2. *acquire proper skills in diluting concentrated acids and alkalis*

Unit 10: Common Acids and Alkalis

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
10.1 Common acids and alkalis	Acids Alkalis	Common acids & alkalis used at home		S. List common acids and alkalis (CS)
10.2 Indicators for testing acids and alkalis	Indicators pH scale Universal indicator	Use of indicators (such as litmus or other natural indicators) to test the acidic and alkaline properties of solutions pH scale as an indication of relative acidity Measurement of pH value: use of pH paper or universal indicator		S. Using common indicators to classify solutions into acidic and alkaline (EA) T. Story about Boyle's discovery of indicators for acids and alkalis S. Prepare natural indicators, e.g. from red cabbage leaves, and compare the colour changes when added to acidic and alkaline solutions (EA) S. Find the pH values of common liquids found at home, e.g. detergents, soft drinks, etc. S. Find out if common soaps and shampoos have the pH values written on the labels.
10.3 Acids and corrosion	Corrosive nature of acids Test for hydrogen Test for carbon dioxide	Action of dilute acids on metals (e.g. magnesium, aluminium, zinc, iron, copper) and building materials (e.g. marble, limestone, sand) Safety in handling acids Choice of utensils for cooking acidic food		S. Carry out experiments with dilute acids on metals or building materials and test the gases produced (EA)

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
		Avoid using acidic solutions to clean marble surfaces		
10.4 Acid rain	Acid rain	Causes of acid rain and its effects on the environment	*Preventive measures against acid rain*	S. Simulation experiment on the effect of acid rain on the growth of seedlings (IF)
10.5 Neutralisation	Neutralisation Salt	Neutralisation of acids and alkalis to get salts		S. Neutralise an alkali with a dilute acid and evaporate the solution to obtain the salt produced (EA)
10.6 Everyday uses of acids, alkalis & neutralisation	Food preservation	Use of acids in food preservation	*Use of acids to prevent browning of fruit*	S. Design an experiment to find out the strength of vinegar needed to preserve fruits at room temperature for at least a month [IN] *S. Design an experiment to find out the effect of different pH on the prevention of apple browning [IN]*
		Acids and alkalis as cleansing agents e.g., hydrochloric acid; caustic soda (sodium hydroxide) and ammonia solution		T. Demonstrate the cleaning action of hydrochloric acid, caustic soda or ammonia solution
		Use of antacid to treat stomach-ache		
		Treatment of wasp, mosquito and ant		

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
		stings Treatment of industrial waste involving		S. Find out how chemical waste is
		acids and alkalis		handled in the school laboratory
10.7 Potential hazards related to the use of acids & alkalis	Strong acids Strong alkalis Concentrated acids Concentrated alkalis Dilution	The potential dangers in handling strong acids & alkalis Emergency treatment involving acids and alkalis Proper procedures in diluting concentrated acids and alkalis		S. Discuss the safe handling of acids & alkalis (CM) T. Demonstrate the correct way of diluting concentrated sulphuric acid (EA)

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. inferring from observations
2. classifying according to intrinsic properties
3. handling household chemicals safely
4. identifying aspects of a situation which can be explained in terms of science
5. consulting different sources of information
6. checking claims scientifically
7. conducting a fair test
8. applying science to solve everyday problems
9. evaluating the balance between modernisation and environmental cost

Unit 11 - Sensing the Environment

Introduction

This Unit focuses on how man perceives environmental stimuli using his sense organs (i.e. eye, ear, tongue, nose and skin). The structures and functions of the different parts of the eye and ear are considered in some details. For some sense organs, activities are suggested to show the limitation of the sensing mechanism, such as the existence of the blind spot and the audible range. The unreliability of our senses is also mentioned. Human perception of environmental stimuli is treated as the integration of all sensory signals. The role of the brain as an interpreter of sensory signals is also introduced.

The Unit ends with a discussion of the effects of drugs and solvents on our senses. Students' attention is drawn to the fact that drugs and solvents affect our judgments and responses.

Unit Objectives

All students should

1. be able to identify the main parts of the eye and relate them to our sense of vision
2. understand some of the methods we use to extend our vision
3. be able to outline how sound is produced and transmitted
4. be able to identify the main parts of the ear and relate them to our sense of hearing
5. recognise that there is an audible range of frequencies in man
6. be aware of the noise pollution problem and its harmful effects on our health
7. be committed to reducing noise in everyday life
8. understand some of the measures for protecting the eye and the ear
9. acquire some knowledge about our senses of smell, taste and touch
10. be aware that our senses are not always reliable
11. recognise the importance of the brain in interpreting sensory signals and hence in perceiving the environment
12. recognise that drugs and solvents can affect our senses
13. be able to make informed decisions on the use and the abuse of drugs

The more able students should

1. be able to select the right type of lens for correcting long sight and short sight
2. acquire knowledge of the main parts of our brain and their functions

Unit 11 - Sensing the Environment

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
11.1 Sensing the environment	Sense organs Senses	Need to respond to the environment Perceiving the environment: types of stimuli & corresponding sense organs Our senses, e.g. sight, hearing, taste, touch and smell		S. List how we depend on our senses, e.g. avoidance of danger, searching for food *S. Library search on specialised methods used by other animals to sense the environment (CM)*
11.2 How we see	Functions of main parts of the eye *Focusing*	Main parts of the eye, including the cornea, iris, pupil, lens, retina and optic nerve and their functions	*Light sensitive cells on our retina - the rods and the cones* *Focusing by eye lens*	S. Using an eye model, identify the main parts of the eye S. Dissection of an ox eye and identification of the main parts(EA) *S. Observe printed characters through the ox eye lens. What happens to the size of the print when you squeeze the lens? (IF)*
11.3 Limitations of our eyes	Extending our vision *Blind spot*	Use of telescope, hand lens and microscope to extend our vision	*Blind spot*	S. Construct a telescope using lenses *S. Experiment showing the presence of the blind spot (IF)*

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
11.4 Defects of the eye	*Long sight* *Short sight* *Cataract* *Colour blindness*		*Long sight & short sight: causes & correction* *Cataract* *Colour blindness*	*T. Demonstration of long sight & short sight and their correction* *S. Test colour-blindness using charts*
11.5 How we hear	Sound production Sound transmission Frequency hertz Functions of main parts of the ear	Production of sound by vibrations Sound must travel through a medium Frequency as the number of vibrations per second Unit of frequency: hertz (Symbol, Hz) Main parts of the ear including the eardrum, ear bones, cochlea and auditory nerve and their functions		S. Identify and observe the parts of musical instruments which produce vibrations (OB) S. Observe the wave pattern when a vibrating tuning fork is placed lightly on the surface of water (IF) T. Demonstrate the 'electric bell in bell jar' experiment (PD) S. Study an ear model and identify the main parts
11.6 Limitations of our ears	Audible frequencies Sound level Decibel meter	Range of frequencies audible to man Measurement of loudness of sound using a decibel meter	*Audible range of other animals (e.g. bats, dolphins and dogs)*	T. Experiment to show the limits of our audible range of frequencies S. Measurement of loudness level in different environments using a decibel meter (MS, ID)

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
11.7 Effects of noise pollution	Noise pollution	Noise pollution and its harmful effects on our health Protecting our sense of hearing		S. Case study on noise pollution around your school, hence decide if air-conditioners should be installed. (CM) S. Discuss the effects of prolonged use of ear phones on hearing (CM)
11.8 Senses of smell, taste & touch	Smell Taste Touch Our senses are not always reliable	Smell receptors in our nose Taste buds on our tongue Our sense of smell affects our sense of taste Skin as a sense organ of touch and heat Our skin is not reliable in detecting hot and cold	*Four primary types of taste* *Different parts of our body are not equally sensitive to touch*	S. Experiment to demonstrate the use of taste and smell in detecting the flavour of our food (IF) *S. Library search on careers that require people with excellent senses of smell and taste (CM)* S. Experiment with ice, warm and hot water to show the unreliability of our senses (IF) *S. Find the area in our body limbs that is most sensitive to touch*
11.9 The brain and our senses	Interpretation of signals Illusions *Functions of main parts of the brain*	The brain as interpreter of sense signals Illusions	*Main parts of the brain, including cerebrum, cerebellum*	S. Experiments on illusions *S. Examine a model of the human brain to identify the different parts*

Topics	Key Points	Content		Suggested activities
		Core	*Extension*	
			and	
			medulla and their functions	
11.10 Responses to stimuli	Responding to stimuli	Sensory and motor functions of the brain		S. Experiment to measure reaction time (MS)
11.11 Effects of drugs and solvents on our senses	Drugs and solvents affect our judgments and responses *Breathalyser*	Effects of alcohol on our judgments and responses Our senses can be affected by drugs such as sleeping pills, LSD, cannabis, heroin, morphine, etc Solvent-sniffing affects the respiratory centre of the brain and can lead to suffocation	*Use of breathalyser in measuring the alcohol content of breathed air*	S. Newspaper cutting on road accidents related to drunk driving (CM) *S. Simulation experiment on the working principle of a breathalyzer: pass alcohol vapour into acidified dichromate solution and observe the colour change* S. Discuss the harmful effects of solvent-sniffing (CM) S. Design slogans to persuade young people not to drink alcohol / take drugs / sniff solvents

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. using instruments for detailed observations
2. interpreting observations
3. identifying aspects of a situation which can be explained in terms of science
4. handling equipment and apparatus safely
5. basic dissection techniques
6. data collecting
7. extracting relevant information from various sources and suitably organising it
8. communicating effectively during discussion
9. making interpretations based on all available data
10. consulting different sources of information
11. interpreting a variety of forms of information
12. making generalisations
13. building and using models to explain phenomena
14. predicting outcomes based on evidence
15. evaluating the effects of drugs on our body
16. making informed decisions on the use and the abuse of drugs
17. evaluating the balance between modernisation and environmental cost

Unit 12 - A Healthy Body

Introduction

This Unit deals with selected aspects of body health. In studying this Unit, students should acquire some knowledge and understanding of the functioning of their bodies. Students are first introduced to the different types of food substances and the idea of a balanced diet. The health problems related to under-eating, over-eating and eating processed food are then brought up. How food is digested and absorbed in our body is also discussed.

The circulatory system is introduced as the transport system of the body, by which the digested food substances and oxygen are carried to the body cells where energy in food is released to support body activities. Attention then focuses on the heart, and its role in pumping blood around the body. The links between a healthy heart and aspects of lifestyle including diet, especially fatty foods; exercise and rest are also discussed.

Unit objectives

All students should

1. recognise the requirements for a healthy body
2. be able to identify the main types of food substances and state their functions
3. recognise the relevance of a balanced diet to a healthy body
4. recognise the effects of under-eating and over-eating on health
5. develop an awareness of the substances present in their daily food
6. acquire some knowledge about the main parts of the human digestive system and their functions
7. be able to identify the different types of human teeth and relate their functions to their shapes
8. be able to describe how food is digested and absorbed in our body
9. be able to explain how digested food is carried to all parts of our body
10. recognise the importance of exchange of materials between blood and body cells
11. recognise the problems associated with eating fatty foods
12. commit to establishing eating habits that enhance good health
13. understand the fitness of oneself by some common indicators
14. develop a positive attitude towards one’s physical strength
15. value the need for exercise and rest

The more able students should

1. *be familiar with some common food additives and their functions*
2. *be able to describe the causes and methods of prevention of tooth decay*
3. *be familiar with the structure and function of the circulatory system of man*
4. *be able to test for presence of glucose, starch, fats and proteins*
5. *be familiar with the normal count ranges of components of blood in a blood test*

Unit 12 - A Healthy Body

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
12.1 Keeping our bodies healthy	A healthy body	Requirements for a healthy body: appropriate food, enough exercise and rest	***	S. Discuss what is meant by a 'healthy body'
12.2 Food substances	Main types of food substances and their functions *Function of water*	Water and six main types of food substances: carbohydrates, fats, proteins, vitamins, minerals and dietary fibre	*Tests for glucose using clinistix paper* *Test for proteins using albustix paper* *Test for fats using filter paper (spot test)*	*S. Test for glucose, protein and fats (EA)*
		Main functions of carbohydrates, fats, proteins, vitamins, minerals and dietary fibre in our diet		S. Observe slides / photographs to recognise the health problems associated with the deficiencies of proteins, minerals and vitamins in the diet S. Discuss the types of foods which provide the six main types of food substances
			Water and its functions	

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
12.3 Balanced diet	Energy values of food Food pyramid Importance of dietary fibre Balanced diet Obesity Anorexia	Energy values of food Different energy requirement for people of different age, sex and occupation Food pyramid Dietary fibre is important for the contractions of the intestine, which help to move food forward Balanced diet involves the intake of the different food substances in the right proportion and quantities Effect of under-eating and over-eating on weight and health Obesity due to eating too much fat and carbohydrates Anorexia	*In developed countries where the diet is low in fibre, constipation and colon cancer are more common*	S. Inspect food labels to find out the nutritional value and energy value of the food (ID S. Data analysis exercise on the different energy requirements for people of different age, sex and occupation (ID) S. Design a balanced menu for a day (limit the cost of food) S. Library search on the causes, adverse effects and prevention of obesity / anorexia (CM)
12.4 Natural food and processed food	Natural food Processed food *Food additives*	What are natural food Examples of processed food	*Food additives, including food preservatives, colourings and flavourings*	S. Record the natural food and processed food consumed in a week S. Visit an organic farm S. Library search on the effects of organic farming and conventional farming on our health and the environment *S. Inspect food labels to identify common food additives* S. Design experiments to investigate the preservative effect of sorbic acid (or other preservative) on fresh bread from the bakery [IN]

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
			Choice between natural food and processed food	S. Newspaper cutting on new processed food (CM)
12.5 How food is digested and absorbed in our body	Human digestive system Ingestion *Oral health* Digestion Absorption of food	Food must be changed to simple and soluble substances before it can be absorbed through the wall of the small intestine A brief description of the main parts of the human digestive system (in block diagram form) Types and functions of teeth The digestion of food in the mouth, stomach and small intestine Digested food is absorbed into our blood stream mainly in the small intestine	*Structure of teeth* *Causes and prevention of tooth decay* *Periodontal disease and its prevention*	T. Show the main parts of the human digestive system with a model S. Identify the different types of human teeth (CS) S. Observe the slides of villi structures in mammals under the microscope (OB)
12.6 The fate of the digested food	Transport of digested food Exchange of materials between blood	The digested food absorbed is carried to all parts of our body by blood via blood vessels The exchange of materials (respiratory gases, nutrients and waste) between		

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
	and body cells	blood and body cells		
		Energy is released, in a control process, from digested food in the presence of oxygen; carbon dioxide and water are released as by-products		
12.7 Our circulatory system	*Composition of blood* *Circulatory system of man* *Pumping action of our heart* *Structure of our heart* *Pulse* *Blood pressure*		*Composition of blood, including red blood cells, white blood cells, platelets and plasma* *General plan of circulatory system of man* *Arteries, veins and capillaries and their functions* *The heart acts as a pump to pump blood to all parts of our body* *The structure of our heart as a four-chambered organ and the direction of the flow of blood in these chambers*	*S. Using the video imaging device, examine a slide of blood smear (OB)* *S. Library search on the functions of red blood cells, white blood cells, platelets and the plasma (CM)* *S. Watch video on the simulation of the flow of blood in man* *S. Observe the transverse sections of an artery and a vein under the microscope (OB)* *S. Observe the blood flow in the capillaries of a fish's tail fin or a frog's web under the microscope (OB)* *S. Dissect a pig's heart (EA)*

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
			Detailed structure of our heart and related blood vessels *Pulse, blood pressure and heart beat as illustrations of the pumping action of our heart*	*S. Measure arterial blood pressure of the upper arm by means of a sphygmomanometer (EA)*
12.8 How fatty food affects our circulatory system	Adverse effects of too much cholesterol in the blood	Fatty foods in our diet and their effects on our health Cholesterol deposited on the walls of blood vessels can lead to coronary heart disease, high blood pressure and even stroke	*Examples of food with poly-unsaturated fatty acids and saturated fatty acids* *Examine a typical clinical blood test report: the normal level of blood glucose, red blood cells, white blood cells, blood platelets and blood cholesterol*	S. Discuss the nutritive value of fast foods S. Construct a model of a cholesterol-clogged vessel to simulate the blood flow

Topics	Key points	Content		Suggested Activities
		Core	*Extension*	
12.9 Exercise and health	Fitness BMI Vital capacity Strength Suppleness Stamina	Importance of being fit Some common indicators of fitness, e.g. BMI, pulse rate and vital capacity Fit people have strength, suppleness & stamina: the S-factor scores Effectiveness of different exercises (with different S-factor scores) Advantages of doing exercise: using up surplus energy; helping to keep fit; improving the functions of the heart and lungs; helping to relax; exercise can be fun	 *How to avoid sports injuries*	 S. Pool the class data of Body Mass Index [BMI = weight / height ^{2} (in kg / m^2)] among themselves and present it graphically (ID) S. Time how long it takes for pulse rate to return to its normal 'resting rate' after exercise S. Find out the volume of air that can be blown out of the lungs in one breath S. From given data of S-factor scores for different exercises / sports, students choose suitable sports / exercises for themselves (ID) *S. Discuss the necessary measures to prevent sports injuries (CM)*
12.10 Need for rest	Rest and health	Rest helps us recover both physically and mentally		S. Discuss how to spend leisure time (CM)

**** Mental health and emotional health are also very important. Teachers should discuss this with students. Other supportive school activities should also be organised.*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. inferring from observations
2. making use of evidences in stating what might have happened
3. discerning the order in which events take place
4. extracting relevant information from a text
5. interpreting a variety of forms of information
6. predicting possible consequences of continuing a course of action
7. conducting a fair test
8. using models to explain phenomena
9. data handling
10. organising data and presenting them graphically
11. consulting different sources of information
12. making interpretations based on all available data
13. making decision for oneself based on available data
14. evaluating some social customs associated with health
15. evaluating the effects of different dietary habits and living styles on health
16. establishing habits maintaining good physical and mental health

Unit 13 - Metals

Introduction

This Unit begins with common metals and metal ores which leads to the study of elements and compounds. From the extraction of metals, students are introduced to chemical changes and the fact that compounds have properties different from those of their constituent elements.

The choice of metals in everyday applications and the discovery and use of alloys illustrate how advances in science and technology have helped improve our quality of life. The environmental problems associated with the use and disposal of metals are also discussed.

Unit Objectives

All students should

1. be able to relate the use of metals to their ease of extraction and availability
2. recognise that a few metals occur as elements while most exist as compounds
3. be able to outline the method of metal extraction using carbon
4. be able to distinguish between elements and compounds
5. be able to describe some common properties of metals
6. be able to choose the most suitable metal for a particular job
7. recognise that alloys are formed by the introduction of other elements into metals to change the properties of the metals
8. be able to list some common examples of alloys
9. be able to relate the use of some alloys to their properties
10. be aware of the pollution problems arising from the disposal of metals
11. acquire some knowledge of the recycling of metals
12. demonstrate commitment to proper ways of handling used metal
13. appreciate the advancement in science and technology in improving our quality of life

The more able students should

1. be able to use symbols to represent some common elements
2. be able to distinguish between chemical changes and physical changes
3. be able to distinguish between metals and non-metals

Unit 13 - Metals

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
13.1 History of the use of metals	Discovery of metals Historical account on the use of metals	The discovery and use of metals in relation to their ease of extraction and availability - copper age, bronze age, and the iron age		S. List the everyday uses of some metals (CM)
13.2 How to obtain metals	Elements *Symbols of elements* Metal ores Compounds Extraction of metals *Chemical change* *Physical change*	Some metals occur in their elemental forms in nature, e.g. gold and silver Common metal ores and the metallic compounds in them Extraction of metals using carbon Compounds as substances having properties different from those of their constituent elements	*Each element can be represented by a symbol* *Chemical changes and physical changes*	*S. List the symbols of some common elements* S. Extract lead and copper from their ores using carbon (EA) T. Heat iron filings and sulphur powder in a test tube to get iron sulphide (Test the reactants and the product with a magnet) (OB) *T. Burn a magnesium ribbon*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
13.3 Properties and uses of metals	Common properties of metals Choice of metals	Metals are usually shiny, strong, malleable, ductile and are good conductors of heat and electricity From given information, choose suitable metals for particular uses	*Differences between metals and non-metals*	S. Examine some common metals S. Decision making exercises to choose the best metal for a particular job e.g. making cooking utensils, electrical wires, building an aeroplane (ID)
13.4 Making metals more useful	Alloy	Alloys are made by adding other elements into metals for the improvement of the properties of the metal Examples of common alloys including bronze, brass, solder (alloy of tin and lead) and steel Advantages of using alloys	*Alloys made in space and their uses*	S. Make an alloy of tin and lead and compare its properties with those of the individual elements (EA) S. Library search on the use of alloys as super-conducting materials
13.5 Environmental problems associated with the disposal of used metals	Recycling	Environmental problems associated with the disposal of used metals Recycling of metals		S. Library search on the environmental problems associated with the disposal of used metals (CM) S. Watch video on the recycling of metals

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. making generalization from observations or experimental results
2. inferring abstract concept through observing macroscopic phenomena
3. using patterns in evidence to extrapolate
4. classifying from abstract and inferred properties
5. extracting relevant information from a text and suitably organising it
6. consulting different sources of information
7. making decision based on all available data
8. evaluating the balance between convenience and environmental cost
9. managing natural resources wisely and responsibly
10. evaluating the impact of scientific and technological discoveries on the quality of life

Unit 14 - Materials of the Modern World

Introduction

One of the essential requirements for any technological advancement is the availability of the right kind of materials for use. The importance of this is shown by the use of names such as Stone Age, Bronze Age and Iron Age for successive cultures in ancient times. More recently, in the nineteenth century, steel (an iron alloy) became the dominant material for making machinery, bridges, weapons, cars and many other items. In the twentieth century, the invention of plastics and composite materials have opened up a whole range of technological applications. This Unit is about these two families of new materials.

The raw materials from which plastics are made are explored. Their wide applications due to their useful properties are studied. Problems related to the use and disposal of plastics are also discussed.

Many modern technological applications require materials that are strong and stiff on the one hand and light and heat-resistant on the other. The development of composites to meet these requirements is at present a major concern of material scientists and offers exciting possibilities to man in the future. The latter part of the Unit presents students with a brief introduction to this important area of technological advancement.

Unit Objectives

All students should

1. recognise crude oil as a mixture of hydrocarbons
2. be able to outline how useful materials are separated from crude oil by fractional distillation
3. be able to give examples of some major uses of the different fractions from crude oil
4. recognise molecule as group of atoms that forms the smallest stable unit of some elements or compounds
5. be able to give some common examples of molecules
6. recognise plastics as macromolecules built up from smaller molecules
7. be able to describe some of the properties of plastics
8. show concern for environmental problems associated with the disposal of plastics and a willingness to reduce the generation of plastic waste
9. be able to propose some possible solutions to the problem of plastic waste
10. be able to give some examples of composite materials
11. recognise that composite materials are made by combining two or more materials together to give strength and flexibility
12. appreciate that research in material science has helped improve our quality of life

The more able students should

1. *acquire some knowledge of degradable plastics*
2. *be able to relate some common plastics to their uses*
3. *acquire some knowledge about natural composites*

Unit 14 - Materials of the Modern World

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
14.1 Making plastics from crude oil	Mixture Hydrocarbons Molecules Fractional distillation Joining of molecules Plastics Macromolecules	Crude oil is a mixture of hydrocarbons Hydrocarbons are compounds of hydrogen and carbon Different hydrocarbon molecules are of different size; they consist of different number of carbon and hydrogen atoms Molecule as group of atoms that forms the smallest stable unit of some elements or compounds Common examples of molecules, e.g. oxygen, hydrogen, water, glucose, carbon dioxide, methane and butane Separation of crude oil into different fractions by fractional distillation Different fractions consist of hydro-carbons of different boiling points Uses of the different fractions from crude oil, e.g. LPG (liquefied petroleum gas), petrol, naphtha, kerosene, diesel and bitumen Making plastics: small hydrocarbon molecules can be joined together to produce macro-molecules, e.g. ethene (obtained by the breaking down of		T. Show models of some simple molecules T. Distil a small amount of crude oil and investigate the colour and flammability of the products (OB, EA) S. Plastic making (epoxy resin) (IF)

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
		naphtha) to polythene		
			Some examples of commonly used plastics (including polythene, polyester, polystyrene, perspex, PVC, Nylon) and their uses	S. Discuss how the development of plastics has affected our lives over the past 30 years (CM) *S. Identify common plastics used in daily life (CS)* *S. Test the strength of different plastics*
		Advantages of using plastics including the cost factor and useful properties of plastics		S. Experiments on the action of chemicals such as acids and alkalis on plastics
14.2 Environmental problems associated with the disposal of plastics	Recycling *Degradation*	Environmental problems associated with the disposal of plastics Possible solutions to the problems of disposal of plastics: • reducing the generation of waste plastics • recycling of plastics • reusing of plastics	*Degradable plastics*	S. Debate on the use of plastics (CM) S. Watch video on the recycling of plastics

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
14.3 Composite materials	Composite materials Strength Flexibility	Examples of composite materials: • reinforced concrete • plywood • reinforced glass/plastics Common composites consist of two or more different materials, usually with reinforcing fibres embedded in a binder (or matrix material); they marry the useful characteristics of the two or more materials to give strength and flexibility and hence increase their range of applications	*Examples of natural composites, e.g. wood and bone*	S. List examples of everyday uses of composite materials S. Library search on examples of disasters resulting from imperfections in materials uses in building aircraft and ocean liners (CM) S. Library search on the advantages of using some composite materials (CM) S. Compare the strength of concrete and reinforced concrete / plywood and wood [IN]

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. interpreting observations
2. inferring abstract concept through observing macroscopic phenomena
3. identifying aspects of a situation which can be explained in terms of science
4. carrying out an investigation
5. extracting relevant information from a text and suitably organising it for presentation
6. consulting different sources of information
7. managing natural resources wisely and responsibly
8. evaluating the impact of various applications of scientific and technological discoveries on our quality of life
9. positioning oneself in a debate and expressing one's own opinion

Unit 15 - Light, Colour and Beyond

Introduction

This Unit starts with the everyday phenomenon of reflection of light and how it could be utilised to improve our quality of life. The dispersion of white light through a glass prism is employed to introduce the concept of a spectrum. How we perceive colour and the link between colour and reflection are then explored. How the direction of light is changed in a range of common optical devices, for example, periscopes, microscopes, and optical fibres is also discussed

One of the emphases of this Unit is to introduce the different bands of the EM spectrum and their applications. Students are not expected to know what electromagnetic radiation is. Instead, the different parts of the EM spectrum are introduced as bands with different frequencies which produce different effects and can be detected by appropriate detectors.

The discussion of effects of radio waves on health introduces the idea that scientists may disagree among themselves due to their different interpretation of facts. Students should distinguish between claims and arguments that are based on scientific considerations and those that are not.

Unit Objectives

All students should

1. understand how an object is seen
2. be able to establish the relationship between the angle of incidence and the angle of reflection of light at a plane reflecting surface through experimentation
3. be able to describe the general characteristics of plane mirror images
4. appreciate how reflection of light can be put to use in our daily life
5. understand how we perceive colours
6. recognise that all colours can be obtained from mixing the three primary colours
7. be able to relate colour-blindness to defects in some cone cells in the eye
8. appreciate the beautiful world of light and colours
9. be able to describe how different colours are produced on a colour TV
10. be able to infer the existence of invisible radiation from experimental evidence
11. be able to list the different parts of the EM spectrum including infra-red, ultra-violet, microwaves, radio waves, x-rays and gamma rays
12. recognise that the different parts of the EM spectrum are bands with different frequencies
13. acquire some knowledge about the applications of the different parts of the EM spectrum

14. acquire some knowledge about the production, transmission and detection of radio waves
15. appreciate the growing importance of radio waves as carriers of information
16. appreciate the nature of scientific discovery through the study of the discovery of radioactivity

The more able students should

1. *acquire some knowledge about some causes of the thinning of the ozone layer and its effects on us*
2. *be aware of some of the dangers resulting from the interference of radio waves*
3. *develop an awareness of the need to judge between scientific and non-scientific claims*
4. *be familiar with the refraction of light and be able to list some of its applications*
5. *appreciate some practical uses of lenses in our daily life*
6. *apply their knowledge about total internal reflection in the understanding of some physical phenomena*

Unit 15 - Light, Colours and Beyond

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
15.1 How we see an object	Light rays Luminous objects Non-luminous objects	Light travels in a straight line Representing light rays by straight lines and arrows Non-luminous objects are seen because light reflected from them enters our eyes		S. Observe the path of a light beam as it passes through starch solution (OB)
15.2 Reflection at plane surfaces	Law of reflection Angle of incidence Angle of reflection Normal	Law of reflection - angle of reflection is equal to the angle of incidence Plane mirror images • lateral inversion • same size as object Using plane mirrors to extend our field of view More applications of the use of reflection, e.g. to increase the spatial feel of a room	*Design a lighting system for a room*	S. Ray box experiment to find the relationship between the incident angle and the reflected angle (HP, MS) S. Design a device to help • a dentist see the back of your teeth • a child to see over a tall fence [IN] S. Visit a lighting store to find out how reflection is put to use in different lighting systems *S. Design a lighting system for a restaurant with due consideration for the preferences of the target customers [IN]*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
15.3 Colour	Dispersion of white light Colour spectrum of light Primary colours	Dispersion of white light through a glass prism to give a range of colours		S. Production of a spectrum of white light using a prism and then recombining the colours in the spectrum using an identical prism (PD)
	Colour as a human sensation	Rainbows are formed by the dispersion of white light by raindrops		S. Production of a rainbow
	Colour of objects	Mixing coloured lights		S. Mixing the three primary colours of light (OB)
	Colour filters	White light and the 3 primary colours Three types of colour-sensitive cone cells in our retina - each responds best to different colour lights Colour-blindness as a genetic disease caused by defects in some cone cells The colour TV - the three electron guns and the different phosphor dots on the screen How coloured objects appear in white light		
		How coloured objects appear in different coloured lights		S. Investigate how objects look in different coloured light (OB)
		Colour filters: red filter allows red light to pass through		

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			Different coloured objects absorb and reflect different coloured light	
15.4 Beyond the visible spectrum	Existence of invisible radiation Infra-red radiation Ultra-violet radiation *Ozone layer*	Human eyes as the sensor or detector of the visible spectrum Beyond the visible spectrum: detection of infra-red and ultra-violet radiation Applications of infra-red radiation, including its heating effect and its use in remote control systems Applications of ultra-violet radiation, including the checking of bank notes and the sterilisation of drinking water	*The effect of ultra-violet radiation on man* *The causes of the thinning of the ozone layer and the effect of the increasing amount of ultra-violet*	S. Detecting infra-red radiation using a thermometer with a blackened bulb or infra-red detector (IF) S. Detecting ultra-violet radiation using fluorescent materials (IF) S. Using an infra-red transmitter and a detector to build a remote control system (EA) S. Using ultra-violet radiation to check bank notes *S. Library search on the thinning of the ozone layer and the effect of the increasing amount of ultra-violet radiation reaching the Earth (CM)*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
			radiation reaching the earth	
15.5 Beyond infra-red and ultra-violet	The discovery of natural radioactivity EM spectrum Uses of the different parts of the EM spectrum Radio waves as carriers of information Transmission and detection of radio waves	The discovery of radioactivity - image formed on a photographic film The other parts of the EM spectrum including microwaves, radio waves, X-rays and gamma rays and their uses The differences between the different parts of the EM spectrum (Range of frequencies is NOT required) The discovery of the production, transmission and detection of radio waves How the increasing use of radio waves affects modern society		T. Story of how Becquerel discovered radioactivity S. Construct a detector to receive radio waves (EA) S. Library search on the history of the radio and how it affects our lives (CM)
	Making scientific claims and judging scientifically		*Interference of radio communication* *The controversial issue of whether EM radiation affects our health*	*S. Library search on the effect of radio waves from mobile phones on electronic instruments (ID, CM)* *S. Debate on whether EM radiation affects our health (ID, CM)*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
15.6 Refraction and its practical uses	*Refraction* *Images formed by convex lenses* *Magnification* *Magnifier*		*Light is refracted at the boundary between air and any transparent material (e.g. glass, perspex, water)* *Bending of light through lenses leads to a change in the size of the images (nature of image in relation to the object distance is NOT required)* *Uses of convex lenses - the hand lens and the microscope*	*S. Ray box experiments with glass prisms and glass blocks* *S. Refraction phenomena - bending of chopsticks placed in water; apparent depth of a trough of water* *S. Experiments to illustrate the bending of light through lenses (PD)* *S. Observe the images of objects through lenses - glass bottles, magnifying glasses, spectacles* *S. Build a microscope using two convex lenses (EA)*
15.7 Optical fibres and total internal reflection	*Total internal reflection* *Optical fibres*		*Total internal reflection* *(Critical angle is NOT required)*	*S. Observe total internal reflection using an isosceles right angled triangular prism (OB)* *S. Experiments using a semi-circular glass block to show total internal reflection (PD)*

Topics	Key points	Content		Suggested activities
		Core	*Extension*	
				S. Make a periscope using prisms (EA)
			Cat's eyes on roads are triangular prisms which reflect the light from a car headlight back to the driver *Light can travel along a curved path in an optical fibre* *Uses of optical fibres in telecommunicat-ions and endoscopy*	*T. Optical fibre torch (EA)* *T. Demonstrate the transmission of radio signals through an optical fibre* *S. Library search on uses of optical fibres in telecommunication and medicine (e.g. in micro-surgery) (CM)*

The suggested activities in this Unit should facilitate the development of the following competencies to the students' fullest capability:

1. making generalisation from observations
2. recognising patterns
3. using patterns in evidence to extrapolate
4. predicting outcomes based on evidence
5. inferring abstract concept through observing macroscopic phenomena
6. suggesting explanation which is consistent with evidence
7. identifying aspects of a situation which can be explained in terms of science
8. using technology to record information
9. interpreting a variety of forms of information
10. consulting different sources of information
11. evaluating claims scientifically
12. carrying out an investigation
13. applying science to solve everyday problems
14. evaluating the impact of various applications of scientific discoveries on our quality of life

ASSESSMENT

Purpose of Assessment

Assessment provides information for a teacher to find out about students' achievement in relation to set objectives. Students of different abilities should not be expected to reach the same level of achievement and development. Teachers should set course objectives according to the abilities of their students. Assessment should be designed to find out whether students are achieving the objectives set. With this in mind, a teacher could make informed decisions about what should be done to enhance the learning of students or to employ a more appropriate teaching method.

Assessment should be carried out on a regular basis and through different modes, such as oral questioning and observation of students by teachers during class, assignments, practical and written tests. Only when assessment is carried out on a continual basis can the teacher have the feedback to plan his/her day-to-day teaching.

The aims of the syllabus include the acquisition of knowledge and an understanding of the basic science concepts, the ability to use scientific skills and the development of attitudes important to the learning of science. Hence, a variety of assessment methods must be designed to measure the attainment of these aims.

Assessment Methods

Some suitable methods to assess the main objectives of the syllabus are suggested below :

- **Assessment of Knowledge, Understanding and Application of Science Concepts**

  Oral questioning by teachers, class assignments and paper-and-pencil tests are suitable for assessing cognitive skills.

  Asking students questions during lessons and encouraging them to respond provide immediate feedback on students' understanding.

  Class assignment that requires students to think and work actively can help reinforce and assess classroom learning, especially in the application of science concepts. Library search, collection of information, visits, writing essays, designing a new device, assembling a toy model, collecting newspaper cutting etc. are all useful possibilities.

Applied appropriately and imaginatively, paper-and-pencil tests and written assignments can be used to test the higher order thinking skills in addition to recall and understanding of facts.

- **Assessment of Science Skills**

Although written tests and assignments can also be used to assess practical skills, they have their drawbacks. The skills tested are isolated and students are not involved in doing practical work. The more suitable methods for assessing science skills are practical assessment and project work. A practical test involves students in concrete situations. Project work provides excellent opportunities not only for students to use the practical skills and apply what they have learnt, but also for teachers to assess students on these skills. Investigative projects, in particular, are suitable for assessing enquiry skills such as identifying problems, formulating hypotheses and designing strategies to solve problems.

- **Assessment of Attitudes**

Attitudes such as curiosity, perseverance, care and concern for living things, and co-operation with others are important in science learning. As these attitudes take time to develop, their assessment should take place over a period of time to show the progress that students have made. Some common means of assessing attitudes open to teachers include, observing behaviour, asking students to write essays, and using questionnaires

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   Working with Science — Switching on
   Teacher's Guide — Skin deep making sense of IT
   Evaluation Pack — Having babies Neighbours

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   Working with Science — Full of beans Body care Wear & tear
   Teacher's Guide — Child's play Conditions for life
   Evaluation Pack — On the rocks Fire, frined or foe?

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   Teacher's Guide — Green machine Drinks
   Evaluation Pack — Global concerns Metals Seeing stars

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F. World Wide Web Sites

1. Useful Local Web Sites

Local web sites are usually bilingual. They are most suitable for accessing updated information on current issues.

	Address	Name of HomePage	Details
(1)	http://www.gov.hk	Information Services Department, Hong Kong Special Administrative Region (HKSAR)	All government departments can be accessed through this site. Of special interest to science teachers would be the Environmental Protection Department (http://www.epd.gov.hk/epd), the Department of Health (http://www.dh.gov.hk), the Hong Kong Observatory (http://www.hko.gov.hk) the Water Supplies Department (http://www.wsd.gov.hk).
(2)	http://www.lcsd.gov.hk	Leisure and Cultural Services Department	You can access the websites of the Hong Kong Science Museum (http://hk.science.museum), the Hong Kong Space Museum (http://hk.space.museum) and Food and Environmental Hygiene Department (http://www.fehd.gov.hk).
(3)	http://www.wwf.org.hk/	World Wide Fund Hong Kong	Includes updated local conservation news, press releases of the organisation and links to other environmental sites
(4)	http://www.hkbws.org.hk	The Hong Kong Bird Watching Society	Colourful pictures of local birds
(5)	http://foe.org.hk	Friends of the Earth (Hong Kong)	
(6)	http://www.consumer.org.hk	Consumer Council	

(7)	http://www.cmi.hku.hk	CMI Centre, HKU	The site is designed to provide supporting resources for teachers using Chinese as the medium of instruction.
(8)	http://www.fed.cuhk.edu.hk/sci_lab/	Science Lab, Faculty of Education, CUHK	
(9)	http://www.hku.hk/curric/websm	SMILE (Science as a Motivating and Invigorating Learning Experience) project	This website aims at providing teachers with a better understanding of the rationale behind the SMILE project. It also includes lesson plans of some school-based curriculum materials which have been tried out at schools for teachers' reference.
(10)	http://www.edb.gov.hk/cd/sc	Science Education Section, Curriculum Development Institute	

2. Overseas Educational Sites

Below are some sites maintained by ministries of education of other countries or educational organisations. These sites are good for information on current educational issues, curriculum resource materials, lesson plans, ideas and activities that could enrich teaching and link to other educational sites of interest.

	Address	Name of HomePage	Details
(1)	http://www.eric.ed.gov	Education Resources Information Center	It maintains a database of a broad range of education related issues. Searches can be carried out online.
(2)	http://ofcn.org/cyber.serv/academy/ace/sci/inter.html	Academy Curricular Exchange Science Intermediate School (6-8)	Includes lesson plans and teaching materials related to general science
(3)	http://www.psrc-online.org	Physical Science Resource Centre (sponsored by the American Association of Physics Teachers)	This website provides resources and links to resources for the entire spectrum of teaching physics and physical sciences for primary and secondary. It includes, curriculum and resource materials, evaluation instruments, demos and activities, problems of the week, toys of the month etc.
(4)	http://www.edna.edu.au/edna/go	Education Network Australia	A directory service for the education community maintained by the Australian government. It contains lesson plans, project specifications and ideas and activities for use in the classroom.
(5)	http://www.col-ed.org/smcnms	Science and Mathematics Consortium for Northwest Schools	The Science and Mathematics Consortium for Northwest Schools is one of the ten "Regional Eisenhower Consortia" established by the U.S. Department of Education. It aims to help teachers to access information and resources that may be time-consuming to find elsewhere; and to enhance their ability to teach mathematics and science.

(6)	http://www.tc.cornell.edu/Edu/MathSciGateway/	Cornell Math and Science Gateway for Grades 9-12	Cornell Theory Center Math and Science gateway for secondary school students and teachers provides an essay starting point for locating science and mathematics resources on the web.
(7)	http://www.eelink.net/pages/EE-Link+Introduction	Environmental Education on the Internet	Includes very comprehensive education resources, complete lesson plans or ideas for designing learning activities on environmental education.
(8)	http://www.ase.org.uk	The Association for Science Education UK	The ASE Web site offers a wealth of relevant information and links. There is also a chat area, where you can have a “conversation” in real time.
(9)	http://www.nsta.org	National Science Teachers Association USA	
(10)	http://www.education.vic.gov.au	Department of Education and Early Childhood Development	
(11)	http://www1.moe.edu.sg	Ministry of Education of Singapore	

3. Interesting Science Website

Below are sites of special science interest for the layman or specially maintained at a level suitable for the students. They provide accurate and up-to-date information about scientific, health and environmental issues in the news. They bridge the gap between classroom theory and real life science.

	Address	Name of HomePage	Details
(1)	http://scienceclub.org	The Science Club	The Science Club is a non-profit organisation that uses humor and science to get children and adults to learn and play together. The activities included use common household materials and aim to create an enthusiasm to learn. It also includes project ideas and links to other science education websites.
(2)	http://www.kidshealth.org	Kidshealth.org	The site is maintained by the Alfred I. duPont Hospital for Children and other children's health facilities in the States. It contains answers to questions on health that kids and parents often ask. It also contains simulations and videos explaining the working principle of the major systems of our body
(3)	http://marsweb.jpl.nasa.gov	NASA’s Mars Exploration Program	It contains the most updated information about mars and the pathfinder mission
(4)	http://www.science.org.au/nova	Australian Academy of Science	Provides accurate and up-to-date information about scientific, health and environment issues in the news. It bridges the gap between classroom theory and real life science.

As the internet changes, 'linkrot' is inevitable. Please visit the website of the Science Education Section, Curriculum Development Institute for updates.

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The membership since 1 September 1994 has been as follows:

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