

MINISTRY OF EDUCATION MALAYSIA

Integrated Curriculum for Secondary Schools

Curriculum Specifications

SCIENCE

Form 3



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Ministry of Education Malaysia
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THE NATIONAL PHILOSOPHY

Our nation, Malaysia, is dedicated to achieving a greater unity of all her peoples; 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 orientated towards modern science and technology;

The people of Malaysia pledge their united efforts to attain these ends guided by the following principles:

BELIEF IN GOD

LOYALTY TO KING AND COUNTRY

UPHOLDING 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

The aspiration of the nation to become an industrialised society depends on science and technology. It is envisaged that success in providing quality science education to Malaysians from an early age will serve to spearhead the nation into becoming a knowledge society and a competitive player in the global arena. Towards this end, the Malaysian education system is giving greater emphasis to science and mathematics education.

The Science curriculum has been designed not only to provide opportunities for students to acquire science knowledge and skills, develop thinking skills and thinking strategies, and to apply this knowledge and skills in everyday life, but also to inculcate in them noble values and the spirit of patriotism. It is hoped that the educational process en route to achieving these aims would produce well-balanced citizens capable of contributing to the harmony and prosperity of the nation and its people.

The Science curriculum aims at producing active learners. To this end, students are given ample opportunities to engage in scientific investigations through hands-on activities and experimentations. The inquiry approach, incorporating thinking skills, thinking strategies and thoughtful learning, should be emphasised throughout the teaching-learning process. The content and contexts suggested are chosen based on their relevance and appeal to students so that their interest in the subject is enhanced.

In a recent development, the Government has made a decision to introduce English as the medium of instruction in the teaching and learning of science and mathematics. This measure will enable students to keep abreast of developments in science and technology in contemporary society by enhancing their capability and know-how to tap the diverse sources of information on science written in the English language. At the same time, this move would also provide opportunities for students to use the English language and hence, increase their proficiency in the language. Thus, in implementing the science curriculum, attention is given to developing students' ability to use English for study and communication, especially in the early years of learning.

The development of this curriculum and the preparation of the corresponding Curriculum Specifications have been the work of many individuals over a period of time. To all those who have contributed in one way or another to this effort, may I, on behalf of the Ministry of Education, express my sincere gratitude and thanks for the time and labour expended.



(Dr. SHARIFAH MAIMUNAH SYED ZIN)
Director
Curriculum Development Centre
Ministry of Education Malaysia

INTRODUCTION

As articulated in the National Education Policy, education in Malaysia is an on-going effort towards developing the potential of individuals in a holistic and integrated manner to produce individuals who are intellectually, spiritually, 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. In line with this, there is a need to produce citizens who are creative, critical, inquisitive, open-minded and competent in science and technology.

The Malaysian 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 subjects 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 in the field of science and technology and play a leading role in this 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 2 years for elective science subjects and 5 years for core science subjects. The curriculum specifications provide the details of the curriculum which includes the aims and objectives of the curriculum, brief descriptions on thinking skills and thinking strategies, scientific skills, scientific attitudes and noble values, teaching and learning strategies, and curriculum content. The curriculum content provides the learning objectives, suggested learning activities, the intended learning outcomes, and vocabulary.

AIMS

The aims of the science curriculum for secondary school are to provide students with the knowledge and skills in science 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 secondary science curriculum will have the foundation in science to enable them to pursue formal and informal further education in science and technology.

The curriculum also aims to develop a concerned, 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 science curriculum for secondary school enables students to:

1. Acquire knowledge in science and technology in the context of natural phenomena and everyday life experiences.
2. Understand developments in the field of science and technology.
3. Acquire scientific and thinking skills.
4. Apply knowledge and skills in a creative and critical manner for problem solving and decision-making.
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. Realise the importance of inter-dependence among living things and the management of nature for survival of mankind.
9. Appreciate the contributions of science and technology towards national development and the well-being of mankind.
10. 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.
11. Create awareness on the need to love and care for the environment and play an active role in its preservation and conservation.

SCIENTIFIC SKILLS

Science emphasises inquiry and problem solving. In inquiry and problem solving processes, scientific and thinking skills are utilised. Scientific skills are important in any scientific investigation such as conducting experiments and carrying out projects.

Scientific skills encompass science process skills and manipulative skills.

Science Process Skills

Science process skills enable students to formulate their questions and find out the answers systematically.

Descriptions of the science process skills are as follows:

Observing	Using the sense of hearing, touch, smell, taste and sight to collect information about an object or a phenomenon.
Classifying	Using observations to group objects or events according to similarities or differences.
Measuring and Using Numbers	Making quantitative observations using numbers and tools with standardised units. Measuring makes observation more accurate.

Inferring	Using past experiences or previously collected data to draw conclusions and make explanations of events.
Predicting	Stating the outcome of a future event based on prior knowledge gained through experiences or collected data.
Communicating	Using words or graphic symbols such as tables, graphs, figures or models to describe an action, object or event.
Using Space-Time Relationship	Describing changes in parameter with time. Examples of parameters are location, direction, shape, size, volume, weight and mass.
Interpreting Data	Giving rational explanations about an object, event or pattern derived from collected data.

Defining Operationally

Defining concepts by describing what must be done and what should be observed.

Controlling Variables

Identifying the fixed variable, manipulated variable, and responding variable in an investigation. The manipulated variable is changed to observe its relationship with the responding variable. At the same time, the fixed variable is kept constant.

Hypothesising

Making a general statement about the relationship between a manipulated variable and a responding variable in order to explain an event or observation. This statement can be tested to determine its validity.

Experimenting

Planning and conducting activities to test a certain hypothesis. These activities include collecting, analysing and interpreting data and making conclusions.

Manipulative Skills

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

- use and handle science apparatus and laboratory substances correctly.
- handle specimens correctly and carefully.
- draw specimens, apparatus and laboratory substances accurately.
- clean science apparatus correctly, and
- store science apparatus and laboratory substances correctly and safely.

THINKING SKILLS

Thinking is a mental process that requires an individual to integrate knowledge, skills and attitude in an effort to understand the environment.

One of the objectives of the national education system is to enhance the thinking ability of students. This objective can be achieved through a curriculum that emphasises thoughtful learning. Teaching and learning that emphasises thinking skills is a foundation for thoughtful learning.

Thoughtful learning is achieved if students are actively involved in the teaching and learning process. Activities should be organised to provide opportunities for students to apply thinking skills in conceptualisation, problem solving and decision-making.

Thinking skills can be categorised into critical thinking skills and creative thinking skills. A person who thinks critically always evaluates an idea in a systematic manner before accepting it. A person who thinks creatively has a high level of imagination, is able to generate original and innovative ideas, and modify ideas and products.

Thinking strategies are higher order thinking processes that involve various steps. Each step involves various critical and creative thinking skills. The ability to formulate thinking strategies is the ultimate aim of introducing thinking activities in the teaching and learning process.

Critical Thinking Skills

A brief description of each critical thinking skill is as follows:

- Attributing** Identifying criteria such as characteristics, features, qualities and elements of a concept or an object.
- Comparing and Contrasting** Finding similarities and differences based on criteria such as characteristics, features, qualities and elements of a concept or event.
- Grouping and Classifying** Separating and grouping objects or phenomena into categories based on certain criteria such as common characteristics or features.

Sequencing Arranging objects and information in order based on the quality or quantity of common characteristics or features such as size, time, shape or number.

Prioritising Arranging objects and information in order based on their importance or priority.

Analysing Examining information in detail by breaking it down into smaller parts to find implicit meaning and relationships.

Detecting Bias Identifying views or opinions that have the tendency to support or oppose something in an unfair or misleading way.

Evaluating Making judgements on the quality or value of something based on valid reasons or evidence.

Making Conclusions Making a statement about the outcome of an investigation that is based on a hypothesis.

Creative Thinking Skills

A brief description of each creative thinking skill is as follows:

Generating Ideas	Producing or giving ideas in a discussion.
Relating	Making connections in a certain situation to determine a structure or pattern of relationship.
Making Inferences	Using past experiences or previously collected data to draw conclusions and make explanations of events.
Predicting	Stating the outcome of a future event based on prior knowledge gained through experiences or collected data.
Making Generalisations	Making a general conclusion about a group based on observations made on, or some information from, samples of the group.
Visualising	Recalling or forming mental images about a particular idea, concept, situation or vision.

Synthesising Combining separate elements or parts to form a general picture in various forms such as writing, drawing or artefact.

Making Hypotheses Making a general statement on the relationship between manipulated variables and responding variables in order to explain a certain thing or happening. This statement is thought to be true and can be tested to determine its validity.

Making Analogies Understanding a certain abstract or complex concept by relating it to a simpler or concrete concept with similar characteristics.

Inventing Producing something new or adapting something already in existence to overcome problems in a systematic manner.

Thinking Strategy

Description of each thinking strategy is as follows:

Conceptualising	Making generalisations based on inter-related and common characteristics in order to construct meaning, concept or model.
Making Decisions	Selecting the best solution from various alternatives based on specific criteria to achieve a specific aim.
Problem Solving	Finding solutions to challenging or unfamiliar situations or unanticipated difficulties in a systematic manner.

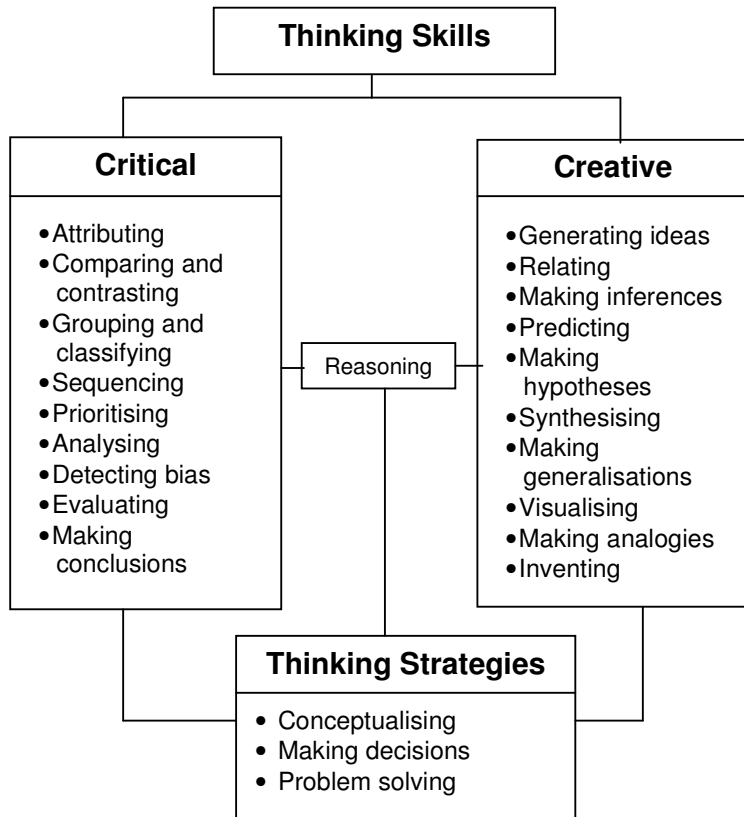
Besides the above thinking skills and thinking strategies, another skill emphasised is reasoning. Reasoning is a skill used in making logical, just and rational judgements. Mastering of critical and creative thinking skills and thinking strategies is made simpler if an individual is able to reason in an inductive and deductive manner. Figure 1 gives a general picture of thinking skills and thinking strategies.

Mastering of thinking skills and thinking strategies (TSTS) through the teaching and learning of science can be developed through the following phases:

1. Introducing TSTS.
2. Practising TSTS with teacher's guidance.
3. Practising TSTS without teacher's guidance.
4. Applying TSTS in new situations with teacher's guidance.
5. Applying TSTS together with other skills to accomplish thinking tasks.

Further information about phases of implementing TSTS can be found in the guidebook "*Buku Panduan Penerapan Kemahiran Berfikir dan Strategi Berfikir dalam Pengajaran dan Pembelajaran Sains*" (Curriculum Development Centre, 1999).

Figure 1 : TSTS Model in Science



manner. It is a mental process that promotes critical, creative, analytical and systematic thinking. Mastering of science process skills and the possession of suitable attitudes and knowledge enable students to think effectively.

The mastering of science process skills involves the mastering of the relevant thinking skills. The thinking skills that are related to a particular science process skill are as follows:

Science Process Skills	Thinking Skills
Observing	Attributing Comparing and contrasting Relating
Classifying	Attributing Comparing and contrasting Grouping and classifying
Measuring and Using Numbers	Relating Comparing and contrasting
Making Inferences	Relating Comparing and contrasting Analysing Making inferences
Predicting	Relating Visualising

Relationship between Thinking Skills and Science Process Skills

Science process skills are skills that are required in the process of finding solutions to a problem or making decisions in a systematic

Science Process Skills	Thinking Skills
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Using Space-Time Relationship	Sequencing Prioritising
Interpreting data	Comparing and contrasting Analysing Detecting bias Making conclusions Generalising Evaluating
Defining operationally	Relating Making analogy Visualising Analysing
Controlling variables	Attributing Comparing and contrasting Relating Analysing
Making hypothesis	Attributing Relating Comparing and contrasting Generating ideas Making hypothesis Predicting Synthesising
Experimenting	All thinking skills
Communicating	All thinking skills

Teaching and Learning based on Thinking Skills and Scientific Skills

This science curriculum emphasises thoughtful learning based on thinking skills and scientific skills. Mastery of thinking skills and scientific skills are integrated with the acquisition of knowledge in the intended learning outcomes. Thus, in teaching and learning, teachers need to emphasise the mastery of skills together with the acquisition of knowledge and the inculcation of noble values and scientific attitudes.

The following is an example and explanation of a learning outcome based on thinking skills and scientific skills.

Example:

Learning Outcome: Compare and contrast metallic elements and non-metallic elements.

Thinking Skills: Comparing and contrasting

Explanation:

To achieve the above learning outcome, knowledge of the characteristics and uses of metals and non-metals in everyday life are learned through comparing and contrasting. The mastery of the skill of comparing and contrasting is as important as the knowledge about the elements of metal and the elements of non-metal.

SCIENTIFIC ATTITUDES AND NOBLE VALUES

Science learning experiences can be used as a means to inculcate scientific attitudes and noble values in students. These attitudes and values encompass the following:

- Having an interest and curiosity towards the environment.
- Being honest and accurate in recording and validating data.
- Being diligent and persevering.
- Being responsible about the safety of oneself, others, and the environment.
- Realising that science is a means to understand nature.
- Appreciating and practising clean and healthy living.
- Appreciating the balance of nature.
- Being respectful and well-mannered.
- Appreciating the contribution of science and technology.
- Being thankful to God.
- Having critical and analytical thinking.
- Being flexible and open-minded.
- Being kind-hearted and caring.
- Being objective.
- Being systematic.
- Being cooperative.
- Being fair and just.
- Daring to try.
- Thinking rationally.
- Being confident and independent.

The inculcation of scientific attitudes and noble values generally occurs through the following stages:

- Being aware of the importance and the need for scientific attitudes and noble values.

- Giving emphasis to these attitudes and values.
- Practising and internalising these scientific attitudes and noble values.

When planning teaching and learning activities, teachers need to give due consideration to the above stages to ensure the continuous and effective inculcation of scientific attitudes and values. For example, during science practical work, the teacher should remind pupils and ensure that they carry out experiments in a careful, cooperative and honest manner.

Proper planning is required for effective inculcation of scientific attitudes and noble values during science lessons. Before the first lesson related to a learning objective, teachers should examine all related learning outcomes and suggested teaching-learning activities that provide opportunities for the inculcation of scientific attitudes and noble values.

The following is an example of a learning outcome pertaining to the inculcation of scientific attitudes and values.

Example:

Year: Form One

Learning Area: 1. Matter

Learning Objective: 2.3 Appreciating the importance of the variety of earth's resources to man.

Learning Outcome: Practise reducing the use, reusing and recycling of materials, e.g. using old unfinished exercise books as notebooks and collecting old newspaper for recycling.

Suggested Learning Activities Carry out projects, campaigns, or competitions on reducing the use, reusing and recycling of materials.

Scientific attitudes and noble values Love and respect for the environment.

Being responsible for the safety of oneself, others and the environment.

Appreciating the balance of nature.

Being systematic.

Being cooperative.

Inculcating Patriotism

The science curriculum provides an opportunity for the development and strengthening of patriotism among students. For example, in learning about the earth's resources, the richness and variety of living things and the development of science and technology in the country, students will appreciate the diversity of natural and human resources of the country and deepen their love for the country.

TEACHING AND LEARNING STRATEGIES

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 minds to the optimum level. Thoughtful learning can occur through various learning approaches such as inquiry, constructivism, contextual learning, and mastery learning. 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 process should enable students to acquire knowledge, master skills and develop scientific attitudes and noble values in an integrated manner.

Teaching and Learning Approaches in Science

Inquiry-Discovery

Inquiry-discovery emphasises learning through experiences. Inquiry generally means to find information, to question and to investigate a phenomenon that occurs in the environment. Discovery is the main characteristic of inquiry. Learning through discovery occurs when the main concepts and principles of science are investigated and discovered by students themselves. Through activities such as experiments, students investigate a phenomenon and draw conclusions by themselves. Teachers then lead students to understand the science concepts through

the results of the inquiry. Thinking skills and scientific skills are thus developed further during the inquiry process. However, the inquiry approach may not be suitable for all teaching and learning situations. Sometimes, it may be more appropriate for teachers to present concepts and principles directly to students.

Constructivism

Constructivism suggests that students learn about something when they construct their own understanding. The important attributes of constructivism are as follows:

- Taking into account students' prior knowledge.
- Learning occurring as a result of students' own effort.
- Learning occurring when students restructure their existing ideas by relating new ideas to old ones.
- Providing opportunities to cooperate, sharing ideas and experiences, and reflecting on their learning.

Science, Technology and Society

Meaningful learning occurs if students can relate their learning with their daily experiences. Meaningful learning occurs in learning approaches such as contextual learning and Science, Technology and Society (STS).

Learning themes and learning objectives that carry elements of STS are incorporated into the curriculum. STS approach suggests that science learning takes place through investigation and discussion based on science and technology issues in society. In the STS approach, knowledge in science and technology is to be learned with the application of the principles of science and technology and their impact on society.

Contextual Learning

Contextual learning is an approach that associates learning with daily experiences of students. In this way, students are able to appreciate the relevance of science learning to their lives. In contextual learning, students learn through investigations as in the inquiry-discovery approach.

Mastery Learning

Mastery learning is an approach that ensures all students are able to acquire and master the intended learning objectives. This approach is based on the principle that students are able to learn if they are given adequate opportunities. Students should be allowed to learn at their own pace, with the incorporation of remedial and enrichment activities as part of the teaching-learning process.

Teaching and Learning Methods

Teaching and learning approaches can be implemented through various methods such as experiments, discussions, simulations, projects, and visits. In this curriculum, the teaching-learning methods suggested are stated under the column "Suggested Learning Activities." However, teachers can modify the suggested activities when the need arises.

The use of a variety of teaching and learning methods can enhance students' interest in science. Science lessons that are not interesting will not motivate students to learn and subsequently will affect their performance. The choice of teaching methods should be based on the curriculum content, students' abilities, students' repertoire of intelligences, and the availability of resources and infrastructure. Besides playing the role of knowledge presenters and experts, teachers need to act as

facilitators in the process of teaching and learning. Teachers need to be aware of the multiple intelligences that exist among students. Different teaching and learning activities should be planned to cater for students with different learning styles and intelligences.

The following are brief descriptions of some teaching and learning methods.

Experiment

An experiment is a method commonly used in science lessons. In experiments, students test hypotheses through investigations to discover specific science concepts and principles. Conducting an experiment involves thinking skills, scientific skills, and manipulative skills.

Usually, an experiment involves the following steps:

- Identifying a problem.
- Making a hypothesis.
- Planning the experiment
 - controlling variables.
 - determining the equipment and materials needed.
 - determining the procedure of the experiment and the method of data collection and analysis.
- Conducting the experiment.
- Collecting data.
- Analysing data.
- Interpreting data.
- Making conclusions.
- Writing a report.

In the implementation of this curriculum, besides guiding students to do an experiment, where appropriate, teachers

should provide students with the opportunities to design their own experiments. This involves students drawing up plans as to how to conduct experiments, how to measure and analyse data, and how to present the outcomes of their experiment.

Discussion

A discussion is an activity in which students exchange questions and opinions based on valid reasons. Discussions can be conducted before, during or after an activity. Teachers should play the role of a facilitator and lead a discussion by asking questions that stimulate thinking and getting students to express themselves.

Simulation

In simulation, an activity that resembles the actual situation is carried out. Examples of simulation are role-play, games and the use of models. In role-play, students play out a particular role based on certain pre-determined conditions. Games require procedures that need to be followed. Students play games in order to learn a particular principle or to understand the process of decision-making. Models are used to represent objects or actual situations so that students can visualise the said objects or situations and thus understand the concepts and principles to be learned.

Project

A project is a learning activity that is generally undertaken by an individual or a group of students to achieve a certain learning objective. A project generally requires several lessons to complete. The outcome of the project either in the form of a report, an artefact or in other forms needs to be presented to the teacher

and other students. Project work promotes the development of problem-solving skills, time management skills, and independent learning.

Visits and Use of External Resources

The learning of science is not limited to activities carried out in the school compound. Learning of science can be enhanced through the use of external resources such as zoos, museums, science centres, research institutes, mangrove swamps, and factories. Visits to 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.

Use of Technology

Technology is a powerful tool that has great potential in enhancing the learning of science. 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. Application tools such, as word processors, graphic presentation software and electronic spreadsheets are valuable tools for the analysis and presentation of data.

The use of other tools such as data loggers and computer interfacing in experiments and projects also enhance the effectiveness of teaching and learning of science.

CONTENT ORGANISATION

The science curriculum is organised around themes. Each theme 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 affective 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 areas in the psychomotor domain are implicit in the learning activities.

Learning outcomes are written in the form of measurable behavioural terms. In general, the learning outcomes for a particular learning objective are organised in order of complexity. However, in the process of teaching and learning, learning activities should be planned in a holistic and integrated manner that enables the achievement of multiple learning outcomes according to needs and context. Teachers should avoid employing a teaching strategy that tries to achieve each learning outcome

separately according to the order stated in the curriculum specifications.

The Suggested Learning Activities provide information on the scope and dimension of learning outcomes. The learning activities stated under the column Suggested Learning Activities are given with the intention of providing some guidance as to how learning outcomes can be achieved. A suggested activity may cover one or more learning outcomes. At the same time, more than one activity may be suggested for a particular learning outcome. Teachers may modify the suggested activity to suit the ability and style of learning of their students. Teachers are encouraged to design other innovative and effective learning activities to enhance the learning of science.

THEME: MANAGEMENT AND CONTINUITY OF LIFE

LEARNING AREA: 1. RESPIRATION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing the human breathing mechanism.</p>	<p>Observe models or computer software to identify the structure of the human respiratory system which consists of the nasal cavity, trachea, bronchus, lungs, ribs, diaphragm and the intercostal muscles.</p> <p>Examine a model of a lung to identify the bronchus, bronchiole and alveolus.</p> <p>Build a functional model of the human respiratory system to show the relationship between the air pressure in the thoracic cavity and the process of inhalation and exhalation.</p> <p>Discuss the breathing mechanism.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the structure of the human respiratory system, ▪ identify the structure of the lung, ▪ describe the process of inhalation and exhalation, ▪ relate the changes of air pressure in the thoracic cavity to inhalation and exhalation, ▪ describe the breathing mechanism. 	<p>The contraction and relaxation of the internal and external intercostal muscles are not required.</p>	<p>breathing mechanism – <i>mekanisme pernafasan</i> exhalation – <i>hembusan nafas</i> inhalation – <i>tarikan nafas</i> intercostal muscle – <i>otot interkosta</i> nasal cavity – <i>rongga nasal</i> rib – <i>tulang rusuk</i> thoracic cavity – <i>rongga toraks</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Understanding the transport of oxygen in the human body.</p>	<p>View a video or computer software then gather and interpret data on the following:</p> <p>a) diffusion of oxygen from the alveoli into the blood capillaries and from the blood capillaries into the cells,</p> <p>b) transport of oxygen by the red blood cells in the form of oxyhaemoglobin.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the diffusion of oxygen from the alveoli into the blood capillaries, ▪ describe the transport of oxygen by blood, ▪ describe the diffusion of oxygen from the blood capillaries into the cells. 		<p>diffusion – <i>peresapan</i></p>
<p>1.3 Realising the importance of a healthy respiratory system.</p>	<p>Collect and interpret data on the following:</p> <p>a) substances that are harmful to the respiratory system, i.e. nicotine and tar (from the smoke of cigarettes), sulphur dioxide (from factories), and carbon monoxide (from the smoke of vehicles) and haze,</p> <p>b) effects of harmful substances such as toxin and carcinogen on the respiratory system,</p> <p>c) diseases of the respiratory system.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ list the substances which are harmful to the respiratory system, ▪ explain the effects of pollutants on the respiratory system, ▪ list the diseases that affect the respiratory system, ▪ practise good habits to improve the quality of air. 		<p>carcinogen – <i>karsinogen</i> toxin – <i>bahan beracun</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Carry out an activity to show the effects of smoking on the lungs.</p> <p>Hold or visit an exhibition on the effects of smoking and diseases of the lungs.</p> <p>Brainstorm ideas on how to improve air quality and put these ideas into practice.</p>			

LEARNING AREA: 2. BLOOD CIRCULATION AND TRANSPORT

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.1 Understanding the transport system in humans.</p>	<p>Observe and study models, computer software or videos on the structure of the heart and types of blood vessels (i.e. artery, vein and capillary) in the blood circulatory system.</p> <p>Examine a live specimen of a heart to identify its structure.</p> <p>Discuss the following: a) functions of the heart, b) characteristics of the blood vessels and their functions.</p> <p>Carry out an activity to compare and contrast oxygenated and deoxygenated blood.</p> <p>Simulate the flow of blood in the circulatory system.</p> <p>Discuss the role of the blood circulatory system in the transport of substances.</p> <p>Invite a medical officer to give a talk on 'Taking Care of Your Heart'.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the circulatory system as a system of tubes with a pump and valves that ensure one-way flow of blood, ▪ state the functions of the heart, ▪ identify the structure of the human heart, ▪ compare and contrast the structure of arteries, veins and capillaries, ▪ relate the characteristics of the blood vessels to their functions, ▪ compare and contrast oxygenated and deoxygenated blood, ▪ illustrate the path of blood flow in the circulatory system, ▪ describe the role of the blood circulatory system in the transport of substances, ▪ explain the importance of maintaining a healthy heart. 		<p>blood vessel – <i>salur darah</i> deoxygenated blood – <i>darah terdeoksigen</i> heart – <i>jantung</i> oxygenated blood – <i>darah beroksigen</i> vein – <i>vena</i> artery – <i>arteri</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
2.2 Analysing the human blood.	Invite a physician to give a talk on the following: a) the constituents of blood, i.e. plasma, red blood cells, white blood cells, platelets and their functions, b) the blood groups, i.e. A, B, AB and O, c) the compatibility between the blood group of the donor and that of the recipient, d) the importance of blood donation, e) the storage and handling of donated blood.	A student is able to: <ul style="list-style-type: none"> ▪ state the constituents of blood and their functions, ▪ state the blood groups, ▪ match the blood group of the donor to that of the recipient, ▪ justify the importance of blood donation, ▪ describe how donated blood is stored and handled. 	Universal donor and universal recipient should be included.	blood donation – <i>derma darah</i> blood group – <i>kumpulan darah</i> physician – <i>doktor</i> universal donor – <i>penderma universal</i> universal recipient – <i>penerima universal</i>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.3 Analysing the transport system in plants.</p>	<p>Observe a wilted plant and discuss how it occurred.</p> <p>Examine the epidermis of a leaf under a microscope to identify the stomata and discuss its functions.</p> <p>Carry out experiments to study the factors affecting the rate of transpiration.</p> <p>Carry out activities to study the following:</p> <p>a) transport of synthesised food substances via the phloem, b) transport of water from roots to the leaves via the xylem.</p> <p>Examine cross-sections of root, stem and leaf to identify the location of xylem and phloem.</p> <p>Discuss the roles of transpiration in the transport of water and minerals.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe how wilting occurs, ▪ describe what transpiration is, ▪ describe the functions of stomata, ▪ identify the factors affecting the rate of transpiration, ▪ describe how the factors affect the rate of transpiration, ▪ describe the roles of transpiration, ▪ investigate the pathway of water in a cut stem using a suitable stains, ▪ identify the locations of xylem and phloem, ▪ describe the functions of xylem and phloem. 	<p>The transport of water and minerals in transpiration should be emphasized.</p>	<p>transport – <i>pengangkutan</i> transpiration - <i>transpirasi</i></p>

LEARNING AREA: 3. EXCRETION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>3.1 Understanding human excretion.</p>	<p>Discuss what excretion is.</p> <p>Examine models, charts or view computer software to identify the excretory organs, i.e. skin, lungs and kidneys.</p> <p>Discuss the excretory products of each excretory organ, i.e. water, carbon dioxide, minerals, salt and urea.</p> <p>Discuss the importance of excretion.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ explain what excretion is, ▪ identify the excretory organs in humans, ▪ state the excretory products of each excretory organ, ▪ explain the importance of excretion. 		<p>excretion – <i>perkumuhan</i></p>
<p>3.2 Analysing the urinary system in human.</p>	<p>Examine models, charts or view computer software of the urinary system to identify the locations of kidneys, ureters, urinary bladder and urethra.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the locations of kidneys and other parts of the urinary system, ▪ describe the shape of the kidney, ▪ identify the structures of the kidney, 	<p>The structure and the function of the nephron is not required.</p>	<p>kidney – <i>ginjal</i> urinary bladder – <i>pundi kencing</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Collect and interpret data on the functions of the kidney.</p> <p>Examine a live specimen of a kidney to:</p> <p>a) describe the shape of the kidney,</p> <p>b) identify the components of the kidney, i.e. the cortex, medulla and pelvis.</p> <p>Discuss the following:</p> <p>a) the importance of the kidneys,</p> <p>b) living with kidney failure.</p>	<ul style="list-style-type: none"> ▪ describe the functions of the kidney, ▪ explain the importance of maintaining healthy kidneys. 	<p>Describe briefly how a dialysis machine works.</p>	
<p>3.3 Analysing excretion in plants.</p>	<p>Collect and interpret data on the following:</p> <p>a) the ways plants eliminate their excretory products,</p> <p>b) the excretory products of plants, i.e. carbon dioxide, water and complex waste products.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the ways plants eliminate their excretory products, ▪ identify the excretory products of plants. 		

LEARNING AREA: 4. REPRODUCTION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.1 Understanding sexual and asexual reproduction.</p>	<p>Discuss the following;</p> <p>a) the importance and types of reproduction,</p> <p>b) the similarities and differences between sexual and asexual reproduction.</p> <p>Using charts, diagrams, videos or computer software to study the following:</p> <p>a) fertilisation,</p> <p>b) internal and external fertilisation,</p> <p>c) the various ways of asexual reproduction, i.e. binary fission, budding, spore formation, vegetative reproduction and regeneration.</p> <p>Discuss and classify animals and plants according to how they reproduce.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the importance of reproduction, ▪ state the types of reproduction, ▪ state what fertilisation is, ▪ describe internal and external fertilisation, ▪ compare and contrast sexual and asexual reproduction, ▪ classify animals and plants according to their ways of reproduction. 	<p style="text-align: center;">Reproduction</p> <pre> graph TD Reproduction --> sexual Reproduction --> asexual asexual --> binary_fission[binary fission] asexual --> budding asexual --> spore_formation[spore formation] asexual --> vegetative asexual --> regeneration </pre>	<p>asexual reproduction – <i>pembiakan aseks</i></p> <p>binary fission – <i>belahan dedua</i></p> <p>budding – <i>pertunasan</i></p> <p>external fertilisation – <i>persenyawaan luar</i></p> <p>internal fertilisation – <i>persenyawaan dalam</i></p> <p>sexual reproduction – <i>pembiakan seks</i></p> <p>spore formation – <i>pembentukan spora</i></p> <p>vegetative reproduction – <i>pembiakan vegetatif</i></p> <p>regeneration – <i>penjanaan semula</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.2 Analysing the male reproductive system.</p>	<p>Identify the following parts of the male reproductive system with the help of charts, models, videos or computer software:</p> <ol style="list-style-type: none"> a) the sexual organs, i.e. testes and penis, b) the other related parts, i.e. the scrotum, urethra, sperm ducts and prostate gland. <p>Discuss the following:</p> <ol style="list-style-type: none"> a) the functions of the different parts of the male reproductive system, b) the role of sperm in reproduction, c) the physical, physiological and emotional changes in male during puberty. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the parts of the male reproductive system, ▪ describe the functions of the different parts of the male reproductive system, ▪ state the role of sperm in reproduction, ▪ describe the changes in male during puberty. 		<p>emotional changes – <i>perubahan emosi</i> penis – <i>zakar</i> puberty – <i>baligh</i> sperm – <i>sperma</i> sperm duct – <i>duktus sperma</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.3 Analysing the female reproductive system.</p>	<p>Identify the following parts of the female reproductive system with the help of diagrams, models, videos or computer software:</p> <ol style="list-style-type: none"> the sexual organs, i.e. ovaries and uterus, the other related parts, i.e. the fallopian tube, vagina and cervix. <p>Discuss the following:</p> <ol style="list-style-type: none"> the functions of the different parts of the female reproductive system, the role of an ovum in reproduction, the physical, physiological and emotional changes in female during puberty. <p>Simulate the differences between male and female gametes in terms of size, numbers and mobility.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the parts of the female reproductive system, ▪ describe the functions of the different parts of the female reproductive system, ▪ state the role of an ovum in reproduction, ▪ describe the changes in female during puberty, ▪ compare and contrast male and female gametes in terms of size, numbers and mobility. 		<p>cervix - <i>servik</i> vagina – <i>faraj</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.4 Analysing the menstrual cycle.</p>	<p>Discuss the following:</p> <ol style="list-style-type: none"> menstruation and the menstrual cycle, the changes in the uterus wall during menstrual cycle, the relationship between the fertile phase of the menstrual cycle and fertilisation, the importance of personal hygiene during menstruation. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the meaning of menstruation, ▪ describe the menstrual cycle, ▪ describe the changes in the uterus wall during menstrual cycle, ▪ relate the fertile phase of the menstrual cycle to fertilisation, ▪ explain the importance of personal hygiene during menstruation. 	<p>The description of the menstrual cycle should not include hormones.</p>	<p>fertile phase – <i>fasa subur</i> menstrual cycle – <i>kitar haid</i> personal hygiene – <i>kebersihan diri</i></p>
<p>4.5 Analysing fertilisation and pregnancy.</p>	<p>Discuss the following with the help of diagrams, charts, models, videos or computer software:</p> <ol style="list-style-type: none"> the location of implantation of embryo, the development of a zygote into an embryo and subsequently into a foetus until birth. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe fertilisation in human, ▪ identify the location of implantation of embryo, ▪ describe the development of a zygote into an embryo and subsequently into a foetus until birth. 	<p>The concept of fertilisation in human should include tracing the pathways of sperm and ovum until they meet and fuse.</p>	<p>fertilisation – <i>persenyawaan</i> implantation – <i>penempelan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.6 Understanding the importance of pre-natal care.</p>	<p>Organise an exhibition or a multimedia presentation on the following:</p> <ul style="list-style-type: none"> a) the importance of taking nutritious food during pregnancy, b) the effects of smoking and the taking of certain substances such as drugs and alcohol on the embryo and foetus. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ relate the importance of taking nutritious food to the health of both mother and foetus during pregnancy, ▪ explain the importance of avoiding the intake of substances that are harmful to the foetus. 		<p>deformity – <i>kecacatan</i> nutritious food – <i>makanan berhasiat</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.7 Evaluating the importance of research in human reproduction.</p>	<p>Collect and interpret data on the following:</p> <ul style="list-style-type: none"> a) the meaning of sterility, b) ways to overcome sterility, i.e. nutrition, hormone treatment, surgery and in vitro fertilisation (IVF), c) birth control, i.e. rhythm method, the use of condom, contraceptive pills, intra-uterine contraceptive device (IUCD), spermicides, vasectomy and ligation. <p>Debate on birth control and its effects on society.</p> <p>Discuss the importance of research on human reproduction.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the meaning of sterility, ▪ describe ways to overcome sterility, ▪ describe the methods of birth control, ▪ debate on the abuse of birth control and its effects on the community, ▪ explain the importance of research on human reproduction. 	<p>Birth control methods to be included: Natural, chemical, mechanical, hormonal and surgical.</p>	<p>ligation – <i>ligasi</i> sterility – <i>kemandulan</i> vasectomy – <i>vasektomi</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.8 Analysing the sexual reproductive system of flowering plants.</p>	<p>Examine flowers to identify the following parts:</p> <ol style="list-style-type: none"> petal and sepal, the male part, i.e. the stamen which consists of the filament, anther and pollen grains, the female part, i.e. the pistil which consists of the stigma, style, ovary and ovules. <p>Use a microscope or hand lens to observe the following:</p> <ol style="list-style-type: none"> the cross-section and longitudinal section of an ovary to identify the ovules, pollen grains. <p>Discuss the functions of the following;</p> <ol style="list-style-type: none"> flowers in reproduction, male reproductive parts of the flower, female reproductive parts of the flower. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the different parts of a flower, ▪ identify the male and female reproductive parts of a flower, ▪ identify the male and female gametes, ▪ describe the functions of the male and female reproductive parts of a flower in sexual reproduction. 		<p>petal – <i>ranggi</i> pollen grain – <i>butir debunga</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.9 Analysing pollination.</p>	<p>Discuss the following with the help of models, charts, videos or computer software:</p> <ol style="list-style-type: none"> pollination, types of pollination, similarities and differences of self-pollination and cross-pollination, advantages of cross-pollination, uses of cross-pollination in agriculture. <p>Carry out an activity to study the various types of flowers to identify their pollinating agents.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe what pollination is, ▪ relate the characteristics of flowers to their agents of pollination, ▪ state the types of pollination, ▪ compare and contrast self-pollination and cross-pollination, ▪ explain the advantages of cross-pollination, ▪ explain with examples the uses of cross-pollination in agriculture. 		<p>agriculture – <i>pertanian</i> cross-pollination – <i>pendebungaan kacuk</i> self-pollination – <i>pendebungaan sendiri</i></p>
<p>4.10 Understanding the development of fruits and seeds in plants.</p>	<p>Use a microscope to observe the development of pollen tubes in different percentage of sucrose solution (5% - 10%).</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the location where fertilisation occurs in flower, ▪ describe fertilisation in plants, ▪ describe the formation of fruits and seeds. 		<p>germination – <i>percambahan</i> sucrose solution – <i>larutan sukrosa</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Draw annotated diagrams of the following:</p> <ul style="list-style-type: none"> a) the fertilisation process in plants, b) the formation of fruits and seeds. <p>Discuss the following:</p> <ul style="list-style-type: none"> a) the location where fertilisation occurs in flower, b) fertilisation in plants, c) formation of fruits and seeds. 			

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.11 Synthesising the concept of germination of seeds.</p>	<p>Dissect a seed longitudinally and identify its structure using hand lens or microscope.</p> <p>Collect and interpret data on the following:</p> <p>a) functions of the different parts of a seed, i.e. the embryo (radicle, plumule and cotyledons) and testa, protected by the pericarp (fruit wall),</p> <p>b) physical changes of seedlings in terms of the development of radicle, plumule and cotyledon.</p> <p>Carry out small group discussions to:</p> <p>a) identify the variables related to the germination of seeds,</p> <p>b) formulate hypotheses about the conditions required for the germination of seeds.</p> <p>Design and carry out experiments to determine the conditions required for the germination of seeds.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the structure of a seed, ▪ explain the functions of the different parts of a seed, ▪ describe the physical changes of seedlings during germination, ▪ make hypotheses on the conditions required for the germination of seeds, ▪ design an experiment to study the conditions required for the germination of seeds, ▪ carry out the experiment to study the conditions required for the germination of seeds, ▪ draw conclusions on the conditions required for germination of seeds. 		<p>cotyledon – <i>kotiledon</i> plumule – <i>plumul</i> radicle – <i>radikel</i> seedling – <i>anak benih</i> germination - <i>percambahan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>4.12 Application of vegetative reproduction in flowering plants.</p>	<p>Carry out a study of the vegetative reproduction of various plants in a nursery to identify the types of vegetative reproduction.</p> <p>Discuss what vegetative reproduction is.</p> <p>Discuss the application of research carried out in vegetative reproduction in agriculture.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ explain with examples the meaning of vegetative reproduction, ▪ state the parts of the plants that can reproduce vegetatively, ▪ classify flowering plants according to the parts that can reproduce vegetatively, ▪ describe the application of research carried out on vegetative reproduction in agriculture. 	<p>Biotechnology can be introduced.</p> <p>Example of vegetative reproduction is plant tissue culture.</p> <p>Details of plant tissue culture are not required.</p>	

LEARNING AREA: 5. GROWTH

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>5.1 Analysing the pattern of human growth.</p>	<p>Discuss the following:</p> <ul style="list-style-type: none"> a) characteristics used to measure growth rate such as height and weight, b) meaning of growth, c) growth pattern in male and female, d) effects of nutrition on the development of physical and mental well-being of children. <p>Carry out activities to interpret the growth curve for male and female from infancy to adulthood.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe what growth is, ▪ identify the characteristics used to measure growth rate, ▪ analyse the growth curve for male and female, ▪ compare and contrast the growth rate in male and female, ▪ describe the effects of nutrition on the growth in children. 		<p>growth - <i>pertumbuhan</i></p>

THEME: MATTER IN NATURE

LEARNING AREA: 1. LAND AND ITS RESOURCES

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing the various minerals found in the Earth's crust.</p>	<p>Discuss what a mineral is.</p> <p>Collect and interpret data on the various types of minerals that exist in the Earth's crust:</p> <p>a) natural elements, i.e. gold and silver,</p> <p>b) natural compounds, i.e. oxides, carbonates, sulphides and silicates.</p> <p>Discuss and identify the elements in a few natural compounds.</p> <p>Carry out activities to study the following:</p> <p>a) hardness of minerals,</p> <p>b) solubility of minerals in water,</p> <p>c) the effect of heat on some metal carbonates, oxides and sulphides.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe what a mineral is, ▪ explain through examples that minerals exist in the form of natural elements or natural compounds, ▪ identify the elements in natural compounds, ▪ describe the properties of minerals, ▪ write equations in words to show the effect of heat on the minerals. 		<p>compound – <i>sebatian</i> earth crust – <i>kerak bumi</i> element – <i>unsur</i> gold – <i>emas</i> hardness – <i>kekerasan</i> silver (argentum) – <i>perak</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Understanding the reactions between metals and non-metals.</p>	<p>Brainstorm and discuss the following: a) examples of metals, b) examples of non-metals.</p> <p>Carry out activities to study the reactions of some metals, i.e magnesium, aluminium, zinc and iron with the following non-metals: a) oxygen, b) sulphur.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state examples of metals and non-metals, ▪ describe the reactions between metals and non-metals, ▪ write equations in words for the reaction between metals and non-metals, ▪ state that metals react with non-metals at different rate. 	<p>The reactivity series need not be introduced.</p>	<p>non-metal – <i>bukan logam</i> metal – <i>logam</i></p>
<p>1.3 Understanding silicon compounds.</p>	<p>Collect and interpret data on silicon compounds that exist in the form of silica and silicate.</p> <p>Carry out activities to study the properties of silica and silicate as follows: a) solubility in water, b) reaction with hydrochloric acid, c) effects of heat.</p> <p>Visit factories to learn about the process of making glass, ceramic, electronic chips and fibre optics.</p> <p>Discuss the uses of silicon compounds in our daily life.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the different forms of silicon compounds, ▪ state examples of silica, ▪ state examples of silicate, ▪ relate the properties of silicon compounds to their stability, ▪ explain through examples the uses of silicon compounds in our daily life. 		<p>silicon compound – <i>sebatian silikon</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
1.4 Analysing calcium compounds.	<p>Collect and interpret data on calcium carbonate.</p> <p>Carry out activities to study the following:</p> <p>a) the properties of calcium carbonate in terms of its reaction with acid, solubility in water and the effects of heat,</p> <p>b) the formation of calcium oxide (quicklime) and calcium hydroxide (slaked lime).</p> <p>Discuss the following:</p> <p>a) uses of calcium compounds, i.e. calcium carbonate, calcium oxide and calcium hydroxide,</p> <p>b) properties of calcium compounds with reference to their uses.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the elements in calcium carbonate, ▪ identify the various forms of calcium carbonate, ▪ describe the properties of calcium carbonate, ▪ write equations in words for the reactions of calcium carbonate, ▪ describe the formation of calcium oxide and calcium hydroxide, ▪ relate the properties of calcium compounds to their uses. 		<p>calcium carbonate – <i>kalsium karbonat</i> slaked lime - <i>kapur mati</i> quicklime – <i>kapur tohor</i> solubility – <i>kelarutan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.5 Analysing natural fuel resources and their importance.</p>	<p>Access websites or visit PETROSAINS, National Science Centre or an oil refinery to collect information on the formation of natural fuel resources found in Malaysia.</p> <p>Carry out an activity to study fractional distillation of petroleum.</p> <p>Discuss the following:</p> <ol style="list-style-type: none"> characteristics and uses of the various fractions of petroleum, contributions of petroleum and natural gas industry to the economic development of our country, efficient ways of using petroleum and other natural fuel resources. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ list the natural fuel resources, ▪ explain the formation of natural fuel resources, ▪ describe the fractional distillation of petroleum, ▪ describe the characteristics of the various fractions from the fractional distillation of petroleum, ▪ describe the uses of the various fractions of petroleum, ▪ explain the contributions of petroleum and natural gas industry to the economic development of our country, ▪ generate ideas on how to use natural fuel resources efficiently. 		<p>fraction – <i>pecahan</i> fractional distillation – <i>penyulingan berperingkat</i> natural fuel resource – <i>sumber bahan api semula jadi</i> petroleum – <i>minyak mentah</i></p>

THEME: ENERGY IN LIFE

LEARNING AREA: 1. ELECTRICITY

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Understanding electrostatics.</p>	<p>Carry out the following activities:</p> <ol style="list-style-type: none"> producing static electrical charges in materials through friction, detecting static electrical charges using an electroscope, observing what happens when two objects with the same or opposite charges are brought near to each other and making conclusions about static electrical charges. <p>Discuss the following:</p> <ol style="list-style-type: none"> what electrostatics is, types of static electrical charges, properties of static electrical charges, examples of material that are easily charged, i.e. acetate and polythene, everyday phenomena related to static electrical charges, e.g. lightning, safety measures to be taken when dealing with electrical charges, e.g. the use of lightning conductor. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe what electrostatics is, ▪ state the types of static electrical charges, ▪ state the properties of static electrical charges, ▪ describe how static electrical charges can be produced in some materials, ▪ describe ways to detect static electrical charges, ▪ explain everyday phenomena caused by static electrical charges, ▪ state the safety measures to be taken when dealing with static electricity. 		<p>polythene – <i>politena</i> charge - <i>cas</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Understanding electricity.</p>	<p>Collect and interpret data on the sources of electrical energy used in everyday life.</p> <p>Carry out an activity to observe the flow of electric current using a Van de Graff generator and a galvanometer.</p> <p>Discuss the following:</p> <ol style="list-style-type: none"> electricity, current, voltage, resistance, directions of current and electron flow in an electric circuit. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ give examples of sources of electrical energy used in everyday life, ▪ state what electricity is, ▪ state what voltage is, ▪ state what resistance is, ▪ describe the directions of current and electron flow in an electric circuit. 		<p>current – <i>arus</i> resistance – <i>rintangan</i> voltage – <i>voltan</i></p>
<p>1.3 Applying the understanding of measuring electricity.</p>	<p>Collect information and carry out a multimedia presentation on the discovery of the unit for:</p> <ol style="list-style-type: none"> current, i.e. ampere, voltage, i.e. volt, resistance, i.e. ohm. <p>Examine the instruments and discuss its use for measuring:</p> <ol style="list-style-type: none"> current, voltage. <p>Assemble an electric circuit and measure its current and voltage.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the instrument for measuring current, ▪ identify the instrument for measuring voltage, ▪ state the unit for current, ▪ state the unit for voltage, ▪ state the unit for resistance, ▪ measure current in an electric circuit, ▪ measure voltage in an electric circuit. 		

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
1.4 Synthesising the relationship between current, voltage and resistance.	Design and carry out an experiment to study the following: a) effects of the change in resistance on current, b) effects of the change in voltage on current, Discuss the following: a) relationship between voltage, current and resistance, b) Ohm's Law.	A student is able to: <ul style="list-style-type: none"> ▪ design an experiment to study the relationship between resistance and current, ▪ carry out the experiment to study the relationship between resistance and current, ▪ describe the effects of the change in resistance on current, ▪ design an experiment to study the relationship between voltage and current, ▪ carry out the experiment to study the relationship between voltage and current, ▪ describe the effect of the change in voltage on current, ▪ state Ohm's Law. 	Interpretation of graphs should be emphasised.	

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.5 Synthesising the concept of parallel and series circuit.</p>	<p>Match the components found in an electric circuit to their symbols.</p> <p>Draw the following circuit diagrams and assemble the circuits:</p> <p>a) a complete circuit, b) a series circuit, c) a parallel circuit.</p> <p>Discuss the similarities and differences between a series circuit and a parallel circuit with the help of illustrations.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the components of an electric circuit and their symbols, ▪ draw a diagram of a complete circuit, ▪ build a complete electric circuit, ▪ build a series circuit, ▪ build a parallel circuit, ▪ compare and contrast the arrangement of components in a series circuit and a parallel circuit. 		<p>complete circuit – <i>litar lengkap</i> parallel circuit – <i>litar selari</i> series circuit – <i>litar bersiri</i></p>
<p>1.6 Analysing current, voltage and resistance in a series circuit.</p>	<p>Carry out activities to study current, voltage and resistance in a series circuit.</p> <p>Discuss the advantage and disadvantage of a series circuit.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the current flowing through the components in a series circuit, ▪ describe the voltages across the components in a series circuit, ▪ describe the resistance in a series circuit, ▪ explain the advantage and the disadvantage of a series circuit. 	<p>Simple calculations can be introduced.</p>	

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
1.7 Analysing current, voltage and resistance in a parallel circuit.	Carry out activities to study the current, voltage and resistance in a parallel circuit. Discuss the following: a) advantage and disadvantage of a parallel circuit, b) similarities and differences between series and parallel circuits in terms of current, voltage and resistance.	A student is able to: <ul style="list-style-type: none"> ▪ describe the current flowing through the components in a parallel circuit, ▪ describe the voltage across the components in a parallel circuit, ▪ describe the resistance in a parallel circuit, ▪ explain the advantage and the disadvantage of a parallel circuit, ▪ compare and contrast a series circuit and a parallel circuit in terms of current, voltage and resistance. 	Simple calculations can be introduced. The differences between a series circuit and a parallel circuit should be demonstrated using meters and brightness of bulbs.	

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.8 Understanding magnetism.</p>	<p>Carry out the following activities:</p> <p>a) use iron fillings to study the magnetic field of a bar magnet,</p> <p>b) use compass to plot the directions of the magnetic field.</p> <p>Discuss the following:</p> <p>a) magnetic field,</p> <p>b) relationship between magnetic field lines and strength of magnetic field.</p> <p>Study and discuss the use of a magnet in a compass.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe what a magnetic field is, ▪ draw the magnetic field of a bar magnet, ▪ draw the directions of the magnetic field, ▪ relate magnetic field lines and strength to magnetic field, ▪ explain the use of a magnet in a compass. 		<p>magnetic field – <i>medan magnet</i> magnetism – <i>kemagnetan</i></p>
<p>1.9 Understanding electro-magnetism.</p>	<p>Carry out an activity to study the magnetic field produced by a straight wire carrying electric current.</p> <p>Discuss the meaning of</p> <p>a) electromagnetism,</p> <p>b) electromagnet.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ relate the current flow through a conductor to magnetism, ▪ describe what an electromagnet is. 		<p>electromagnetism – <i>keelektromagnetan</i></p>

LEARNING AREA: 2. GENERATION OF ELECTRICITY

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.1 Understanding the generation of electrical energy.</p>	<p>Explore websites or visit a power station to collect and interpret data on the following:</p> <ul style="list-style-type: none"> a) various types of generators, i.e. thermal, hydroelectric, diesel, nuclear and gas turbine, b) generation of electrical energy in various types of power stations, c) alternative sources of energy, e.g. solar energy and biomass. <p>Discuss the similarities and differences in the generation of electrical energy in various types of power stations.</p> <p>Carry out an activity on the utilisation of solar energy using devices such as solar box or solar cell (photovoltaic cell).</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ list the various types of generators, ▪ describe the generation of electrical energy in various types of power stations, ▪ compare and contrast the generation of electrical energy in various types of power stations, ▪ give examples of alternative sources of energy. 		<p>biomass – <i>biojisim</i> photovoltaic – <i>fotovolta</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.2 Understanding transformer.</p>	<p>Build a simple transformer and study its physical structure.</p> <p>Carry out an activity to show the function of the simple transformer.</p> <p>Collect and interpret data on the working principle of a step-up transformer and a step-down transformer.</p> <p>Discuss step-up and step-down transformers in terms of: a) similarities and differences, b) their uses in the transmission and distribution of electricity.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the different parts of a transformer, ▪ describe how a transformer works, ▪ compare and contrast a step-up transformer and a step-down transformer, ▪ describe the roles of transformer in the transmission and distribution of electricity. 		<p>step-down transformer – <i>transformer injak turun</i> step-up transformer – <i>transformer injak naik</i> distribution - <i>pengagihan</i> transmission - <i>penghantaran</i></p>
<p>2.3 Analysing the electricity transmission and distribution system.</p>	<p>Observe a model or a chart and discuss the electrical transmission and distribution system which includes the National Grid Network, transformer stations, switch zone, main sub-station and its branches.</p> <p>Collect and interpret data on the National Grid Network in Malaysia.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ arrange in order the components in the electricity transmission and distribution system, ▪ describe the functions of the components in the electricity transmission and distribution system, ▪ describe how electricity is transmitted and distributed from power stations to consumers. 		<p>national grid network – <i>rangkaian grid nasional</i> switch zone – <i>lapangan suis</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.4 Understanding the electrical supply and wiring system at home.</p>	<p>Collect and interpret data on electrical energy supply at home.</p> <p>Study and discuss the following:</p> <p>a) electrical wiring system at home including fuse box, mains switch, circuit breaker, live wire, neutral wire, earth wire and electric meter,</p> <p>b) international colour code.</p> <p>Carry out an activity to:</p> <p>a) study the structure and design of a 3-pin plug,</p> <p>b) complete the wiring of a 3-pin plug.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the value of the main voltage, ▪ state the types of current, ▪ identify the type of electric current supplied to homes, ▪ state the types of electrical wiring, ▪ identify the parts in an electrical wiring system, ▪ describe the functions of the parts of an electrical wiring system, ▪ describe the wiring in a 3-pin plug. 	<p>Types of wiring include single-phase and three-phase wiring.</p> <p>Explain briefly when three-phase wiring is required.</p>	<p>circuit breaker – <i>pemutus litar</i> earth wire – <i>dawai bumi</i> mains switch – <i>suis sesalur</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.5 Analysing the cost of electrical energy usage.</p>	<p>Examine various home appliances to collect and interpret data on the power, voltage and current ratings.</p> <p>Calculate the amount of current flowing through home electrical appliances.</p> <p>Discuss the relationship between electrical energy usage, power and time.</p> <p>Carry out a home electrical energy usage audit to determine the cost of electrical energy use per month.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the power and voltage rating of home electrical appliances, ▪ calculate the amount of current flowing through an electrical appliance, ▪ recall the relationship between electrical energy usage, power and time, ▪ solve problem by calculating the cost of electricity used. 	<p>Introduce the following formulae:</p> <p>Power = Voltage x Current $P = V \times I$</p> <p>Energy (kWh) = Power (kW) x Time (h)</p>	<p>appliance – <i>peralatan</i> power – <i>kuasa</i></p>
<p>2.6 Understanding the functions of fuse and earth wire.</p>	<p>Discuss the following:</p> <ol style="list-style-type: none"> a) types of fuses, b) ratings of fuses, c) function of fuse in electrical wiring system, d) the role of earth wire in electrical wiring system. <p>Carry out an activity to study the occurrence of a short circuit.</p> <p>Carry out activities to determine the suitable ratings of fuses for different electrical appliances.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the types of fuses, ▪ state the ratings of fuses, ▪ describe the function of fuse in electrical wiring system, ▪ determine the suitable rating of a fuse for an electrical appliance, ▪ describe the role of earth wire in electrical wiring system. 		<p>short circuit – <i>litar pintas</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.7 Evaluating the importance of safety precautions in the use of electricity.</p>	<p>Collect and interpret data on the following:</p> <ul style="list-style-type: none"> a) causes of electrical accidents, b) steps to be taken if electrical accidents occur, c) safety features at home to prevent electrical accidents. <p>Discuss the need to take safety precautions when using electricity.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ state the safety measures to be taken when using electricity, ▪ describe the steps to be taken when accidents involving electricity occur, ▪ justify the need for having safety precautions and safety features at home to prevent electrical accidents. 	<p>Mention the following safety features:</p> <ul style="list-style-type: none"> i. Miniature Circuit Breaker (MCB), ii. Earth Leakage Circuit Breaker (ELCB). 	<p>safety precautions – <i>langkah-langkah keselamatan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.8 Evaluating the importance of conserving electricity.</p>	<p>Collect and interpret data about activities that cause electricity wastage.</p> <p>Discuss the ways to conserve electricity.</p> <p>Carry out a project on energy efficiency.</p> <p>Discuss and justify the needs for conserving electricity.</p> <p>Brainstorm the problems faced by the country if there is a shortage of electricity.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ identify the activities that cause electricity wastage, ▪ describe ways to conserve electricity, ▪ justify the needs for conserving electricity, ▪ predict problems our country would face if there is a shortage of electricity. 	<p>Introduce energy labelling of appliances to improve energy efficiency.</p>	<p>wastage – <i>pembaziran</i> energy efficiency – <i>kecekapan tenaga</i></p>

THEME: ASTRONOMY AND SPACE EXPLORATION

LEARNING AREA: 1. STARS AND GALAXIES

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing the Sun.</p>	<p>Collect and interpret data on the following:</p> <ol style="list-style-type: none"> characteristics of the Sun, i.e. size, mass, density relative to the Earth and surface temperature, structures of the Sun, i.e. the corona, chromosphere and photosphere, phenomena occurring at the surface of the Sun, i.e. prominences, flares and sunspots, effects of the phenomena on the surface of the Sun on the Earth, generation of energy by the Sun. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the characteristics of the Sun, ▪ identify the structures of the Sun, ▪ identify the phenomena occurring on the surface of the Sun, ▪ explain the effects of the phenomena on the surface of the Sun on the Earth, ▪ state how energy is generated by the Sun. 	<p>Aurorae, frequently associated with flares should be introduced.</p>	<p>aurorae – <i>aurora</i> chromosphere – <i>kromosfera</i> corona – <i>korona</i> density – <i>ketumpatan</i> flare – <i>nyala</i> photosphere – <i>fotosfera</i> prominence – <i>prominen</i> sunspot – <i>tompok matahari</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Understanding the stars and the galaxies in the Universe.</p>	<p>Discuss the following: a) the definition of star, b) the Sun as a star.</p> <p>Visit the National Planetarium or National Science Centre to collect and interpret data on the following: a) bright stars such as the Sirius and Rigel, b) the Sun as a star, c) various types of stars based on temperature, size and brightness, d) formation of stars, e) death of stars leaving behind the white dwarf, neutron star and the black hole, f) types of galaxies, i.e. elliptical, spiral and irregular, g) the Milky Way, h) the Universe.</p> <p>Take part in star gazing activities.</p> <p>View computer software or videos to gather information about the topics in this learning area.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ define what a star is, ▪ identify the Sun as a star, ▪ identify the bright stars in the sky, ▪ compare and contrast the stars based on certain characteristics, ▪ describe the formation of stars, ▪ describe the death of stars, ▪ state the types of galaxies, ▪ describe the Milky Way, ▪ describe the Universe, ▪ state the position of the Solar System in the Universe. 		<p>black hole – <i>lohong hitam</i> brightness – <i>kecerahan</i> star – <i>bintang</i> elliptical – <i>bujur</i> irregular – <i>tak teratur</i> light year – <i>tahun cahaya</i> Milky Way – <i>Bima Sakti</i> solar system – <i>sistem suria</i> spiral – <i>lingkaran</i> universe – <i>alam semesta</i> white dwarf – <i>kerdil putih</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.3 Thankful for the existence of the Universe as a gift from God.</p>	<p>Write a poem or haiku about the uniqueness, orderliness, beauty and harmony of the Universe as a sign of the glory of God.</p> <p>Discuss the following:</p> <ul style="list-style-type: none"> a) the expanse of the Universe, b) all that exists in the Universe is not permanent, c) the importance of the Sun and the Moon to life on Earth. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ appreciate the uniqueness, orderliness, beauty and harmony in the Universe as a sign of the glory of God, ▪ describe the expanse of the Universe compared to Earth, ▪ state that all that exists in the Universe is not permanent, ▪ explain the importance of the Sun and the Moon to life on Earth. 	<p>Haiku is a Japanese poem that comprise of three lines. The first and third is made up of five syllables while the second line is made up of seven syllables. The theme and message of the poem is often associated with nature.</p> <p><u>For example:</u></p> <p><i>Up the sky I stare, I look up and wish I'm there, Beautiful and rare.</i></p> <p>This learning objective (1.3) should be integrated with the other learning objectives when relevant.</p>	

LEARNING AREA: 2. SPACE EXPLORATION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.1 Understanding developments in the field of astronomy and space exploration.</p>	<p>Surf the Internet, visit the Planetarium or the National Science Centre to collect and interpret data on the following:</p> <ul style="list-style-type: none"> a) developments in the field of astronomy, b) applications of technology related to space exploration and astronomy, e.g. remote sensing, c) developments in space exploration, e.g. launching of rockets, satellites, probes as well as man's landing on the Moon. <p>Debate on the need to continue space exploration.</p> <p>Carry out a multimedia presentation on the developments in the field of astronomy and space exploration.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ▪ describe the developments in the field of astronomy, ▪ describe the developments in space exploration, ▪ explain with examples the applications of technology related to space exploration and astronomy, ▪ justify the need to continue space exploration. 	<p>Include the applications of remote sensing, e.g. in geology, agriculture, forestry, disaster management, national security management, etc.</p> <p>Malaysian Centre for Remote Sensing (MACRES) is responsible for the remote sensing projects in the country.</p>	<p>exploration – <i>penerokaan</i> space – <i>angkasa lepas</i></p>

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Advisors	Sharifah Maimunah Syed Zin (Ph.D)	Director Curriculum Development Centre
	Rohani Abd. Hamid (Ph.D)	Deputy Director Curriculum Development Centre
Editorial Advisors	Cheah Eng Joo	Assistant Director (Head of Elective Science Unit) Curriculum Development Centre
	Yeap Chin Heng (Ph.D)	Assistant Director (Head of Core Science Unit) Curriculum Development Centre
	S. Sivagnanachelvi	Assistant Director (Head of English Unit) Curriculum Development Centre
Editor	Aizatul Adzwa Mohd. Basri	Assistant Director Curriculum Development Centre

PANEL OF WRITERS

Cheah Eng Joo	Curriculum Development Centre	Salbiah Mohd. Som	Curriculum Development Centre
Yeap Chin Heng (Ph.D)	Curriculum Development Centre	Salehuddin Mustafa	Curriculum Development Centre
Aizatul Adzwa Mohd. Basri	Curriculum Development Centre	Salina Hanum Osman Mohamed	Curriculum Development Centre
Ho Heng Leng	Curriculum Development Centre	Zaidah Mohd. Yusof	Curriculum Development Centre
Norani Abd. Bari	Curriculum Development Centre	Zaidi Yazid	Curriculum Development Centre
Rosli Suleiman	Curriculum Development Centre	Zainon Abdul Majid	Curriculum Development Centre
Aizuddin Dato' Hj. Husin	SMK Sri Kota, Taiping, Perak	Rohani Mustaffa	SMK Sultan Abdul Aziz Shah, Kajang
Chan Ah Jun	SMK Durian Tunggal, Melaka	Rosita Wati Abdul Aziz	SMK Sultan Salahuddin Abd.Aziz Shah
Emily Ng Joo Lee	SMK Tengku Ampuan Jemaah	Radziah Mohd. Yamin	SMK Bukit Saujana, Port Dickson
Katheeza Begum Ibrahim	SMK Putrajaya (1), Selangor	Rosnaza Abdul Razak	SMK Ahmad, Pekan, Pahang
Lanita Md. Yusoff	SMK Taman Connaught	Rusilawati Mohd. Salleh	SMK Rantau Panjang, Kapar
Lee Yuet Lai	SMK Sulaiman, Bentong, Pahang	Yap Poh Kyut	SMK Ketari, Bentong, Pahang
Narimah Mohd. Yusof	SMK Seksyen 16, Shah Alam	Zainol Azhar	Kolej Sultan Abdul Hamid, Alor Setar
Noor Anum Abdullah	SM Sains Sultan Haji Ahmad Shah		



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