MINISTRY OF EDUCATION MALAYSIA

Integrated Curriculum for Secondary Schools

CHEMISTRY

Syllabus

CURRICULUM DEVELOPMENT CENTRE
Ministry of Education
2006

THE NATIONAL PHILOSOPHY

Our nation, Malaysia, is dedicated to achieving a greater unity of all her people; maintaining a democratic way of life; creating a just society in which the wealth of the nation shall be equitably shared; ensuring a liberal approach to her rich and diverse cultural traditions; building a progressive society which shall be oriented towards modern science and technology.

We, the people of Malaysia, pledge our united efforts to attain these ends guided by the following principles:

BELIEF IN GOD

LOYALTY TO KING AND COUNTRY

SUPREMACY OF THE CONSTITUTION

RULE OF LAW

GOOD BEHAVIOUR AND MORALITY

NATIONAL PHILOSOPHY OF EDUCATION

Education in Malaysia is an on-going effort towards developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards and who are responsible and capable of achieving a high level of personal well being as well as being able to contribute to the harmony and betterment of the family, society and the nation at large.

NATIONAL SCIENCE EDUCATION PHILOSOPHY

In consonance with the National Education Philosophy,
science education in Malaysia nurtures
a Science and Technology Culture by focusing
on the development of individuals who are competitive,
dynamic, robust and resilient and able
to master scientific knowledge and technological competency.

PREFACE

Science and technology plays a crucial role in meeting Malaysia's aspiration to become a developed nation. Therefore, the provision of quality science education from an early age in the education process is of paramount importance.

The syllabus as outlined in this document has been designed to provide opportunities for students to acquire scientific knowledge and skills. It also seeks to inculcate noble values and love for the nation towards developing a future generation which is capable of contributing to the harmony and prosperity of the nation and its people.

The curriculum aims at producing active learners. The pupils are given ample opportunities to observe, ask questions, formulate and test hypotheses, analyse, interprete data, report and evaluate findings. Throughout the investigative learning process, the pupils will be encouraged to apply science process skills, thinking skills and thinking strategies for thoughtful learning.

The teaching of Science using English as the medium of instruction enables pupils to obtain various sources of information written in English either in electronic or print forms and helps them to keep abreast of developments in science and technology. Pupils will be able to see science and technology in a wider context and learn to relate their knowledge to the world beyond their school.

This syllabus is the work of many individuals and experts in the field. On behalf of the Ministry of Education, I would like to express my deepest appreciation to those who have given their vital support and contributed in one way or another on this effort.

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INTRODUCTION

As articulated in the National Education Policy, education in Malaysia is an ongoing effort towards further developing the potential of individuals in a holistic and integrated manner to produce individuals who are intellectually, spritually, emotionally, and physically balanced and harmonious. The primary and secondary school science curriculum is developed with the aim of producing such individuals.

As a nation that is progressing towards a developed nation status, Malaysia needs to create a society that is scientifically oriented, progressive, knowledgeable, having a high capacity for change, forward looking, innovative and a contributor to scientific and technological developments in the future. This society should also have the capability to manage the environment and its resources in a responsible manner. In line with this, there is a need to produce citizens who are creative, critical, inquisitive, open-minded and competent in science and technology.

Science is a discipline comprising knowledge, skills and scientific attitudes and noble values. The integration of these three elements is very important in ensuring a quality science education. As a discipline of knowledge, science provides a conceptual framework that will enable students to understand the world around them.

Science is also a process that emphasises inquiry and problem solving. Thus, science develops skills in investigating the environment, which involves thinking skills, thinking strategies and scientific skills. Knowledge is therefore acquired as the product of an investigation. Scientific inquiry also requires and enables students to develop scientific attitudes and noble values.

The science curriculum for the Integrated Curriculum for Primary School and the Integrated Curriculum for Secondary School are desgned for students from primary to secondary schools. The curriculum is fomulated based on the needs of the nation as well as global scientific requirements. The focus is directed towards thoughtful learning and optimising learning.

The science curriculum comprises three core science subjects and four elective science subjects. The core subjects are Science at primary school level, Science at lower secondary level and Science at upper secondary level. Elective science subject are offered at the upper secondary level and consist of Biology, Chemistry, Physics, and Additional Science.

The core science subjects for the primary and lower secondary levels are designed to provide students with basic science knowledge, prepare students to be literate in science, and enable students to continue their science education at the upper secondary level. Core science at the upper secondary level is designed

to produce students who are literate in science, innovative and able to apply scientific knowledge in decision-making and problem solving in everyday life. The elective science subjects prepare students who are more scientifically inclined to pursue the study of science at post-secondary level. This group of students would take up careers ini the field of science and technology and play a leading role ini the field for national development.

For every science subject, the curriculum for the year is articulated in two documents; the syllabus and the curriculum specifications. The syllabus presents the aims, objectives and the outline of the curriculum content for a period of two years for elective science subjects and five years for core sciece subjects. The curriculum specifications provide the details of the curriculum, which includes the learning objectives, suggested learning activities, the intended learning outcomes, and vocabulary.

AIMS

The aims of the Chemistry curriculum for secondary school are to provide students with the knowledge and skills in chemistry and technology and enable them to solve problems and make decisions in everyday life based on scientific attitudes and noble values.

Students who have followed the Chemistry curriculum will have a basic foundation in chemistry to enable them to pursue formal and informal futher education in science and technology.

The curriculum also aims to develop a dynamic and progressive society with a science and technology culture that values nature and works towards the preservation and conservation of the environment.

OBJECTIVES

The Chemistry curriculum for secondary school enables students to:

1. Acquire knowledge in chemistry and technology in the context of natural phenomena and everyday life experiences.

2. Understand developments in the field of chemistry and technology.

3. Acquire scientific and thinking skills.

4. Apply knowledge and skills in a creative and critical manner to solve problems and make decisions.

5. Face challenges in the scientific and technological world and be willing to contribute towards the development of science and technology.

6. Evaluate science and technology related information wisely and effectively.

7. Practise and internalise scientific attitudes and good moral values.

8. Appreciate the contributions of science and technology towards national development and the well-being of mankind.

9. Realise that scientific discoveries are the result of human endeavour to the best of his or her intellectual and mental capabilities to understand natural phenomena for the betterment of mankind.

10. Be aware of the need to love and care for the environment and play an active role in its preservation and conservation.

CONTENT ORGANISATION

The chemistry curriculum is organised by topics. Each topic consists of various learning areas, each of which consists of a number of learning objectives. A learning objective has one or more learning outcomes. Learning outcomes are written based on the hierarchy of the cognitive and affective domains. Levels in the cognitive domain are: knowledge, understanding, application, analysis, synthesis and evaluation. Levels in the effective domain are: to be aware of, to be in awe, to be appreciative, to be thankful, to love, to practise, and to internalise. Where possible, learning outcomes relating to the affective domain are explicitly stated. The inculcation of scientific attitudes and noble values should be integrated into every learning activity. This ensures a more spontaneous and natural inculcation of attitudes and values. Learning outcomes in the psychomotor domain are achieved implicitly through the learning activities.

The Suggested Learning Activities in the supporting document entitled 'Curriculum Specifications' provides information on the scope and dimension of learning outcomes. The suggested learning activities aim at providing some guidance as to how learning outcomes can be achieved. At the same time, more than one activity may be suggested for a particular learning outcome. Teachers may modify the suggested activities to suit the ability and style of learning of their students. At the same time, teachers are encouraged to design other innovative and effective learning activites to enhance the learning of science.

Teaching and learning strategies in the science curriculum emphasise thoughtful learning. Thoughtful learning is a process that helps students acquire knowledge and master skills that will help them develop their mind to an optimum level. Thoughtful learning can occur through various learning approaches such as inquiry, constructivism, contextual learning, and mastery learning. These learning approaches encompass learning methods such as experiments, discussions, simulations, projects, visits and future studies. Learning activities should therefore

be geared towards activating students' critical and creative thinking skills and not be confined to routine or rote learning.

Students should be made aware of the thinking skills and thinking strategies that they use in their learning. They should be challenged with higher order questions and problems and be required to solve problems utilising their creativity and critical thinking. The teaching and learning processes should enable students to acquire knowledge, master skills and develop scientific attitudes and noble values in an integrated manner.

The learning of science is not limited to activities carried out in the school compound. The latest trend in science education is to encourage smart partnership between the Ministry of Education and various organisations such as institutions of higher learning, other governmental agencies, non-governmental agencies and private corporations to provide new ideas, opportunities, strategies and skills. Learning of science can also be enhanced through the use of external resources such as zoos, animal sanctuaries, museums, science centres, research institutes, mangrove swamps, and factories. Visits to the these places make the learning of science more interesting, meaningful and effective. To optimise learning opportunities, visits need to be carefully planned. Students may be involved in the planning process and specific educational tasks should be assigned during the visit. No educational visit is complete without a post-visit discussion.

The skills to select, analyse and evaluate information from various sources are also developed. Through the use of technology such as television, radio, video, computer and internet, the teaching and learning of science can be made more interesting and effective. Computer simulation and animation are effective tools for the teaching and learning of abstract or difficult science concepts. Computer simulation and animation can be presented through courseware or web page. The use of technology will enhance the effectiveness of teaching and learning of science besides optimising the intended learning outcomes.

SCIENTIFIC SKILLS

Scientific skills encompass science process skills and manipulative skills. Science process skills promote thingking in a critical, creative, analytical and systematic manner. The mastering of science process skills together with scinetific attiudes and knowledge will enable the students to think, fomulate questions and find out answers systematically.

Science Process Skills

Science process skills that need to be developed in the science curriculum are as follows:

- Observing
- Classifying
- Measuring and Using Numbers
- Inferring
- Predicting
- Communicating
- Using Space-Time Relationship
- Interpreting Data
- Defining Operationally
- Controlling Variables
- Hypothesising
- Experimenting

Manipulative Skills

Manipulative skills are psychomotor skills in scientific investigation which enable students to:

- Use and handle science apparatus and laboratory substances correctly
- Store science apparatus correctly and safely
- Clean science apparatus correctly
- Handle specimens correctly and carefully
- Observe, record and measure accurately

Thinking Skills

Teaching and learning of science provides a good opportunity to develop students' thinking skills. Strategies in teaching and learning science require the mastering of thinking skills and thinking strategies which will be the foundation for thoughtful learning. Thinking strategies can be categorised into critical thinking skills and creative thinking skills.

SCIENTIFIC ATTITUDES AND NOBLE VALUES

Science learning experiences can be used as a mean to inculcate positive scientific attitudes and noble values in students. The inculcation of scientific attitudes and noble values can be done through proper planning or spontaneously. In this curriculum, the learning objectives for the affective domain are articulated as specific learning outcomes. The specific activities to achieve the learning objectives have also been suggested.

KNOWLEDGE CONTENT

The curriculum content is organised based on the following themes:

1. Introduction to Chemistry
2. Matter Around Us
3. Interactions Between Chemicals
4. Production and Management of Manufactured Chemicals

The following are the learning areas within each theme:

A. Introducing Chemistry

This theme aims to provide an understanding of Chemistry as a field of study. Students are introduced to matter and the method of acquiring science knowledge in a scientific manner through scientific investigation. The topic also discusses careers in the field of chemistry.

The content of this theme is as follows:

1. Introduction to Chemistry

- Understanding Chemistry
- Understanding the Importance of Chemistry
- Scientific Method of Investigation
- Scientific Attitudes and Good Moral Values in Conducting Scientific Investigation

B. Matter Around Us

This theme aims to introduce chemistry as a field that studies matter. This theme provides basic concepts in chemistry which is a prerequisite to the learning of chemistry. The mastery of these concepts is important to the understanding of chemistry. This theme also relates chemistry to careers pertaining to chemistry.

The content of this theme is as follows:

1. Structure of Atom

This learning area aims to provide understanding of the concepts and princples related to the structure of atoms.

The content of this learning area is as follows:

- Understanding Matter
- Atomic Structure

- Importance of Isotopes
- The Electronic Structure of Atom

2. Formula and Chemical Equation

This learning area aims to provide understanding of the concepts and principles related to formula and chemical equation.

The content of this learning area is as follows:

- Relative Atomic Mass and Relative Molecular Mass
- Mole Concept
- Chemical Formula
- Empirical Formula and Molecular Formula
- Balancing Chemical Equation

3. Periodic Table of Elements

This learning area aims to provide understanding of the concepts and principles of Periodic Table of elements.

The content of this learning area is as follows:

- Development of The Periodic Table
- Group and Period
- Group 18
- Group 1
- Group 17
- Transition Elements

4. Chemical Bonds

This learning area aims to provide understanding of concepts and principle of chemical bonds.

The content of this learning area is as follows:

- Stability of Inert Gases
- Formation of Ionic Bonds
- Formation of Covalent Bonds
- Properties of Ionic Compounds
- Properties of Covalent Compounds

C. Interactions Between Chemicals

This theme aims to provide understanding of chemical reations which cause chemical changes to substances. This theme also investigates the idea that matter interacts to produce new substances and causes energy change. The application of chemical reacitons in industries is also covered in this theme.

1. Electrochemistry

This learning area aims to provide understanding of electrochemistry and its applicatons.

The content of this learning area is as follows:

- Electrolyte and non-electrolyte
- Electrolysis of molten compounds
- Electrolysis of aqueous solutions
- Half equations for the discharge of ions
- Electrolysis in industries
- Chemical cells
- Electrochemical series

2. Acids, Bases And Salts

This learning area aims to provide understanding of acid, base and salt and its applications.

The content of this learning area is as follows:

- The Meaning of Acid, Base and Salt
- Role of Water In The Formation of Hydroxonium Ions
- Characteristics of Acid and Alkali
- Strong Acid and Weak Acid
- Strong Alkali and Weak Alkali
- Molarity
- Neutralisation
- Preparation of Salts
- Uses of Salts in Daily Life
- Qualitative Analysis of Salts

3. Carbon Compounds

This learning area aims to provide understanding of carbon compounds and its applications.

The content of this learning area is as follows:

- Organic Compounds and Inorganic Compounds
- Hydrocarbons
- Alkanes
- Alkenes
- Isomerism
- Alchohols
- Carboxylic Acids
- Esters
- Fats and Oils
- Natural Polymers

4. Oxidation and Reduction Reactions

This learning area aims to provide a basic understanding of the principles of oxidation and reduction reactions and their applications.

The content of this learning area is as follows:

- Redox Reactions
- Rusting
- Extraction of Metals
- Redox Reactions in Electrolysis and Chemical Cells

5. Thermochemistry

This learning area aims to provide an understanding of thermochemistry and its applications.

The content of this learning area is as follows:

- Exothermic Reaction and Endothermic Reaction
- Heat of Combustion
- Heat of Neutralisation
- Heat of Displacement
- Heat of Precipitation
- Energy Level Diagram

6. Rate of Reaction

This learning area aims to provide an understanding of rate of reaction and its applications.

The content of this learning area is as follows:

- ? High Reaction Rate and Low Reaction Rate
- ? Average Rate of Reaction and Rate of Reaction at Any Given Time
- ? Factiors that Influence the Rate of Reaction

D. Production and Management of Manufactured Chemicals

This theme aims to enable student to understand the manufacturing of chemicals fo daily and social needs. Student relates knowledge and skills that they have learned in chemistry lessons to experiences in daily life. The importance of responsible way of managing manufactured chemicals is also highlighted in this theme.

1. Manufactured Subtance In Industry

This learning area aims to provide an understanding of manufactured substances in industry and its applications.

The content of this learning area is as follows:

- ? The manufacture of sulfuric acid in industry
- ? The uses of sulfuric acids
- ? The manufacture of ammonia
- ? Alloy
- ? Synthetic polymers
- ? Glass and ceramics
- ? Composite materials

2. Chemicals For Consumers

This learning area aims to provide an understanding of chemicals for consumers.

The content of this learning area is as follows:

- ? Soap and detergent
- ? Food additive
- ? Traditional medicines
- ? Modern medicines