Science

Introduction

1. Science is one of the elective subjects in the Key Learning Area (KLA) of Science Education[1]. It is a new curriculum designed to encourage an interdisciplinary approach to the learning and teaching of science. It recognizes the diverse interconnectedness among the sciences as practiced today. It will provide a range of balanced learning experiences with the inclusion of interrelated key concepts from the disciplines of biology, chemistry and physics. The curriculum aims to empower students to be inquisitive, reflective and critical thinkers, by equipping them with a variety of ways of looking at the world and by emphasizing the importance of evidence in forming conclusions. It is believed that in a technologically advanced society, like Hong Kong's, many people will find a knowledge and understanding of science concepts useful to their work, and a competency in scientific inquiry of great value in creative problem solving in life.

Rationale

2. Science is a new subject designed in response to the call for providing a broad and sound knowledge base for our students. Students taking this subject will, on the one hand, be provided with comprehensive and balanced learning experiences in the six strands[2] of the Science Education KLA, and, on the other, be able to widen their horizons by taking up subjects from other KLAs.

3. The senior secondary Science curriculum serves to develop students' scientific literacy essential for participating in a dynamically changing society, and to support other aspects of learning across the school curriculum. It is designed to nurture students' curiosity about the world and enhance their scientific thinking. Through systematic inquiry, students will develop scientific knowledge and skills to help them evaluate the impact of scientific and technological developments.

4. Building on the foundations developed in the Science (S1-3) curriculum, students will learn about a wider range of scientific ideas and consider them in greater depth, laying foundations for life long learning. The curriculum will be a broad one encompassing

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[1] Please refer to the appendix on p.225 for the overall curriculum framework of science education and the proposed elective subjects in the Key Learning Area of Science Education

[2] For the purpose of curriculum planning and organization, the subject knowledge and skills in the Science Education KLA are arranged into the following six strands: "Scientific Investigation", "Life and Living", "The Material World", "Energy and Change", "The Earth and Beyond" and "Science, Technology and Society".

concepts and understandings in the six strands of the Science Education KLA. A modular approach will be adopted and students will benefit from learning concepts and scientific ideas in contexts that bring out their relevance to everyday life. The curriculum will enable students to cultivate and maintain an enthusiasm across a wide scientific spectrum, whilst retaining the option of going more deeply into a specific science discipline, or branching out into other subject areas.

5. Science is designed for students taking only one elective subject in the Science Education KLA. In drawing up the curriculum, we have looked into the fact that to cover all topics in the existing curricula of Biology (S4-5), Chemistry (S4-5), and Physics (S4-5), 360 lesson hours would be required, which is beyond the curriculum time for this curriculum (255 hours). Furthermore, a curriculum consisting of topics selected from these 3 curricula would not meet the academic rigour required of a curriculum at the new senior secondary level. Considering the aptitude of the target students of this curriculum, we have decided to adopt a modular approach focusing on the **key ideas in science.** In terms of coverage of topics, the Science curriculum will cover less than the total of the Biology (S4-5), Chemistry (S4-5), and Physics (S4-5) curricula, while the depth of treatment for some topics will be beyond the S4-5 Level.

6. In addition, to help students see the coherence in the seemingly diverse sets of ideas, **unifying concepts** (such as systems, order and organization) that pervade science and transcend disciplinary boundaries will be highlighted. These are powerful conceptual tools that help students see the overarching coherence in our understanding of the natural world. The curriculum also calls attention to the understanding of the **nature of science**, that is, the process by which scientific knowledge is constructed and validated. For students, the ability to see beyond facts, and the development of a scientific way of thinking and knowing through inquiry are essential for both formal and informal learning and for a lifetime of participation in society as a whole.

7. One consequence of the advancing globalization and technological dependence of our society is that even people outside the professional sciences are finding that issues of concern to them tend to have a scientific dimension. It is our vision that with the values, attitudes, skills and knowledge developed through this curriculum, our students will be better equipped to deal sensibly with everyday problems in this technological society which often involve evidence, quantitative considerations, logical arguments and uncertainty.

Curriculum Aims

8. The overarching aim of the senior secondary Science curriculum is to provide learning experiences that will enable students to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further study or a career in fields where a knowledge of science will be useful; and become life-long learners in science and technology.

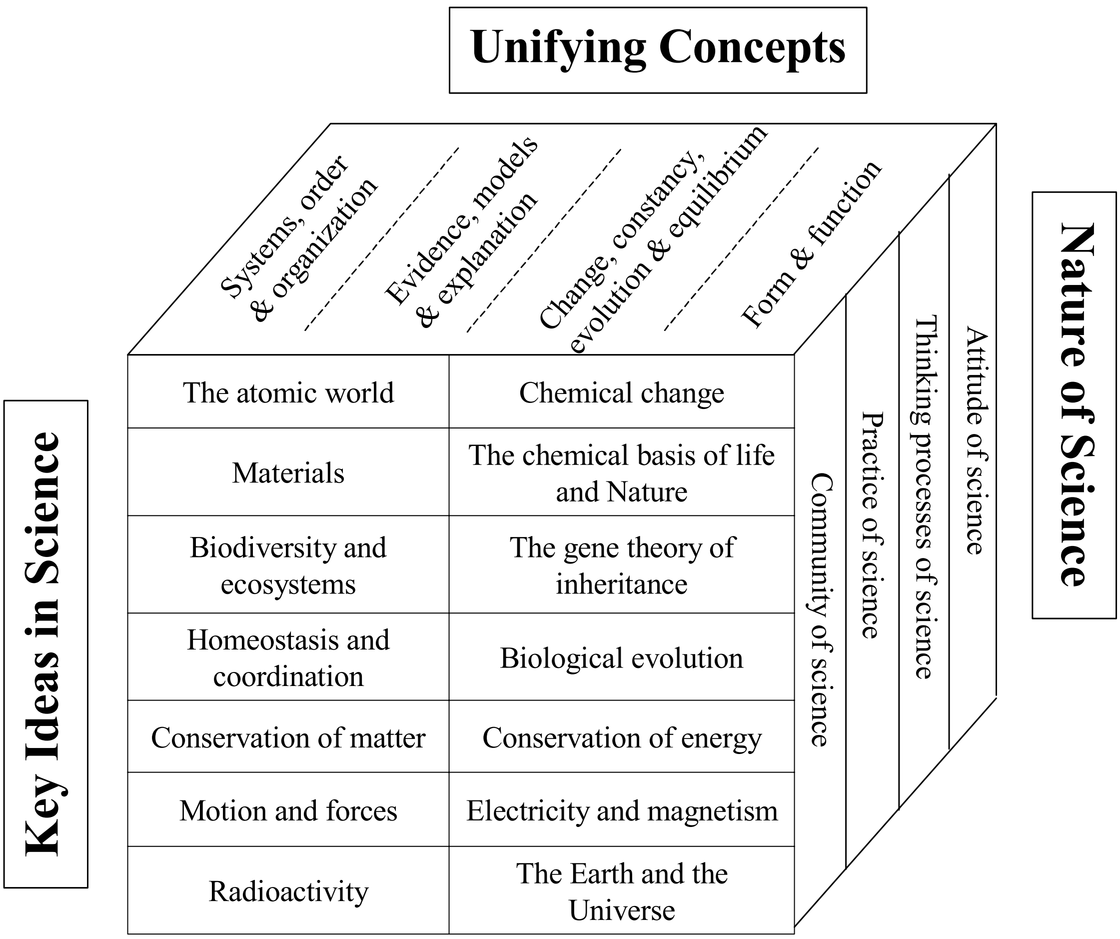
The broad aims of the curriculum are to enable students to:

- develop interest and maintain a sense of wonder and curiosity about the natural and technological world
- acquire a broad and general understanding of key science ideas and explanatory frameworks of science, and appreciate how the ideas were developed and why they are valued
- appreciate and develop an understanding of the nature of scientific knowledge
- develop skills for making scientific inquiries
- develop the ability to think scientifically, critically and creatively, and to solve problems individually or collaboratively in science-related contexts
- use the language of science and communicate ideas and views on science-related issues
- make informed decisions and judgments about science-related issues
- be aware of the social, ethical, economic, environmental and technological implications of science and develop an attitude of responsible citizenship
- develop conceptual tools for thinking and making sense of the world

Curriculum Framework

(This part should be read in conjunction with the section "Curriculum Framework" of the Main Document. It should be noted that the curriculum framework suggested below is for initial consultation only. Feedback from the public will be taken into account and further details will be provided in the next stage of consultation.)

9. A modular approach, using contexts of daily relevance, will be adopted in this curriculum, and it is expected that, through investigating phenomena, students will develop understanding in (i) the key ideas in science, (ii) the nature of science and (iii) the unifying concepts that pervade science. The following diagram summarizes the relationship between the various elements of the senior secondary Science curriculum.



Framework for the Senior Secondary Science Curriculum

Key ideas in science

10. The modules in this curriculum are structured around a number of key ideas in science. Students will be led to explore key questions of interest and daily relevance, such as "What is the chemical basis of life and Nature?"; "Why is there such diversity of living things on Earth? What is the importance of such biodiversity?"; "How old is the Earth and how did it come to be?". Explanatory stories will be used to provide students access to "How do we know?". It is also our intention that students should focus on a small number of key ideas and work on them in enough depth to gain a real understanding of them and to be able to apply what they have learned. The following key ideas in science have been selected after consulting a range of international curriculum documents and considering their relevancy and usefulness to students:

- The atomic world;
- Chemical change;
- Materials;
- The chemical basis of life and Nature;

- Biodiversity and ecosystems;
- The gene theory of inheritance;
- Homeostasis and coordination;
- Biological evolution;
- Conservation of matter;
- Conservation of energy;
- Motion and forces;
- Electricity and magnetism;
- Radioactivity;
- The Earth and the Universe

Nature of science

11. The senior secondary Science curriculum is concerned about the process by which scientific knowledge is constructed and validated. In the course of study, students will be led to "stand back and examine what happened, to live through some of the intellectual experience, to analyse, and to assess the line of thought, recognizing the elements of its logic, its strength, and its limitations" [3]. This will provide students with an understanding of the nature of science, i.e. they will develop an understanding of the ways in which reliable knowledge of the natural world has been, and is being, obtained. Below are the different facets of the nature of science that will be highlighted in the curriculum:

- Attitude of science: searching for truth; science is based on evidence and empirical standards; it also encourages innovation and scepticism
- Thinking processes of science: scientific knowledge is built on creative thinking; the application of deductive and inductive logic leads to the emergence of new scientific theories, which are then tested empirically; scientific knowledge, while durable, has a tentative character
- Practice of science: precise experimental design and proper instrumentation; prudent handling of quantitative and qualitative data; honest reporting
- Community of science: making use of collective wisdom, encouraging free exchange and open-minded discussion and debate; scientists critically assess new discoveries via the peer-reviewing system

[3] Millar, R. & Osborne, J. (Eds.) (1998). *Beyond 2000: Science education for the future. The report of a seminar series funded by the Nuffield Foundation.* London: King's College London, School of Education. Website: http://www.kcl.ac.uk/education (accessed September 2004)

Unifying concepts

12. The senior secondary Science curriculum will encompass concepts and understandings in the six strands of the Science Education Key Learning Area. Apart from widening students' exposure to contemporary science relevant to their daily lives, the curriculum also attempts to provide some conceptual tools with which students can proceed beyond the facts. Thus, the unifying concepts that pervade science and transcend disciplinary boundaries will be highlighted. These unifying concepts are powerful conceptual tools, which help students see the overarching coherence in our understandings of the natural world. The unifying concepts that will be highlighted in this curriculum are:

- ✧ Systems, order, and organization: Systems, order, and organization are ways to observe and describe phenomena that are related to each other and/or work together as a whole.
- ✧ Evidence, models and explanation: Scientists use evidence and models to understand, explain and/or predict scientific phenomena.
- ✧ Change, constancy, evolution and equilibrium: Change, constancy, evolution and equilibrium all describe states of being of a scientific phenomenon.
- ✧ Form and function: Form and function are usually interrelated; the function of an object frequently relies on its form.

(For a simple explanation of the above, please refer to Annex I)

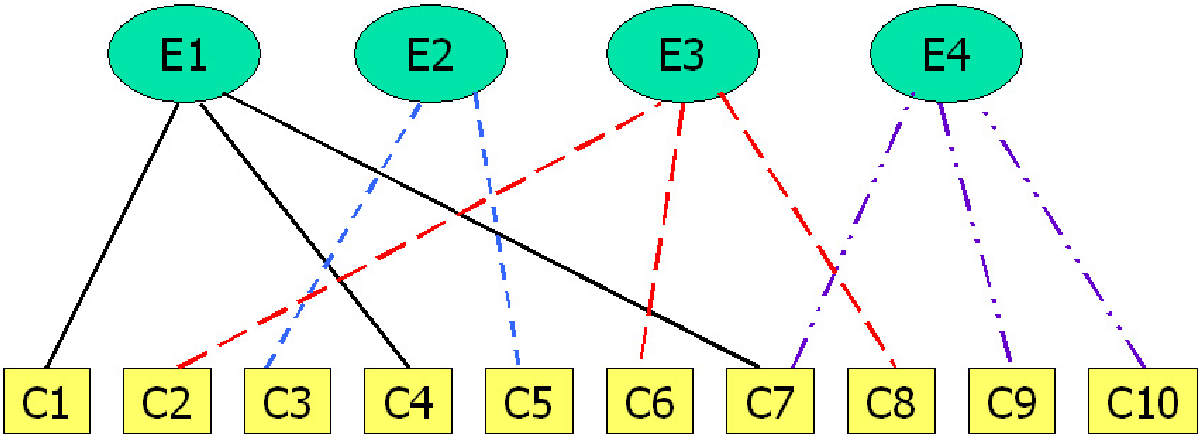
Curriculum Structure

13. The curriculum will consist of a compulsory part, made up of several modules, and some electives, offering choice to students with different interests and aspirations, and preparing them for different tertiary programmes and career paths. The suggested content and time allocation for the compulsory and elective parts are listed in the following tables.

Compulsory Part (Consists of 9 – 12 modules, each will take about 12-15 lesson hours)	Suggested Lesson Time (hrs)
Modules will be built according to the following criteria: • They will be contemporary and relevant to students • They will illustrate key ideas in science and help students appreciate how these ideas were developed and why they are valued • They will elucidate the unifying concepts that give students a framework for making sense of the world • They will illustrate the nature of science Some proposed compulsory modules are: • Water for Living; • The Atomic World and Radioactivity; • From Genes to Life; • Chemical Patterns; • Ecosystems; • Homeostasis; • Motion and Forces: Road Safety; and • From Lightning to Maglev Trains.	190

Elective Part (Students to choose 2 from 4 modules, each module will take about 30 lesson hours)	Suggested Lesson Time (hrs)
The modules will be built according to the following criteria: • They will extend the knowledge and skills acquired through some of the compulsory modules and will provide opportunities to apply scientific concepts and understanding in an integrated manner • They will illustrate ways in which science is applied in contemporary life • They will involve students in extended problem-solving investigations Some proposed elective modules are: - Medical Technology; - Scientific Detection and Analysis; and - Our Earth and the Universe.	65

The following diagram illustrates the interconnection between the modules in the compulsory part and the modules in the elective part:



14. An example of a module is included in Annex II to show how the various elements advocated in the curriculum is incorporated in a selected context which embodies several key ideas in science.

Learning and Teaching

15. The learning and teaching of the subject will emphasize the understanding and application of scientific concepts covered in the curriculum, and the development of critical thinking and problem-solving skills. Besides a broad understanding of the main scientific explanations that give us a framework for making sense of the world, students will also consider the contributions and limitations of science in addressing industrial, ethical and environmental issues, and appreciate the different views of people about the roles of science in shaping the development of our society.

16. To help students appreciate the reasoning behind scientific knowledge claims, students will become familiar with the processes and practices of science and will be given opportunities to conduct inquiries and practical work in the laboratory or in the field. The problems to be investigated by the students should be suggested by the students themselves, from their desire to know, to understand or to find a solution. In carrying out investigations, students will be expected to employ a range of approaches and select appropriate reference sources, working on their own and collaboratively with others. They will also engage in quantitative work and evaluate critically the evidence they collected and the conclusions they draw. They will learn to communicate their ideas clearly and precisely in a variety of ways.

17. In addition, through providing students with opportunities to explore and investigate phenomena in a wide range of contexts, it is hoped that students will come to see the broad patterns that cut across science disciplines. Thus, while unifying concepts of science may be presented to students in their own right, it is considered better to deal with them as they emerge in the context of the modules. Through constant reference and application, students will learn to use the unifying concepts as a lens through which to focus their scientific thinking.

Assessment

(This part should be read in conjunction with the section "Assessment" of the Main Document.)

Aims of Assessment

18. Assessment is an integral part of the learning and teaching cycle. Assessment is the practice of collecting evidence of student learning. The aims of assessment are to improve learning and teaching as well as to recognize the achievement of students. It is therefore essential that assessment should be aligned with curriculum aims and with the processes of learning and teaching.

Internal Assessment

19. Internal assessment refers to the assessment practices that schools employ as part of the learning and teaching process. Schools should assess students formatively, in order to collect feedback on what students have learned and achieved. Specific comments and feedback should be made to students to indicate how well they are progressing in relation to the learning objectives, so that students can plan and take control of their learning. The information collected in formative assessment will also help teachers to find ways of promoting more effective learning and teaching. A wide range of assessment modes, such as oral questioning, observation of students, project work, practical work and assignments, should be used, to promote the attainment of the various learning aims and objectives of the curriculum.

Public Assessment

20. Public assessment of students' achievements in the senior secondary Science curriculum refers to the assessment measures that lead to a qualification in the subject to be offered by the Hong Kong Examinations and Assessment Authority (HKEAA). It will comprise two components: the Written Examination and School-based Assessment (SBA). The grading and reporting of students' achievements in the subject will be based on a standards-referenced approach.

21. The purpose of adopting a standards-referenced approach is to recognize individual student's attainment after the completion of the course. Each student's performance will be matched against a set of performance standards, rather than compared to the performance of other students. It makes the implicit standards explicit by providing specific indication of student performance. Descriptors will be provided for the set of standards at a later stage.

22. The Written Examination will consist of two papers, which are to be taken on the same day. The modules in the compulsory part will be assessed in Paper 1 and those in the elective part in Paper 2. The total examination time will be about 4 hours for the two papers. Various types of items such as multiple choice, structured questions and essay questions will be included to assess students' performance in a broad range of skills and abilities.

23. The public assessment will include an SBA component that will take up 25% of the total weighting of public assessment. The merits of adopting SBA are as follows:

- SBA provides a more valid assessment than an external written examination alone, since it can cover a more extensive range of learning outcomes, through employing a wider range of assessment modes that are not all possible in written examinations.
- SBA enables the sustained work of students to be assessed. It provides a more comprehensive picture of student performance throughout the period of study rather than their performance in an one-off examination alone.

24. It should be noted that SBA is not an "add-on" element in the curriculum. In SBA, students are being assessed continuously by their teachers in the various aspects of the curriculum during the process of learning and teaching. Being the ones most familiar with the performance of the students, teachers are in the best position to assess their students. While a variety of assessment methods should be employed, the design and implementation of SBA should avoid unduly increasing the workload of both teachers and students.

Supporting Measures

25. A subject Curriculum and Assessment Guide will be published as a basis to support learning and teaching. The Guide will provide stakeholders with information on the rationale, aims, curriculum framework, learning targets, learning and teaching strategies, internal assessment and public assessment for the senior secondary curriculum. In addition, it is anticipated that quality textbooks and related learning and teaching materials, aligned with the rationale and recommendations of the curriculum, will be available on the market.

26. Resource materials that facilitate learning and teaching will be developed by the Education and Manpower Bureau to support the implementation of the senior secondary Science curriculum. Tertiary institutions and professional organizations will be invited to contribute to the development of resource materials. Schools are encouraged to adapt these resources or to develop their own learning and teaching materials to meet the needs of their students. Schools are also advised to adopt a wide variety of suitable learning resources, such as school-based curriculum projects, useful information from the Internet, the media, relevant learning packages and educational software.

27. To facilitate the implementation of the curriculum, professional development programmes will be organized for teachers. Listed below are the major areas in the professional development programmes to be provided.

- ✧ Understanding of the curriculum design
- ✧ Sharing of learning and teaching strategies and good practices
- ✧ Latest scientific developments (science update programmes)
- ✧ Curriculum management and leadership (curriculum leadership courses)
- ✧ Internal assessment, School-based Assessment and Standards-referenced Assessment

28. Teacher networks and learning communities will be formed to facilitate reflection and discussion on various aspects related to the curriculum. Further information on support materials will be available at the CDI homepage: http://www.emb.gov.hk/cd

Annex I

Simple definitions and examples of **unifying concepts** are:

✧ Systems, order, and organization are ways **to observe and describe phenomena that are related to each other and/or work together as a whole**.

- Systems: A system is an organized group of related objects or components that form a whole. Thinking and analyzing in terms of systems will help students to keep track of mass, energy, objects, organisms and events. Drawing the boundary of a system well can make the difference between understanding and not understanding what is going on. The conservation of mass during burning, for instance, was not recognized for a long time, because the gases produced were not included in the system whose weight was measured.
- Order: an arrangement showing patterns or sequence. Examples include the four seasons, life cycles, and planets of the solar system.
- Organization: the act or process of being organized, a condition of things being put into a structural framework according to a particular hierarchy. Examples include periodic table of the elements, the different levels of organization in living systems such as cells, tissues, organs, organisms, and biological classification systems.

✧ Scientists use evidence and models **to understand, explain and/or predict scientific phenomena**.

- Model: Models are representations that are taken to illustrate real systems, objects, concepts, events, or classes of events. They can be used to explain, predict and study how real objects work. Models can be physical, conceptual, or mathematical. Examples of physical models include simulations of the solar system, molecular structure of chemical substances, cell model, the globe. Examples of conceptual models include models of the atom showing the nucleus and orbiting electrons, gas molecules colliding to produce pressure. An example of a mathematical model can be the symbolic relation between the final velocity (v) of a car, starting from rest with an acceleration (a), and time (t): $v=at$.
- Evidence: consists of observations and data on which to base scientific explanations. Using evidence to understand interactions allows individuals to predict changes in natural and designed systems. Examples of evidence include smell of food (evidence that dinner is ready), and water droplets formed on the glass (evidence of the content inside the glass being cooler).

- Change, constancy, evolution and equilibrium all describe **states of being of a scientific phenomenon**.
  - Change: a process resulting in alteration. Examples include erosion and tree growth.
  - Constancy: the state of being unchanged or some aspects of systems that have the remarkable property of always being conserved. Examples include the speed of light and the conservation of energy and momentum.
  - Evolution: Evolution is a series of changes, some gradual and some sporadic, that account for the present form and function of objects, organisms, and natural systems. The general idea of evolution is that the present is a consequence of materials and forms of the past. Examples include landscape change, and biological change.
  - Equilibrium: A physical state in which forces or changes occur in opposite and offsetting directions. The ultimate fate of most physical systems, as energy available for action dissipates, is that they settle into a state of equilibrium. Examples include a falling rock coming to rest at the foot of a cliff, and maintenance of body temperature in man.

- Form and function are usually interrelated, for example, a fish has fins (form), which allow it to swim (function); and a boat is designed with a streamlined body (form) so as to reduce friction (function). The function of an object frequently relies on its form, e.g. a bird cannot fly without wings.
  - Form: is the shape and structure of an object
  - Function: the function of an object, activity or job, etc is the role that it has, or the purpose for which it is used.

Annex II

An example module - Chemical patterns

Suggested learning time: 15 hours

Overview

The periodic table is one of the greatest human endeavours in attempting to seek trends and regularities in the natural world. In trying to establish relationships between physical properties and chemical properties of different elements, scientists constructed a systematic way of organizing our understanding of elements. In addition to its practical use as an organizer, the periodic table also helps scientists to explain how the hundred elements can give rise to such a huge variety of chemical compounds. It is upon this platform, that further explanations of key patterns in the behaviours of different materials were built, and predictions of chemical behaviour and the development of new materials were made easier.

By the end of Key Stage 3, students have been applying their understanding of particle theory to explain physical phenomena such as floating and sinking, and the expansion and contraction of substances. They know that the atom is the smallest unit of matter and that the atoms of some elements can join together to form compounds under some specific conditions. They have also encountered a variety of chemical reactions like burning, neutralization and the effect of acid rain on building materials.

In this module, students will explore the world of matter in a new way. They will begin to look at some basic knowledge of chemistry, not only as useful information but also as the product of systematic inquiry. They will be guided to live through the intellectual experiences of seeking patterns from observations, analyzing evidence and explaining patterns with hypotheses. Hence, they will gain a deeper understanding into how reliable knowledge is generated. Another emphasis of the module lies in demonstrating how scientists of different times look for conceptual tools that help us make sense of the world. The two intertwined historical developments of the periodic table and the atomic model will be used to exemplify how major scientific breakthroughs may be built upon different lines of study complementing and supplementing each other. Lastly, students will be challenged to apply their understandings of these fundamental concepts of chemistry to predict and explain the formation of compounds and their properties at the microscopic level.

Focusing Questions:

- What led scientists to develop the periodic table?
- How does the periodic table help explain the trends and similarities in properties in some groups of elements?
- How did we refine our understanding of the structure of an atom through analyzing evidence?
- How did electrolysis provide evidence for the presence of charge carrying species in some chemical compounds?
- How does the octet rule help scientists account for the presence of different chemical species (atom, ion, and molecule) and hence the structure and bonding in some substances?
- How are the properties of different substances explained by their structure and bonding?

Content	Suggested Learning & Teaching Activities	Module Emphasis
1.1 Elements in Order ● Brief history of different hypotheses on the nature of matter in different cultures ● Alchemy and the study of matter ● Work of Mendeleev and his predecessors on the empirical periodic table	Search and compare the views of different philosophers on the nature of matter Role play on "International Conference on the Nature of Matter: Yesterday and Today" Essay writing/Poster presentation on "What kind of problems did scientists try to solve by developing the periodic table?"	Students should be led to ● appreciate how scientists look for trends and regularities in things and events in Nature; and that identifying patterns in things and events helps making predictions easier ● appreciate that despite the existence of general patterns, there are random fluctuations or discrepancies in events in Nature ● recognize the periodic table as an **organizer** resulting from pattern seeking and logical thinking ● recognize hypotheses as products of observation and imagination ● recognize experiments as means to test predictions based on hypotheses ● recognize that scientists develop **models** to illustrate their explanations about phenomena ● appreciate that scientific discoveries are influenced by technological advancements and cultural, as well as,
1.2 The Periodic Table ● Features of the periodic table ● Trends in physical and chemical properties of elements within groups I, VII and VIII ● Comparison on reactivity between group I & group II metals	Identify trends in the physical properties of elements within groups I, VII and VIII Investigate reactions of some metals with oxygen/air, water and dilute acids Compare the reactivity of different halogens Investigate the bleaching and disinfecting properties of chlorine Study the practical uses of noble gases Predict chemical properties of unfamiliar elements in a group of the periodic table Risk assessment in conducting experiments Construct a mind map on patterns and trends identified in the periodic table	
1.3 Looking into an Atom ● Democritus's idea of "atom" ● Development of the atomic model ● Experimental evidence to support the atomic model ● Relationships between protons, neutrons and electrons in an atom	Search and present information on the development of the atomic model from Dalton's time to date	

Content	Suggested Learning & Teaching Activities	Module Emphasis
1.4 Atomic Number and the Modern Periodic Table ● Atomic number ● Mass number ● Isotopes ● Electronic arrangements	Identify relationship between the position of elements in the periodic table and their electronic arrangements Write electronic arrangements for some atoms Story telling on "How did the development of atomic model contribute to the refinement of the periodic table?"	personal factors ● appreciate that during the development of scientific knowledge, new **evidence** may lead to modification of a hypothesis ● appreciate that **rules** (e.g. the octet rule) are descriptive statements of behaviour of entities in a system, and that there are exceptions to a rule ● appreciate that symbols, formulae and equations are concise languages to communicate in science ● recognize that the ideas of "conservation of matter" and "balance of charge" play important roles in our understanding of chemical **changes**
1.5 Electrolysis and the Ionic theory ● Electrolysis as the decomposition of substances by electricity ● Patterns in products of electrolysis of alkali metal halides ● Electrolysis provides evidence for the presence of ions ● Cations and anions	Electrolysis of sodium chloride solution Study the discovery of reactive metals such as sodium, magnesium, calcium by Davy using electrolysis Explain electrolysis using the ionic theory Draw a time line to describe "Major events in scientists' journey of understanding matter"	
1.6 The Octet Rule ● Tendency of atoms to achieve electronic configurations of the nearest noble gas in the periodic table ● Chemical species: atom, ion, and molecule	Draw electronic diagrams to represent atoms, ions and molecules Predict the formation of ionic and covalent substances	
1.7 Chemical Bonding and Structure ● Ionic bonding and structure exemplified by sodium chloride ● Covalent bonding and simple molecular structure exemplified by water, oxygen and carbon dioxide	Draw electronic diagrams of ionic and simple molecular substances Build models of ionic and simple molecular substances Explain the properties of ionic substances by their structures Explain the properties of simple molecular substances by their structures Predict structures and properties of substances	

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New Senior Secondary Curriculum
Elective Subjects in the Key Learning Area of Science Education

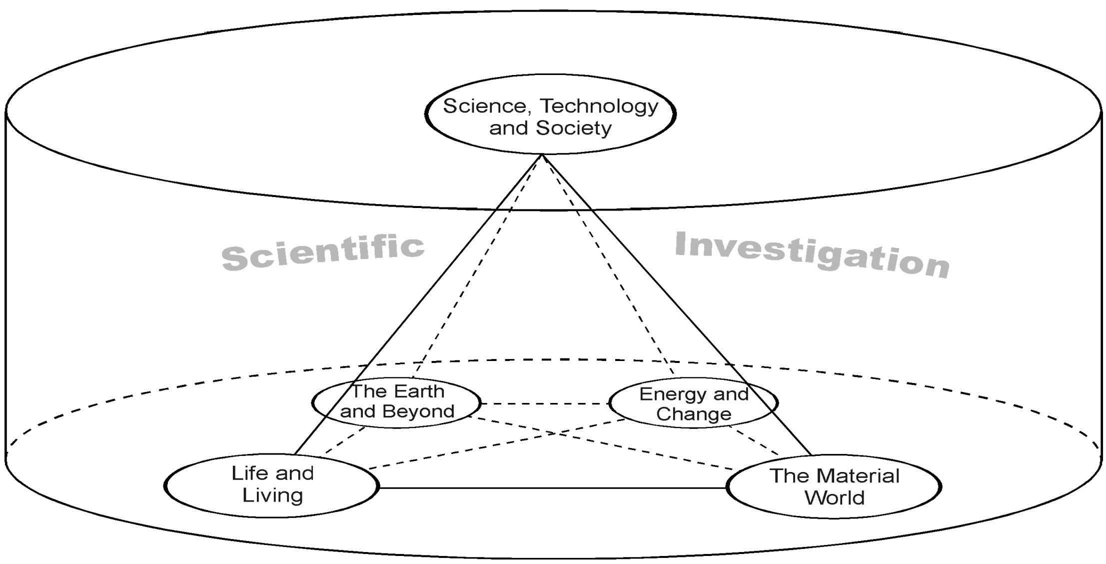
Framework for Science Education Curriculum

The science education curriculum will provide learning experiences through which students acquire scientific literacy. Students will develop the necessary scientific knowledge and understanding, process skills, values and attitudes, for their personal development, for participating actively in a dynamically changing society, and for contributing towards a scientific and technological world.

The essential learning experiences for achieving the aims of science education are organised into six strands, as set out below:

- **Scientific Investigation** – to develop science process skills and understanding of the nature of science
- **Life and Living** – to develop understanding of scientific concepts and principles related to the living world
- **The Material World** – to develop understanding of scientific concepts and principles related to the material world
- **Energy and Change** – to develop understanding of scientific concepts and principles related to energy and change
- **The Earth and Beyond** – to develop understanding of scientific concepts and principles related to the Earth, Space and the Universe
- **Science, Technology and Society (STS)** – to develop understanding of the interconnections between science, technology and society

The six strands are inter-related and can be represented graphically in the following diagram:

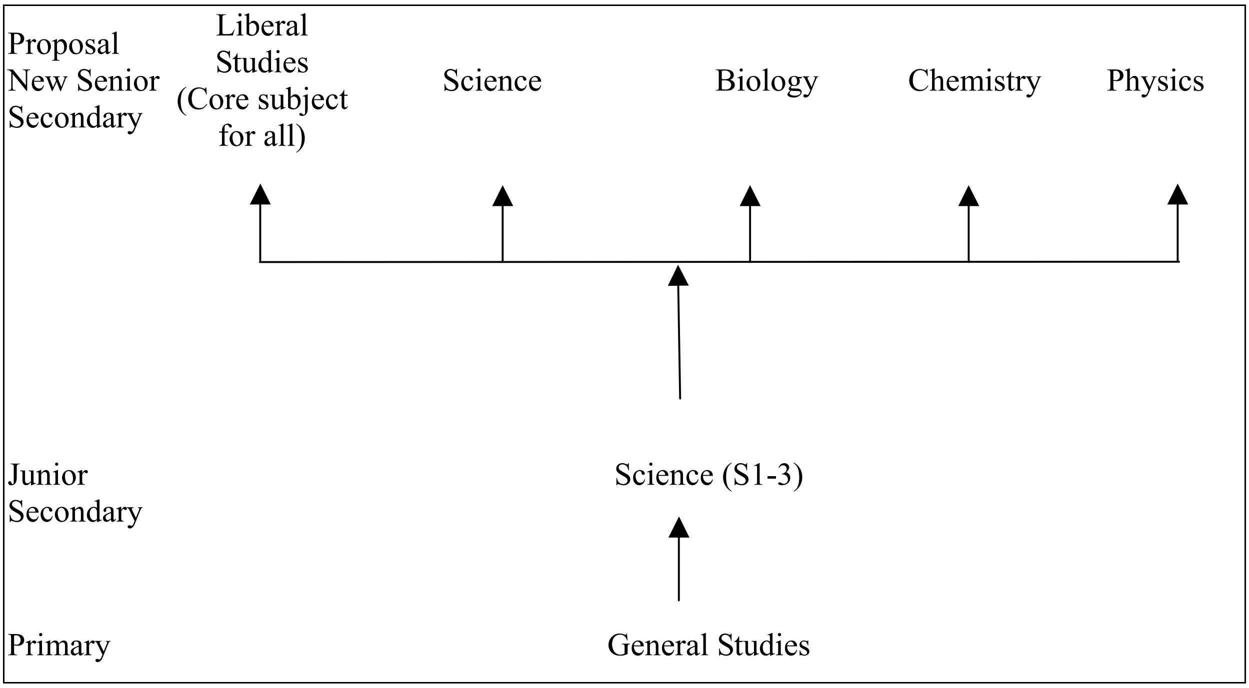


Curriculum and Subject Organisation

At primary and junior secondary levels, science education is provided through the subjects of General Studies and Science (S1-3) respectively. These are common to all students. At Senior Secondary Level, all students will take a core subject entitled Liberal Studies, which aims to enhance their critical thinking through viewing socio-scientific issues from multiple perspectives. It will also help to develop students' scientific literacy and prepare them for adult life. Several elective subjects are included to cater for the diverse needs and interests of students. They are:

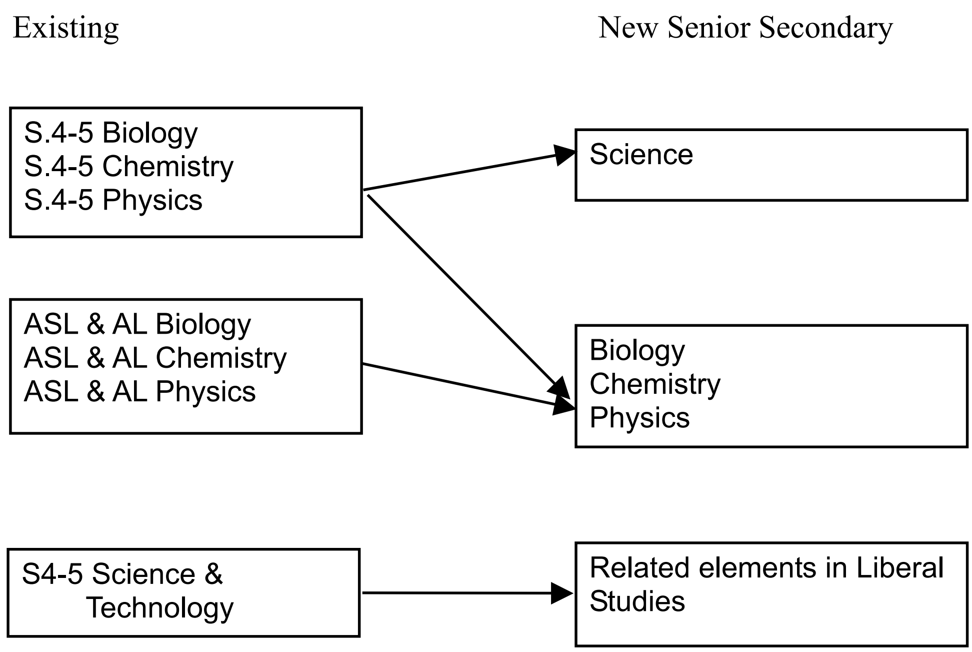
- ✧ Specialised science subjects, namely **Biology**, **Chemistry** and **Physics**,
  These subjects are designed to provide a concrete foundation in these disciplines for further study or career purposes.
- ✧ **Science**
  The Science curriculum is designed for students taking only 1 science subject. It will cover all the 6 strands of science education with emphasis placed on key ideas in science, daily contexts and STS connections. The content will be organized using a modular approach.

Science learning experiences for students at different levels are as follows:



Migration of subjects

The proposed science subjects in the New Senior Secondary Curriculum are developed based on the strength of the recently revised science subjects. Their relationships are illustrated in the following diagram:



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