



MINISTRY OF EDUCATION MALAYSIA

Integrated Curriculum for Secondary Schools

Curriculum Specifications

SCIENCE
Form 5



Curriculum Development Centre
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2006

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THE NATIONAL PHILOSOPHY

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

We, her people, 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 further 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 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.

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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, notes 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. Be aware of 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 explain 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 variables, 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 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 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 explain 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 on, or 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 general statements about the relationship between manipulated variables and responding variables to explain observations or events. The statements can be tested to determine validity.
Making Analogies	Understanding abstract or complex concepts by relating them to simpler or concrete concepts 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.

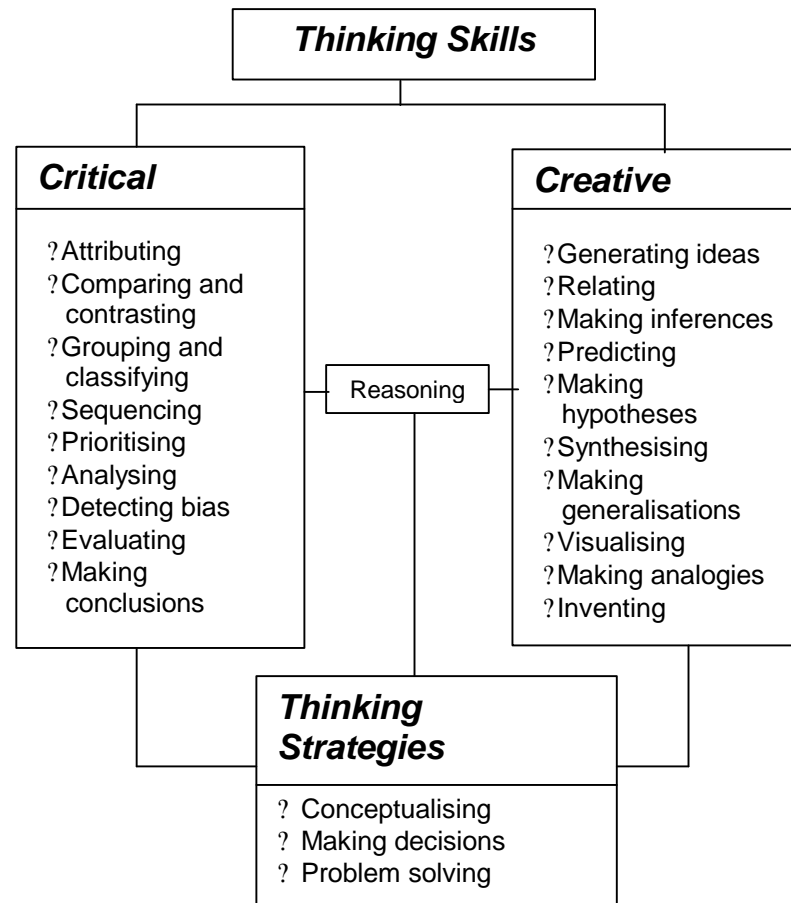
Besides the above thinking skills and thinking strategies, another skill emphasised is reasoning. Reasoning is a skill used in making logical, just and rational judgements. Mastering of critical and creative thinking skills and thinking strategies is made simpler if an individual is able to reason in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



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 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

Science Process Skills	Thinking Skills
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 hypotheses	Attributing Relating Comparing and contrasting Generating ideas Making hypotheses 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 metals and non-metals.

Thinking Skills: Comparing and contrasting

Explanation:

To achieve the above learning outcome, knowledge on the physical properties 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 properties and uses of metals and non-metals.

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.
- ? Dare 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 Five
Learning Area:	1. Microorganisms And Their Effects On Living Things
Learning Objective:	1.7 Realising that microorganisms have profound effects on human being and the balance in nature
Learning Outcome:	Describe the roles and effects of microorganisms on human being and the balance in nature.
Suggested Learning Activities:	Discuss the effects of microorganisms in relation to:

- (a) human life
- (b) balance in nature

Scientific attitudes and noble values:

Having an interest and curiosity towards the environment

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

Appreciating the balance in nature.

Appreciating and practising clean and healthy living

Being objective, systematic and 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 : MAN AND THE VARIETY OF LIVING THINGS

LEARNING AREA: MICROORGANISMS AND THEIR EFFECTS ON LIVING THINGS

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Understanding the classification of microorganisms</p>	<p>Observe prepared slides or view charts of various types of microorganisms:</p> <p>(a) list the characteristics of various types of microorganisms,</p> <p>(b) classify various types of microorganisms into groups i.e. bacteria, fungi, protozoa, viruses and algae based on their characteristics such as variation in size, shape or other appearances.</p> <p>View videos or computer simulations and discuss the following:</p> <p>(a) various groups of microorganism, i.e. bacteria, fungi, protozoa, viruses and algae,</p> <p>(b) characteristics of each group of microorganisms in terms of appearance, shape, size, method of reproduction, nutrition and habitat.</p>	<p>A student is able to:</p> <p>? list the characteristics of various types of microorganisms,</p> <p>? classify microorganisms into bacteria, fungi, protozoa, viruses and algae,</p> <p>? describe the characteristics of each group of microorganisms.</p>		<p>algae – <i>alga</i></p> <p>bacteria – <i>bakteria</i></p> <p>fungi – <i>kulat</i></p> <p>microorganisms – <i>mikroorganisma</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Synthesising ideas about the factors that affect the growth of microorganisms</p>	<p>Observe specimens such as fresh bread, mouldy bread, fresh milk and spoilt milk. Discuss: (a) why the bread and milk turn bad, (b) the factors that affect the growth of microorganisms.</p> <p>Design and conduct experiments to study how each of the following factors affects the growth of microorganisms: (a) nutrient, (b) humidity, (c) light, (d) temperature, (e) pH.</p> <p>Discuss how each factor affects the growth of microorganisms.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? identify factors that affect the growth of microorganisms, ? design an experiments to study how nutrient affects the growth of microorganisms, ? design an experiment to study how humidity affects the growth of microorganisms, ? design an experiment to study how light affects the growth of microorganisms, ? design an experiment to study how temperature affects the growth of microorganisms, ? design an experiment to study how pH affects the growth of microorganisms, ? explain how each factor affects the growth of microorganisms. 	<p>Remind students to adhere strictly to safety precautions while conducting experiments involving microorganisms.</p> <p>Remind students that microorganisms can cause diseases or illness.</p> <p>Microorganism is also known as microbes.</p>	

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.3 Applying knowledge about useful microorganisms</p>	<p>View videos or computer simulations and discuss the uses and roles of microorganisms: (a) food digestion, (b) decaying process, (c) medicine, agriculture and industry.</p> <p>Carry out an activity about the uses of microorganisms such as making bread or yoghurt.</p> <p>Visit factories to study how microorganisms are used to produce food or other industrial products.</p> <p>Gather information from magazines, books and Internet and discuss the potential uses of microorganisms in various fields.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? state examples of uses of microorganisms, ? explain with examples the roles of useful microorganisms, ? suggest potential uses of microorganisms in various fields. 	<p>Scientific names of microorganisms are not required.</p>	<p>decaying process– <i>proses pereputan</i></p> <p>food digestion – <i>pencernaan makanan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.4 Analysing the harmful effects of microorganisms.</p>	<p>Observe specimens or models, or view charts on tooth decay (caries) and discuss how microorganisms cause the decay.</p> <p>Gather information from newspapers, books, magazines and Internet or interview medical experts and discuss other harmful effects of microorganisms on human beings such as causing food poisoning and diseases.</p> <p>Make a folio or scrap book about the groups of microorganisms that cause the following diseases and the major symptoms of the diseases:</p> <p>(a) tuberculosis, cholera and various sexually transmitted diseases such as gonorrhoea and syphilis – caused by bacteria,</p> <p>(b) common cold, dengue fever, hepatitis and the Acquired Immune Deficiency Syndrome (AIDS) – caused by virus,</p> <p>(c) tinea and ring worm – caused by fungi,</p> <p>(d) malaria – caused by protozoa.</p> <p>View videos or computer simulations and discuss the various ways microorganisms</p>	<p>A student is able to:</p> <p>? state the harmful effects of microorganisms on human being,</p> <p>? relate each group of microorganisms to the diseases caused by it,</p> <p>? describe the major symptoms of diseases caused by each group of microorganisms,</p> <p>? describe the various ways how microorganisms can cause infection.</p>	<p>Students do not need to know scientific names of microorganisms involved.</p>	<p>common cold – <i>selesema</i></p> <p>contact – <i>sentuhan</i></p> <p>infection – <i>jangkitan</i></p> <p>ringworm – <i>kurap</i></p> <p>sexually transmitted disease – <i>penyakit jangkitan kelamin / penyakit jangkitan seks</i></p> <p>tinea – <i>panau</i></p> <p>tuberculosis – <i>batuk kering / tibi</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>can infect human being such as through air, water, food, contact and vector.</p>			
<p>1.5 Analysing ways to prevent infection caused by microorganisms</p>	<p>Gather information from books, newspapers, magazines, Internet or visit institutions such as Institute of Medical Research (IMR) and Pusat Kawalan Vektor and discuss the ways to prevent infection such as control of vectors, sterilisation and immunisation.</p> <p>Carry out the following activities: (a) draw the life cycles of vectors such as mosquito and housefly, (b) describe the habits of these vectors, (c) relate the life cycles and habits of these vectors to the control and prevention of infection.</p> <p>Discuss the following methods of sterilisation: (a) the use of heat: heating, boiling and using autoclave, (b) the use of chemicals: antiseptics and disinfectants, (c) the use of radiations: gamma ray and ultraviolet light.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? list ways to prevent infection, ? relate the control of vectors to their habits and life cycles, ? explain with examples various methods of sterilisation, ? state what immunity is, ? state with examples types of immunity. ? compare and contrast the various types of immunity, ? state the importance of immunity. 		<p>disinfectant – <i>disinfektan / bahan penyahjangkit</i></p> <p>immunity – <i>imuniti / keimunan</i></p> <p>immunisation – <i>imunisasi / pengimunan</i></p> <p>radiation – <i>radiasi / sinaran</i></p> <p>sterilisation - <i>pensterilan</i></p> <p>vectors – <i>vektor / agen pembawa penyakit</i></p> <p>ultraviolet – <i>ultralembayung / ultraungu</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>View videos or computer simulations and discuss the following:</p> <p>(a) the meaning of immunity, (b) types of immunity and their examples, (c) the importance of immunity.</p> <p>Carry out an activity to compare and contrast various types of immunity. Illustrate the similarities and differences in a graphic organiser.</p>			
<p>1.6 Understanding how diseases caused by microorganisms are treated</p>	<p>Discuss ways to treat diseases caused by microorganisms such as the use of antibiotics and anti-fungal drugs.</p> <p>Conduct an experiment to study the effects of antibiotics on bacteria.</p> <p>Discuss the effects of antibiotics on bacteria.</p> <p>Invite a medical officer to talk about using drugs without medical advice and through unauthorised prescription.</p>	<p>A student is able to:</p> <p>? state the ways to treat diseases caused by microorganisms,</p> <p>? state the effects of antibiotics on microorganisms,</p> <p>? describe the dangers of using drugs without medical advice and through unauthorised prescription.</p>		<p>antifungal – <i>anti kulat</i></p> <p>antibiotic – <i>antibiotik</i></p> <p>prescription – <i>preskripsi</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.7 Realising that microorganisms have profound effects on human being and the balance in nature</p>	<p>Discuss the effects of microorganisms in relation to: (a) human life, (b) balance in nature.</p>	<p>A student is able to: ? describe the roles and effects of microorganisms on human and the balance in nature.</p>		<p>balance in nature – <i>keseimbangan alam</i></p>

THEME: MAINTENANCE AND CONTINUITY OF LIFE
LEARNING AREA: NUTRITION AND FOOD PRODUCTION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Evaluating the importance of taking good nutrition and practising good eating habits</p>	<p>Carry out an activity to determine the following:</p> <p>(a) the calorific values of the different classes of food such as protein, carbohydrate and fat,</p> <p>(b) the calorific values of meals taken for breakfast, lunch, and dinner.</p> <p>View videos or computer simulations and discuss:</p> <p>(a) factors that affect the calories requirement of an individual such as sex, body size, age, state of health, physical activities and surrounding temperature,</p> <p>(b) health problems related to nutrition such as malnutrition, obesity, anorexia and diseases resulted from unhealthy eating habits.</p> <p>Group discussion and presentation on the importance of taking good nutrition and practising good eating habits.</p>	<p>A student is able to:</p> <p>? identify the calorific values of the different classes of food,</p> <p>? estimate the calorific values in various meals,</p> <p>? explain the factors that affect total calories required by an individual,</p> <p>? relate health problems to nutrition and eating habits,</p> <p>? justify the importance of taking good nutrition and practising good eating habits.</p>	<p>When explaining symptoms, causes and steps taken to alleviate diseases, only a brief explanation is required.</p>	<p>anorexia – <i>anoreksia</i></p> <p>calorie – <i>kalori</i></p> <p>calorific value – <i>nilai kalori</i></p> <p>malnutrition – <i>malnutrisi</i></p> <p>obesity – <i>kegendutan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Analysing the nutrient requirements of plants</p>	<p>Gather information from books, magazines and Internet, and:</p> <p>(a) discuss what macronutrients are, (b) give a list of macronutrients, i.e. carbon, hydrogen, oxygen, nitrogen, phosphorous, potassium, calcium, magnesium, and sulphur, (c) discuss what micronutrients are, (d) give a list of micronutrients such as boron, molybdenum, zinc, manganese, copper and iron.</p> <p>View videos or computer simulations and discuss:</p> <p>(a) the effects of nitrogen, phosphorous and potassium deficiency on plant growth, (b) the major functions of nitrogen, phosphorus and potassium in plant growth.</p>	<p>A student is able to:</p> <p>? state what macronutrients are, ? list macronutrients, ? state what micronutrients are, ? list micronutrients, ? state the effects of nitrogen, phosphorous and potassium deficiency on plant growth, ? state the major functions of nitrogen, phosphorous and potassium in plant growth.</p>		<p>calcium – <i>kalsium</i> deficiency – <i>kekurangan</i> macronutrients – <i>makronutrien</i> manganese – <i>mangan</i> micronutrients – <i>mikronutrien</i> phosphorous – <i>fosforus</i> potassium – <i>kalium</i> sulphur – <i>sulfur</i></p>
<p>1.3 Analysing nitrogen cycle and its importance</p>	<p>View charts, videos or computer simulations on nitrogen cycle and discuss the following:</p> <p>(a) the nitrogen cycle, (b) the processes involved in the nitrogen cycle,</p>	<p>A student is able to:</p> <p>? describe nitrogen cycle, ? explain the processes involved in nitrogen cycle,</p>	<p>Students do not need to know scientific names of the bacteria involved.</p>	<p>Nitrogen cycle – <i>kitar nitrogen</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>(c) the importance of the nitrogen cycle.</p> <p>Draw a labeled diagram of nitrogen cycle.</p>	<p>? explain the importance of nitrogen cycle.</p>		
<p>1.4 Appreciating the importance of having good nutrition</p>	<p>Gather information from books, magazines or Internet on guides to healthy diets and healthy eating habits.</p> <p>Plan and practise taking healthy daily meals.</p> <p>Propose ideas on how to manage food resources to avoid wastage. Make a plan based on the proposed ideas.</p> <p>Discuss the benefits of having healthy eating habits.</p>	<p>A student is able to:</p> <p>? practise healthy eating habits,</p> <p>? plan how to manage food resources to avoid wastage,</p> <p>? describe the benefits of having healthy eating habits.</p>		<p>food resources – <i>sumber makanan</i></p>

THEME : BALANCE AND MANAGEMENT OF THE ENVIRONMENT

LEARNING AREA : 1. PRESERVATION AND CONSERVATION OF THE ENVIRONMENT

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing balance in nature</p>	<p>View videos or computer simulations and discuss: (a) the meaning of balance in nature, (b) the roles of the three natural cycles in maintaining balance in nature, i.e. nitrogen cycle, carbon cycle and water cycle.</p> <p>Visit a garden and carry out the following activities: (a) list the organisms, (b) draw a food web, (c) discuss the role of food webs in maintaining balance in nature.</p> <p>Gather information from books, newspapers, magazines and Internet on natural disasters. Present and discuss: (a) the effects of natural disasters on balance in nature, (b) ways to maintain the balance in nature.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? describe what balance in nature is, ? state the natural cycles that help to maintain balance in nature, ? explain how these natural cycles help to maintain balance in nature, ? explain how food webs help to maintain balance in nature, ? explain with examples the effects of natural disasters on balance in nature, ? suggest ways to maintain balance in nature. 		<p>balance in nature – <i>keseimbangan alam</i></p> <p>food web – <i>siratan makanan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Analysing the effects of environmental pollution</p>	<p>Gather information from books, newspapers, magazines and Internet and discuss:</p> <p>(a) the sources of environmental pollution such as:</p> <ol style="list-style-type: none"> i. the uncontrolled use of fossil fuels, ii. the disposal of byproducts, waste, toxic substances, radioactive substances, smoke and heat from factories, iii. the uncontrolled use of chemical fertilisers, pesticides and fungicides in agriculture, iv. the production of noises, smoke and poisonous gases from vehicles and machinery, v. the disposal of rubbish such as plastic, leftover food and solid substances, the disposal of sewage, vii. the use of chlorofluorocarbon (CFC) in aerosols, air conditioners and refrigerators, and the improper disposal of electrical appliances such as air conditioners and refrigerators that contain CFC. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ? identify the sources of environmental pollution, ? explain the effects of environmental pollution, ? describe global warming, ? relate greenhouse effect to global warming, ? state what ozone layer is, ? explain the importance of ozone layer, ? state the chemicals that damage the ozone layer, ? list the sources of chemicals that can damage the ozone layer, <p>explain how damaging ozone layer affects living things.</p>		<p>coolant – <i>bahan pendingin</i></p> <p>global warming – <i>pemanasan global</i></p> <p>greenhouse effect – <i>kesan rumah hijau</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>(b) the effects of environmental pollution from the aspect of:</p> <ol style="list-style-type: none"> i. human health, ii. habitats and nature, iii. the extinction of species, iv. the loss of economic resources. <p>View videos or computer simulations and discuss:</p> <ol style="list-style-type: none"> (a) global warming, (b) greenhouse effect and its relation to global warming, (c) ozone layer and its importance, (d) chemicals such as CFC and oxides of nitrogen that can damage the ozone layer, (e) chemicals in styrofoam coolant and aerosol that can damage the ozone layer, (f) how damaging ozone layer affects living things. 			
<p>1.3 Synthesising the idea of preservation and conservation of the environment and pollution control</p>	<p>View videos on environmental preservation and conservation and discuss the importance of preservation and conservation of the environment.</p> <p>Discuss the following:</p> <ol style="list-style-type: none"> (a) environmental pollution control, 	<p>A student is able to:</p> <ol style="list-style-type: none"> ? state the importance of preservation and conservation of the environment, ? generate ideas on environmental pollution control, 		<p>environmental pollution – <i>pencemaran alam sekitar</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>(b) examples of how preservation and conservation can contribute to a clean and healthy environment.</p> <p>Carry out a project to study:</p> <p>(a) what efforts are taken to preserve and conserve the environment,</p> <p>(b) what are the impacts produced by these efforts.</p>	<p>? explain with examples how preservation and conservation of the environment can contribute to a clean and healthy environment.</p>		
<p>1.4 Evaluating the importance of proper management of natural resources in maintaining balance in nature</p>	<p>Discuss proper ways of managing natural resources to maintain balance in nature.</p> <p>View videos or computer simulations and write a report on:</p> <p>(a) the effects of improper management of natural resources,</p> <p>(b) the need for proper management of the environment.</p>	<p>A student is able to:</p> <p>? generate ideas on proper ways to manage natural resources in order to maintain balance in nature,</p> <p>? explain with examples the effects of improper management of natural resources,</p> <p>? justify the need for proper management of the environment.</p>		<p>natural resources – <i>sumber alam /sumber semula jadi</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
1.5 Practising responsible attitudes to preserve and conserve the environment	Plan and practise good habits to preserve and conserve the environment through the following activities: <ul style="list-style-type: none"> (a) awareness campaigns on reducing, reusing and recycling, (b) jungle trekking to appreciate the beauty of nature and an unspoilt environment, (c) adopt part of an area such as beach, river, hill and forest to practise responsible and caring attitudes to preserve and conserve, (d) write a proposal on how to preserve and conserve the environment in a local community. 	A student is able to: <ul style="list-style-type: none"> ? practise good habits to preserve and conserve the environment. 		local community – <i>komuniti setempat</i> proper management – <i>pengurusan yang sewajarnya</i>

THEME : MATTER IN NATURE

LEARNING AREA : 1. CARBON COMPOUNDS

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing various carbon compounds</p>	<p>Observe various samples of carbon and non-carbon compounds. Discuss what carbon compounds are.</p> <p>View videos or computer simulations and discuss organic and inorganic compounds in terms of:</p> <p>(a) their sources, (b) their characteristics, i.e., i. elements present, ii. metallic or non-metallic, iii. changes upon heating.</p> <p>Carry out an activity to compare and contrast organic and inorganic compounds. Illustrate the similarities and differences in a graphic organiser.</p> <p>Classify samples of carbon compounds into organic and inorganic compounds.</p> <p>Gather information from books, magazines and Internet and discuss hydrocarbons and their sources.</p>	<p>A student is able to:</p> <p>? state what carbon compounds are,</p> <p>? state what organic compounds are,</p> <p>? give examples of organic compounds,</p> <p>? state what inorganic compounds are,</p> <p>? give examples of inorganic compounds,</p> <p>? compare and contrast organic compounds with inorganic compounds,</p> <p>? classify substances into organic and inorganic compounds,</p> <p>? state what hydrocarbons are,</p> <p>? list sources of hydrocarbons.</p>		<p>carbon compounds – <i>sebatian karbon</i></p> <p>organic compounds – <i>sebatian organik</i></p> <p>inorganic compounds – <i>sebatian tak organik</i></p> <p>hydrocarbon – <i>hidrokarbon</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.2 Analysing alcohol and its effects on health</p>	<p>Gather information from books, newspapers, magazines and Internet on alcohol.</p> <p>Discuss the following: (a) elements found in alcohol, (b) examples of alcohol such as methanol and ethanol.</p> <p>Carry out the following activities: (a) the production of pure ethanol through the process of fermentation and distillation, (b) study the characteristics of alcohol in terms of:</p> <ol style="list-style-type: none"> i. solubility and miscibility with water, ii. combustibility, iii. reaction with acids to form esters. <p>View videos or computer simulations and discuss the following: (a) various uses of alcohol, (b) the effects of alcohol on the brain, the nervous system and the liver.</p>	<p>A student is able to</p> <ul style="list-style-type: none"> ? state the elements found in alcohol, ? give examples of alcohol, ? describe the process of producing alcohol, ? state the general characteristics of alcohol, ? list the uses of alcohol, ? explain with examples the effects of alcohol on health. 	<p>Students need to know only the general equation in words to show the formation of ester.</p>	<p>combustibility – <i>kebolehbakaran</i></p> <p>distillation – <i>penyulingan</i></p> <p>fermentation – <i>penapaian / fermentasi</i></p> <p>miscibility – <i>keterlarutcampuran</i></p> <p>solubility – <i>kelarutan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.3 Analysing fats and their effects on health</p>	<p>Observe various samples of fats such as butter, cooking oil, cheese, ghee and margarine. From the food labels,</p> <p>(a) identify their sources, i.e. plant or animal fats, (b) classify them into saturated and unsaturated fats.</p> <p>Discuss the following: (a) elements found in fats, (b) saturated and unsaturated fats.</p> <p>Carry out an activity to compare and contrast saturated fats and unsaturated fats in terms of: (a) sources, (b) states at room temperature, (c) melting point.</p> <p>Illustrate the similarities and differences in a graphic organiser.</p> <p>Gather information from books, newspapers, magazines, Internet or view videos. Present and discuss the effects of consuming food rich in saturated and unsaturated fats on health.</p>	<p>A student is able to:</p> <p>? give examples of fats, ? state the sources of fats, ? state the elements found in fats, ? state what saturated fats are, ? state what unsaturated fats are, ? compare and contrast saturated fats with unsaturated fats, ? explain with examples the effects of consuming food rich in saturated fats on health, ? explain with examples the effects of consuming food rich in unsaturated fats on health.</p>		<p>saturated fats – <i>lemak tepu</i></p> <p>unsaturated fats – <i>lemak tak tepu</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.4 Analysing oil palm and its importance to national development</p>	<p>Observe the structure of an oil palm fruit.</p> <p>Draw a labelled diagram of the oil palm fruit.</p> <p>Visit an oil palm factory, or view videos or computer simulations and discuss the process of extracting palm oil from the oil palm fruit.</p> <p>Gather information from books, newspapers, magazines and Internet to prepare a folio on: (a) the uses of palm oil, (b) nutritional substances found in palm oil such as fats, vitamins and antioxidants.</p> <p>Visit institutions such as Malaysian Palm Oil Board (MPOB) to gather information on the research and development of oil palm.</p> <p>Discuss the potential uses of oil palm.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ○ describe the structure of an oil palm fruit, ○ describe the process of extracting palm oil from the oil palm fruit, ○ list the uses of palm oil, ○ list the nutritional substances found in palm oil, ? describe the local R&D activities on oil palm, ? suggest the potential uses of oil palm. 		<p>antioxidants – <i>pengantioksida</i></p> <p>extraction – <i>pengekstrakan</i></p> <p>nutritional substances – <i>bahan-bahan berkhasiat</i></p> <p>oil palm – <i>kelapa sawit</i></p> <p>palm oil – <i>minyak sawit / minyak kelapa sawit</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.5 Analysing the process of making soap from oil and the cleansing action of soap</p>	<p>Discuss the following: (a) oils contain fatty acids and glycerol, (b) examples of fatty acids.</p> <p>Carry out an activity to study the process of making soap through the reaction between fatty acids and sodium hydroxide solution.</p> <p>Discuss soap as a salt produced by the reaction between sodium hydroxide and fatty acids.</p> <p>View videos or computer simulations and discuss: (a) the characteristics of the components of a soap molecule, (b) the cleansing action of soap molecules.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? state that oils contain fatty acids and glycerol, ? give an example of fatty acids, ? describe the process of making soap, ? state that soap is a salt produced by the reaction between sodium hydroxide and fatty acids, ? state the characteristics of the components of a soap molecule, ? explain the cleansing action of soap molecules. 	<p>Molecular formula and structure of soap are not required.</p>	<p>cleansing action – <i>tindakan pencucian</i></p> <p>fatty acids – <i>asid lemak</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
1.6 Understanding natural polymers	<p>Carry out an activity using beads and strings to show the following structures or processes:</p> <p>(a) polymer, (b) monomer, (c) polymerisation, (d) depolymerisation.</p> <p>Discuss the following:</p> <p>(a) what polymers and monomers are, (b) examples of polymer and monomer, (c) what polymerisation is, (d) what depolymerisation is.</p> <p>Observe various samples of natural and synthetic polymers.</p> <p>Prepare folios or scrap books on the various uses of natural and synthetic polymers.</p> <p>Carry out activities to study the following:</p> <p>(a) the characteristics of natural rubber, (b) the coagulation of latex by the action of acids, (c) the prevention of coagulation of latex by ammonia solution.</p>	<p>A student is able to:</p> <p>? state what a polymer is, ? give examples of polymer, ? state what a monomer is, ? give examples of monomer, ? describe polymerisation, ? describe depolymerisation, ? state what natural polymer is, ? give examples of natural polymer, ? state what synthetic polymer is, ? give examples of synthetic polymer, ? state the characteristics of natural rubber, ? explain the action of acids on latex, ?</p>		<p>coagulation – <i>penggumpalan</i></p> <p>depolymerisation – <i>penyahpolimeran</i></p> <p>latex – <i>lateks / susu getah</i></p> <p>polymerisation – <i>pempolimeran</i></p> <p>vulcanisation – <i>pemvulkanan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>View videos or computer simulations and discuss the vulcanisation of rubber.</p> <p>Draw a schematic diagram and relate the characteristics of vulcanised rubber to the structure of its molecule.</p> <p>Discuss the uses of vulcanised rubber.</p>	<p>? explain the action of ammonia solution on latex,</p> <p>? describe vulcanisation of rubber,</p> <p>? relate the characteristics of vulcanised rubber to the structure of its molecule,</p> <p>list the uses of vulcanised rubber.</p>		
<p>1.7 Appreciating scientific research on the use of carbon compounds for the betterment of life</p>	<p>Gather information from books, magazines and Internet on scientists' discoveries on the use of carbon compounds. Present and exhibit the information gathered.</p>	<p>A student is able to:</p> <p>? describe the importance of scientists' discoveries on the use of carbon compounds.</p>		

THEME : FORCE AND MOTION
LEARNING AREA: MOTION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing the motion of vehicles on land.</p>	<p>Observe a bicycle and discuss its structure and principle of operation.</p> <p>View charts, videos or computer simulations and discuss the following:</p> <p>(a) the structure and principle of operation of vehicles with engines,</p> <p>(b) the structure and operation of:</p> <ol style="list-style-type: none"> i. four stroke petrol engine, ii. four stroke diesel engine, iii. two stroke petrol engine. <p>Compare and contrast the following in terms of structure, operation and the efficiency of the engines:</p> <p>(a) the four stroke petrol engine with the four stroke diesel engine,</p> <p>(b) the four stroke petrol engine with the two stroke petrol engine.</p>	<p>A student is able to:</p> <p>? describe the structure and principle of operation of vehicles without engines,</p> <p>? describe the structure and principle of operation of vehicles with engines,</p> <p>? explain the structure and operation of the four stroke petrol engine,</p> <p>? explain the structure and operation of the four stroke diesel engine,</p> <p>? explain the structure and operation of a two stroke petrol engine.</p> <p>? compare and contrast the four stroke petrol engine with the four stroke diesel engine,</p>		<p>four stroke petrol engine – <i>enjin petrol empat lejang</i></p> <p>four stroke diesel engine – <i>enjin diesel empat lejang</i></p> <p>two stroke petrol engine – <i>enjin petrol dua lejang</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Illustrate the similarities and differences in a graphic organiser.</p> <p>Discuss the relationship between the structure and operation of the engine and the movement of vehicles.</p>	<p>? compare and contrast the four stroke petrol engine with the two stroke petrol engine,</p> <p>? relate the structure and operation of the engine to the movement of vehicles.</p>		
<p>1.2 Analysing the concepts of speed, velocity and acceleration</p>	<p>View videos or computer simulations and discuss</p> <p>(a) distance, speed, velocity, acceleration and their units,</p> <p>(b) the relationship between speed, velocity and acceleration.</p> <p>Carry out an activity to compare and contrast speed, velocity and acceleration. Illustrate the similarities and differences in a graphic organiser.</p> <p>Carry out activities using a ticker timer or other suitable methods to determine the velocity and acceleration of a moving object.</p> <p>Carry out an activity to solve problems involving velocity and acceleration.</p>	<p>A student is able to:</p> <p>? state what distance is,</p> <p>? define speed,</p> <p>? define velocity,</p> <p>? state the unit for speed and velocity,</p> <p>? define acceleration,</p> <p>? state the unit for acceleration,</p> <p>? explain the relationship between speed, velocity and acceleration,</p> <p>? compare and contrast speed, velocity and acceleration,</p> <p>? determine the velocity and acceleration of a moving object,</p> <p>? solve problems involving velocity and acceleration.</p>		<p>acceleration – <i>pecutan</i></p> <p>speed – <i>kelajuan</i></p> <p>velocity – <i>halaju</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.3 Understanding the concept of inertia</p>	<p>Carry out activities and discuss the following: (a) the meaning of inertia, (b) the occurrences of inertia in everyday life.</p> <p>Design and conduct an experiment to study the relationship between mass and inertia.</p> <p>View videos or computer simulations and discuss safety features used in vehicles to reduce negative effects of inertia.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? state what inertia is, ? give examples of everyday occurrences that involve inertia, ? explain with examples the relationship between mass and inertia, ? state the safety features used in vehicles to reduce negative effects of inertia. 		<p>inertia – <i>inersia</i></p>
<p>1.4 Applying the concept of momentum</p>	<p>Discuss the following: (a) the meaning of momentum, (b) events involving momentum in everyday life.</p> <p>Conduct experiments to study the relationship between momentum, mass and velocity. (a)</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? define momentum, ? explain the relationship between momentum, mass and velocity, ? state the Principle of Conservation of Momentum, ? explain with examples the application of momentum in everyday life. 		<p>Pile driver – <i>pelantak cerucuk</i></p> <p>Principle of Conservation of Momentum – <i>Prinsip Keabadian Momentum</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Carry out an activity using Newton's Cradle to demonstrate the Principle of Conservation of Momentum.</p> <p>View videos or computer simulations and discuss the applications of momentum in the following:</p> <ul style="list-style-type: none"> (b) vehicle design that incorporates safety features, (c) the use of the pile driver, (d) the speed and weight limits for heavy vehicles. 			
<p>1.5 Synthesising the concept of pressure</p>	<p>Carry out activities and discuss what pressure is.</p> <p>Design and conduct experiments to study the relationship between pressure, force and surface area.</p> <p>Discuss the applications of pressure in everyday life.</p> <p>Carry out an activity to solve problems involving pressure.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? define pressure, ? explain the relationship between pressure, force and surface area, ? explain with examples the application of pressure in everyday life, ? solve problems involving pressure. 	<p>The problem solving activity involves direct application of the formula:</p> $P = \frac{F}{A}$	<p>force – <i>daya</i></p> <p>pressure – <i>tekanan</i></p> <p>surface area – <i>luas permukaan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.6 Applying the principle of hydraulic system in everyday life</p>	<p>Observe models, view videos or computer simulations and discuss the following:</p> <ul style="list-style-type: none"> (a) the principle of transmission of pressure in liquids, (b) the relationship of pressure exerted on the small piston to that on the large piston in a hydraulic system. <p>Conduct experiments to study the effect of transmission of pressure in liquids.</p> <p>Carry out an activity to solve problems on the transmission of pressure in liquids.</p> <p>Discuss the following:</p> <ul style="list-style-type: none"> (a) examples on the use of the hydraulic system, (b) principle of operation of the hydraulic system, (c) the application of the hydraulic system in a hydraulic jack and a hydraulic brake. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ? state the principle of transmission of pressure in liquids, ? relate pressure on the small piston to that on the large piston in the operation of a hydraulic system, ? explain the effect of transmission of pressure in liquids, ? solve problems on transmission of pressure in liquids. ? explain with examples the application of the hydraulic system in everyday life. 		<p>hydraulic brake – <i>brek hidraulik</i></p> <p>hydraulic jack – <i>jek hidraulik</i></p> <p>hydraulic system – <i>sistem hidraulik</i></p> <p>piston – <i>omboh</i></p> <p>transmission – <i>pemindahan</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.7 Analysing the motion of vehicles in water</p>	<p>View videos or computer simulations and discuss the principle of operation of vehicles in water such as ships, hovercrafts and hydrofoils.</p> <p>Carry out activities to identify the shape of vehicles that facilitate motion in water.</p> <p>Discuss the relationship between shapes and the design of vehicles in water.</p> <p>Conduct experiments to study Archimedes' principle: (a) the change in weight of an object when it is immersed in a liquid, (b) the relationship between upthrust and the weight of the liquid displaced.</p> <p>Discuss the application of Archimedes' principle in ships and submarines.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? state the principle of operation of vehicles in water, ? identify the shape of vehicles to facilitate motion in water, ? relate shapes to the design of vehicles in water, ? state Archimedes' principle, ? explain with examples the applications of Archimedes' principle. 		<p>displaced – <i>disesarkan</i></p> <p>immersed – <i>dibenam</i></p> <p>motion – <i>gerakan</i></p> <p>upthrust – <i>daya tujah</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.8 Analysing the motion of vehicles in the air</p>	<p>View videos or computer simulations and discuss:</p> <p>(a) the principle of operation of vehicles in the air, (b) forces of motion generated by the jet engine and the rocket.</p> <p>Carry out an activity to compare and contrast forces of motion generated by the jet engine and the rocket. Illustrate the similarities and differences in a graphic organiser.</p> <p>Carry out activities to study Bernoulli's principle.</p> <p>View videos or computer simulations and discuss the application of Bernoulli's principle in air flight.</p>	<p>A student is able to:</p> <p>? state the principle of operation of vehicles in the air, ? compare and contrast how forces of motion are generated by the jet engine and the rocket, ? state Bernoulli's principle, ? explain the application of Bernoulli's principle in air flight.</p>		<p>Bernoulli's Principle –</p> <p>Prinsip Bernoulli</p> <p>jet engine – <i>enjin jet</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.9 Appreciating the ability and creativity of mankind in inventing and designing vehicles for the betterment of life</p>	<p>Discuss the need to invent vehicles such as: (a) to shorten the time of travelling, (b) to transport goods, people and animals.</p> <p>View videos or computer simulations on vehicle designs and discuss the relationship between the creativity of human to the design of vehicles to fulfil the needs of human.</p> <p>Participate in campaigns on the importance of: (a) practising good habits in handling vehicles, (b) practicing caring attitudes when using public transportation system.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? justify the need to invent vehicles, ? relate the creativity of humans to the designing of vehicles, ? practise good habits in handling vehicles, ? practise caring attitudes when using public transport system, 		

THEME : TECHNOLOGICAL AND INDUSTRIAL DEVELOPMENT IN SOCIETY
LEARNING AREA: 1. FOOD TECHNOLOGY AND PRODUCTION

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.1 Analysing the methods and substances used in food technology</p>	<p>Observe samples of fresh food and processed food. Discuss the following:</p> <p>(a) processed food and examples of processed food, (b) the purpose of processing food, (c) chemicals used in food processing such as preservatives, colouring, bleach, flavouring, stabiliser, sweetener, antioxidants and emulsifier, (d) functions of the chemicals used in food processing.</p> <p>View videos or computer simulations and discuss the technology used in:</p> <p>(a) food processing such as:</p> <p>i. pasteurisation, ii. dehydration, iii. freezing, iv. freeze drying, v. cooling, vi. irradiation.</p>	<p>A student is able to:</p> <p>? describe what processed food is, ? give examples of processed food, ? explain the purpose of processing food, ? state the chemicals used in food processing, ? explain the functions of the chemicals used in food processing, ? explain with examples the technology used in food processing and packaging, ? explain the effects of excessive use of chemicals in food processing.</p>		<p>bleach – <i>peluntur</i> canning – <i>pengetinan</i> dehydration – <i>pendehidratan</i> emulsifier – <i>pengemulsi</i> flavouring – <i>perisa</i> irradiation – <i>penyinaran</i> pasteurisation – <i>pempasteuran</i> preservative – <i>bahan awet</i> stabiliser – <i>penstabil</i> sweetener – <i>pemanis</i> freeze drying – <i>kering beku</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>(b) food packaging such as:</p> <ol style="list-style-type: none"> i. canning, ii. vacuum packaging. <p>Gather information from books, magazines, Internet and discuss the effects of excessive use of chemicals in food processing on health.</p>			
<p>1.2 Analysing ways to improve food production</p>	<p>Discuss the need to increase the quality and quantity of food production.</p> <p>Gather information from books, magazines, Internet and discuss ways to increase the quality and quantity of food production such as:</p> <ol style="list-style-type: none"> (a) use of quality breeds, (b) use of modern technology, (c) education and guidance for farmers, (d) research and development, (e) optimum use of land and irrigated areas, (f) efficient land management. 	<p>A student is able to:</p> <p>? explain the need to increase the quality and quantity of food production,</p> <p>? explain with examples ways to increase the quality and quantity of food production,</p> <p>? describe with examples what genetically modified food is,</p> <p>? state the advantages and disadvantages of genetically modified food.</p>		

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>View videos or computer simulations and discuss:</p> <ul style="list-style-type: none"> (a) what genetically modified food is, (b) the characteristics of foods that have been genetically modified. <p>Debate on the advantages and disadvantages of genetically modified food.</p>			
<p>1.3 Appreciating the contribution of technology in food production for the betterment of life</p>	<p>Visit institutions such as Malaysian Agricultural Research and Development Institute (MARDI), Malaysian Palm Oil Board (MPOB) and institutions of higher learning to gather information on R&D in food production and make a report on the information gathered.</p> <p>Discuss the consequences if population increase is faster than the technological development in food production or vice versa.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? describe the R&D activities in food production, ? predict what will happen if there is an imbalance between population increase and technological development in food production. 		

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>1.4 Practising critical and analytical thinking when selecting processed food</p>	<p>Gather information from consumer associations or Internet pertaining to the Food Act and Food Regulations.</p> <p>Discuss the need to educate consumers to be critical and analytical when selecting processed food.</p> <p>Discuss information given on labels of processed food such as: (a) chemicals present in the food, (b) expiry date, (c) ingredients.</p> <p>Carry out an activity and discuss information left out on food labels and packaging.</p> <p>Select a processed food after analysing the information given on the label.</p>	<p>A student is able to:</p> <p>? justify the need to educate consumers in selecting processed food,</p> <p>? practice critical and analytical thinking when selecting processed food.</p>		

THEME : TECHNOLOGICAL AND INDUSTRIAL DEVELOPMENT IN SOCIETY
LEARNING AREA: 2. SYNTHETIC MATERIALS IN INDUSTRY

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.1 Understanding synthetic polymers</p>	<p>Observe objects made from synthetic polymers and discuss synthetic polymers and their uses.</p> <p>View videos or computer simulations and discuss the process of manufacturing synthetic polymers such as synthetic rubber, plastics and synthetic fibres.</p> <p>Discuss the general characteristics of synthetic rubber and relate these characteristics to the uses of synthetic rubber.</p> <p>Gather information from books, magazines, newspapers or Internet on the examples of goods made from synthetic rubber and combination of natural and synthetic rubber.</p> <p>Carry out an activity to compare and contrast synthetic rubber and natural rubber. Illustrate the similarities and differences in a graphic organiser.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? list synthetic polymers, ? state uses of synthetic polymers, ? describe the process of making synthetic polymers, ? relate the general characteristics of synthetic rubber to its uses, ? give examples of goods made from synthetic rubber, ? give examples of goods made from a combination of natural and synthetic rubber, ? compare and contrast synthetic rubber with natural rubber. 		<p>natural rubber – <i>getah asli</i></p> <p>synthetic polymer – <i>polimer sintetik</i></p> <p>synthetic rubber – <i>getah sintetik</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.2 Analysing plastics</p>	<p>Observe various samples of thermoplastic and thermosetts:</p> <p>(a) Discuss the following:</p> <ol style="list-style-type: none"> i. examples of plastics and their uses, ii. types of plastic i.e. thermoplastic and thermosetts, iii. the characteristics of thermoplastic and thermosetts. <p>(b) Classify plastic goods into thermoplastic and thermosetts.</p> <p>Carry out an activity to compare and contrast thermoplastic and thermosetts. Illustrate the similarities and differences in a graphic organiser.</p> <p>Gather information from books, magazines, newspapers or Internet and make a report on potential uses of plastics.</p> <p>View videos or computer simulations and discuss:</p> <ol style="list-style-type: none"> (a) the effects of improper disposal of plastic materials to the environment, (b) the proper management of disposal of plastics. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ? list examples of plastics, ? list the uses of plastics, ? state the types of plastics, ? list the characteristics of thermoplastic materials, ? list the characteristics of thermosetting plastic materials, ? classify various plastic goods into thermoplastic and thermosetts, ? compare and contrast thermoplastic and thermosetts, ? suggest potential uses of plastics, ? explain the effects of improper disposal of plastic materials to the environment, ? describe proper management of disposal of plastics. 		<p>thermoplastic – <i>termoplastik</i></p> <p>thermosetts – <i>termoset</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>2.3 Practising responsible attitudes in the disposal of synthetic polymers</p>	<p>Invite a public health officer to give a talk on management of disposal of synthetic polymers and make a report on the information gathered.</p> <p>Carry out the following activities on ways to dispose synthetic polymers in order to preserve the environment:</p> <ul style="list-style-type: none"> (a) brainstorming, (b) awareness campaigns, (c) visiting waste management centre, (d) setting up disposal bins for synthetic polymers. 	<p>A student is able to:</p> <ul style="list-style-type: none"> ? explain the importance of proper disposal of synthetic polymers, ? suggest ways to dispose synthetic polymers in order to preserve the environment, ? practise good habits in disposing synthetic polymers. 		

THEME : TECHNOLOGICAL AND INDUSTRIAL DEVELOPMENT IN SOCIETY

LEARNING AREA : 3. ELECTRONICS AND INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>3.1 Understanding radio waves</p>	<p>Use an oscilloscope and observe the characteristics of waves i.e. amplitude, frequency, wavelength and wave velocity.</p> <p>View charts on electromagnetic spectrum to locate the position of radio waves.</p> <p>View videos or computer simulations and discuss how the properties of radio waves are applied in communication.</p>	<p>A student is able to:</p> <ul style="list-style-type: none"> ? describe the characteristics of wave, ? identify the location of radio waves in the electromagnetic spectrum, ? relate the properties of radio waves to communication, 		<p>amplitude – <i>amplitud</i></p> <p>electromagnetic spectrum – <i>spektrum elektromagnet</i></p> <p>frequency – <i>frekuensi</i></p> <p>oscilloscope – <i>osiloskop</i></p> <p>radio wave – <i>gelombang radio</i></p> <p>wavelength – <i>panjang gelombang</i></p> <p>wave velocity – <i>halaju gelombang</i></p>
<p>3.2 Analysing radio communication</p>	<p>Observe and identify the symbols of the following electronic components in radios:</p> <ul style="list-style-type: none"> (a) resistors, (b) capacitors, (c) diodes, (d) transistors, (e) inductors, and (f) transformers. <p>Discuss functions of each type of electronic component.</p>	<p>A student is able to</p> <ul style="list-style-type: none"> ? identify electronic components used in radio and their symbols, ? explain the function of electronic components in radio, ? describe the radio transmission 		<p>capacitor – <i>kapasitor</i></p> <p>communication system – <i>sistem komunikasi</i></p> <p>diode – <i>diod</i></p> <p>electronic equipment – <i>alat elektronik</i></p> <p>inductor – <i>induktor</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
	<p>Observe models or view charts on the radio communication system. Draw schematic diagrams and discuss the following:</p> <p>(a) the radio transmission system (b) the radio receiver system.</p> <p>View videos or computer simulations and discuss the transmission and reception of signals in the radio communication system.</p> <p>Carry out project to build simple functional model of radio receiver.</p>	<p>system,</p> <p>? describe the radio receiver system,</p> <p>? explain transmission and reception of signals in the radio communication system.</p>		<p>receiver system – <i>sistem penerima</i></p> <p>resistor – <i>perintang</i></p> <p>signal – <i>isyarat</i></p> <p>transmission system – <i>sistem pemancar</i></p>
<p>3.3 Understanding satellite communication</p>	<p>View videos or computer simulations and discuss:</p> <p>(a) satellite communication system, (b) the advantages of using satellites in transmitting information, (c) other uses of satellites.</p>	<p>A student is able to</p> <p>? describe how satellite communication system works,</p> <p>? state the advantages of using satellites for communication,</p> <p>? list applications of satellite communication.</p>		<p>satellite – <i>satelit</i></p>

Learning Objectives	Suggested Learning Activities	Learning Outcomes	Notes	Vocabulary
<p>3.4 Be aware of the importance of using ICT for the benefit of mankind</p>	<p>Discuss the use of communication system instruments for the benefit of mankind.</p> <p>Collect and interpret data on the perserverance of scientists in inventing modern communication methods and devices.</p>	<p>A student is able to:</p> <p>? justify the use of ICT for the benefit of mankind,</p>		

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