



MINISTRY OF EDUCATION MALAYSIA

## **Integrated Curriculum for Secondary Schools**

### **Curriculum Specifications**

### **SCIENCE Form 4**



Curriculum Development Centre  
Ministry of Education Malaysia  
2005



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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

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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.

(MAHZAN B. BAKAR SMP, AMP)  
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# INTRODUCTION

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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

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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**

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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**

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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

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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.  |

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.

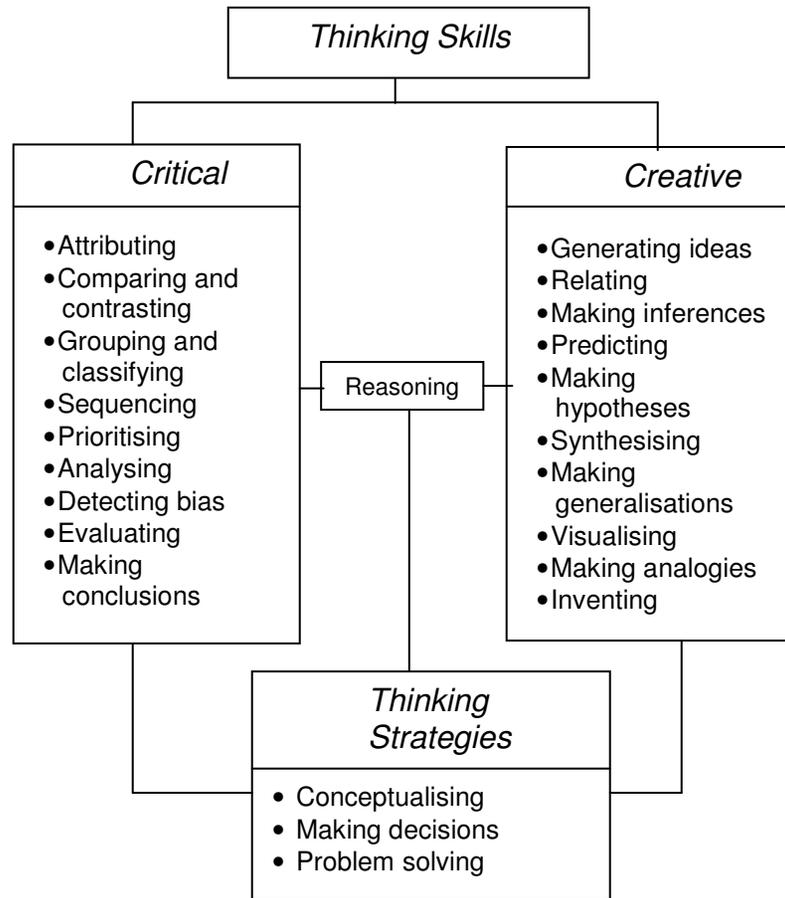
Further information about phases of implementing TSTS can be found in the guidebook *"Buku Panduan Penerapan Kemahiran Berfikir dan Strategi Berfikir dalam Pengajaran dan Pembelajaran Sains"* (Curriculum Development Centre, 1999).

## 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.               |

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<br>Comparing and contrasting<br>Relating                    |
| Classifying                   | Attributing<br>Comparing and contrasting<br>Grouping and classifying    |
| Measuring and Using Numbers   | Relating<br>Comparing and contrasting                                   |
| Making Inferences             | Relating<br>Comparing and contrasting<br>Analysing<br>Making inferences |
| Predicting                    | Relating<br>Visualising   |
| Using Space-Time Relationship | Sequencing<br>Prioritising  |

| Science Process Skills | Thinking Skills   |
|------------------------|---|
| Interpreting data      | Comparing and contrasting<br>Analysing<br>Detecting bias<br>Making conclusions<br>Generalising<br>Evaluating                |
| Defining operationally | Relating<br>Making analogy<br>Visualising<br>Analysing  |
| Controlling variables  | Attributing<br>Comparing and contrasting<br>Relating<br>Analysing   |
| Making hypotheses      | Attributing<br>Relating<br>Comparing and contrasting<br>Generating ideas<br>Making hypotheses<br>Predicting<br>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

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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 Four   |
| Learning Area:                        | 1. Chemicals in Industry  |
| Learning Objective:                   | 1.4 Realising the need for preservation and conservation of the environment from industrial waste pollution for the well-being of mankind.  |
| Learning Outcome:                     | Explain the importance of practising responsibility in disposing industrial waste.  |
| Suggested Learning Activities         | View videos or computer simulations on industrial waste pollution and its effects on environment. Discuss the importance of practising responsibility in disposing industrial waste.<br><br>Love and respect for the environment. |
| Scientific attitudes and noble values | Being responsible for the safety of oneself, others and the environment.<br><br>Appreciating the balance in nature.<br><br>Being systematic.<br><br>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**

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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

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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: INTRODUCING SCIENCE**

**LEARNING AREA: 1. SCIENTIFIC INVESTIGATION**

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary   |
|---|--|--|-------|--|
| <p>1.1<br/>Analysing method in scientific investigation</p> | <p>Carry out a scientific investigation, e.g. investigate how surface area affects the rate of cooling.</p> <p>Students will:</p> <p>identify the problem,<br/>identify the variables,<br/>c) make a hypothesis,<br/>d) plan the investigation to:<br/>i. determine the apparatus and materials needed,<br/>ii. determine the procedure of the investigation, the method in data collection and data analysis.<br/>e) carry out the investigation,<br/>f) collect data,<br/>g) analyse and interpret data,<br/>h) draw conclusions,<br/>i) write a report.</p> <p>Discuss the importance of scientific investigation method in acquiring scientific knowledge.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>explain the steps in scientific investigation,</li> <li>carry out a scientific investigation,</li> <li>write a report on a scientific investigation,</li> <li>explain the importance of scientific investigation.</li> </ul> |       | <p>analyse – <i>menganalisis</i></p> <p>apparatus – <i>radas</i></p> <p>conduct – <i>jalankan</i></p> <p>conclusion – <i>kesimpulan</i></p> <p>determine – <i>tentukan</i></p> <p>hypothesis – <i>hipotesis</i></p> <p>identify – <i>kenal pasti</i></p> <p>interpret – <i>tafsirkan</i></p> <p>investigate – <i>siasat</i></p> <p>material – <i>bahan</i></p> <p>observe – <i>memerhati</i></p> <p>planning – <i>merancang</i></p> <p>procedure – <i>prosedur, tatacara</i></p> <p>steps – <i>langkah-langkah</i></p> <p>variables – <i>pemboleh ubah</i></p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary  |
|---|--|--|-------|---|
| <p>1.2<br/>Realising the need to practise scientific attitudes and noble values when carrying out scientific investigations</p> | <p>View videos or computer simulations then gather and interpret data on the scientific attitudes and noble values practised by scientists.</p> <p>Discuss the need to practise scientific attitudes and noble values when carrying out scientific investigations.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• identify scientific attitudes and noble values practised by scientists,</li> <li>• explain the need to practise scientific attitudes and noble values when carrying out a scientific investigation,</li> <li>• practise scientific attitudes and noble values when carrying out a scientific investigation.</li> </ul> |       | <p><b>noble values – <i>nilai murni</i></b></p> <p>practise – <i>mengamalkan</i></p> <p>scientific attitudes – <i>sikap saintifik</i></p> |

**THEME: MAINTENANCE AND CONTINUITY OF LIFE**

**LEARNING AREA: 1. BODY COORDINATION**

| Learning Objectives                                   | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary   |
|---|---|--|-------|--|
| <p>1.1<br/>Understanding body coordination</p>        | <p>Carry out activities to observe and discuss body coordination.</p> <p>Examine models, view charts or videos to identify the body systems which control coordination, i.e. the nervous system and the endocrine system.</p> <p>Discuss the importance of body coordination in daily activities.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• describe what body coordination is,</li> <li>• identify the body systems that control and regulate coordination,</li> <li>• state the importance of body coordination.</li> </ul>  |       | <p>body coordination – <i>koordinasi badan</i></p> <p>endocrine system – <i>sistem endokrin</i></p> <p>nervous system – <i>sistem saraf</i></p>  |
| <p>1.2<br/>Understanding the human nervous system</p> | <p>Observe models, view charts or videos and identify the human nervous system which consists of:</p> <p>a) central nervous system, i.e. brain and spinal cord,</p> <p>b) peripheral nervous system, i.e. cranial nerves and spinal nerves and their branches which link the receptors and effectors with the central nervous system.</p> <p>Discuss the function of each component part of the nervous system.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• identify the component parts of the human nervous system,</li> <li>• state the function of each component part of the nervous system,</li> <li>• state what a neurone is,</li> <li>• identify the parts of a neurone,</li> <li>• state the function of each part of the neurone,</li> <li>• identify the different types of neurone,</li> <li>• state the function of each type of the neurone,</li> </ul> |       | <p>axon – <i>akson</i></p> <p>cell body – <i>badan sel</i></p> <p>central nervous system – <i>sistem saraf pusat</i></p> <p>motor neurone – <i>neuron motor</i></p> <p>myelin sheath – <i>salut mielin</i></p> <p>peripheral nervous system – <i>sistem saraf periferi</i></p> |

| Learning Objectives                           | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|---|---|---|-------|---|
|   | <p>View videos, charts or examine models and discuss the following:</p> <p>a) neurone as the basic unit of the nervous system,</p> <p>b) parts of a neurone namely cell body, axon, dendrite, and myelin sheath</p> <p>c) functions of various parts of a neurone,</p> <p>d) types of neurone namely the sensory neurone, motor neurone, and the relay neurone,</p> <p>e) functions of various types of neurones,</p> <p>Draw a labelled diagram of the sensory neurone, the motor neuron and the relay neurone.</p> <p>Carry out an activity to compare and contrast the different types of neurone and present the similarities and differences in a graphic organiser.</p> | <ul style="list-style-type: none"> <li>compare and contrast the different types of neurone.</li> </ul>  |       | <p>relay neurone – <i>neuron perantaraan</i></p> <p>sensory neurone – <i>neuron deria</i></p> |
| <p>1.3<br/>Analysing nervous coordination</p> | <p>Discuss the following:</p> <p>a) meaning of receptors and effectors,</p> <p>b) functions of receptors and effectors.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>state what receptors and effectors are,</li> <li>state the functions of receptors and effectors,</li> </ul> |       | <p>reflex action – <i>tindakan refleks</i></p> <p>reflex arc – <i>arka refleks</i></p>        |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary                                     |
|---|--|--|-------|--|
|   | <p>Carry out activities to demonstrate the reactions of sense organs to various stimuli.</p> <p>Carry out activities and discuss reflex actions such as knee-jerk and reaction to touching a hot or sharp object.</p> <p>View computer simulations or charts showing the path taken by an impulse in a reflex arc.</p> <p>Draw a diagram to show the path taken by an impulse in a reflex arc.</p> | <ul style="list-style-type: none"> <li>• explain with examples what a reflex action is,</li> <li>• describe a reflex arc,</li> <li>• illustrate the path taken by an impulse in the reflex arc.</li> </ul> |       |  |
| <p>1.4<br/>Understanding the role of proprioceptors in maintaining balance and coordination</p> | <p>Carry out the following activities to show the importance of proprioceptors:</p> <p>a) stacking objects with both eyes closed,<br/>b) maintaining balance of the body.</p> <p>View charts, videos or computer simulations and discuss the following:</p> <p>a) proprioceptors and their functions,</p>  | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain what proprioceptors are,</li> <li>• explain the importance of proprioceptors.</li> </ul>                                     |       | <p>proprioceptors – <i>reseptor regang</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|---|---|---|-------|---|
|   | <p>b) the importance of proprioceptors in maintaining balance and coordination.</p>   |   |       |   |
| <p>1.5 Understanding the human brain and its complexity</p> | <p>Examine models, view videos or computer simulations to identify the structure of the human brain, i.e. the cerebrum, cerebellum and medulla oblongata. Discuss the functions of the various parts of the brain.</p> <p>Draw and label the main parts of the human brain.</p> <p>Carry out activities and discuss the following:</p> <p>a) voluntary actions such as writing and dancing,</p> <p>b) involuntary actions such as dilation and constriction of the pupil and the beating of the heart.</p> <p>Discuss the effects of injuries to specific parts of the human brain.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• identify the main parts of the human brain,</li> <li>• state the functions of each main part of the human brain,</li> <li>• explain what voluntary action is,</li> <li>• give examples of voluntary action,</li> <li>• explain what involuntary action is,</li> <li>• give examples of involuntary action ,</li> <li>• explain the effects of injuries to specific parts of the human brain.</li> </ul> |       | <p>constriction – <i>penguncupan</i></p> <p>dilation – <i>pembesaran</i>,</p> <p>heart beat- <i>degupan jantung</i></p> <p>involuntary actions – <i>tindakan luar kawal</i></p> <p>voluntary actions – <i>tindakan terkawal</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes   | Notes   | Vocabulary  |
|--|--|---|---|---|
| <p>1.6<br/>Understanding hormonal coordination in the body</p> | <p>Carry out activities such as “match and win” or puzzles to identify the following:</p> <p>a) hormones and the main endocrine glands, i.e. the pituitary gland, thyroid gland, adrenal gland, pancreas, ovary, b) and testes, c) the hormones secreted by each of the main endocrine glands, d) functions of the hormones secreted by each of the main endocrine glands.</p> <p>Draw a labelled diagram to show the locations of the main endocrine glands in the human endocrine system.</p> <p>Discuss the effects of hormonal imbalance on health and present the information in a graphic organiser.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• describe what a hormone is,</li> <li>• describe what endocrine glands are,</li> <li>• identify the main endocrine glands and their respective locations in the body,</li> <li>• state the functions of hormones secreted by the endocrine glands,</li> <li>• describe the effects of hormonal imbalance on health.</li> </ul> | <p>Only adrenaline, insulin, thyroxine oestrogen, progesterone and testosterone are required.</p> | <p>adrenal gland – <i>kelenjar adrenal</i></p> <p>ovary – <i>ovari</i></p> <p>pancreas – <i>pankreas</i></p> <p>pituitary gland – <i>kelenjar pituitari</i></p> <p>testes – <i>testis</i></p> <p>thyroid gland – <i>kelenjar tiroid</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary   |
|---|---|--|-------|--|
| <p>1.7<br/>Analysing coordination between the nervous system and the endocrine system</p> | <p>Carry out an activity to compare and contrast nervous coordination with hormonal coordination and present the similarities and differences in a graphic organiser.</p> <p>Simulate “fright and flight” situations or relate an incident to discuss the following:</p> <p>a) coordination between the nervous system and the endocrine system in producing a response to a stimulus,</p> <p>b) the importance of coordination between the nervous system and the endocrine system in ensuring a smooth and appropriate response to a specific stimulus.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• compare and contrast nervous coordination with hormonal coordination,</li> <li>• explain with examples the coordination between the nervous system and the endocrine system in response to a specific stimulus,</li> <li>• explain the importance of coordination between the nervous system and the endocrine system in response to a specific stimulus.</li> </ul> |       | <p>response – <i>gerak balas</i></p> <p>stimulus – <i>rangsangan</i></p> |
| <p>1.8<br/>Evaluating the effects of drug abuse on body coordination and health</p>       | <p>Invite a representative from Agensi Dadah Kebangsaan (ADK), Polis Di Raja Malaysia (PDRM), Persatuan Mencegah Dadah Malaysia (PEMADAM) or other appropriate institutions to give a talk or an exhibition on drugs, drug abuse and the effects of drug abuse on body coordination and health.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• define what drugs are,</li> <li>• list examples of drugs,</li> <li>• explain what drug abuse is,</li> <li>• describe the effects of drug abuse on body coordination,</li> <li>• describe the effects of drug abuse on health.</li> </ul>   |       | <p>drug abuse – <i>penyalahgunaan dadah</i></p>                          |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary  |
|--|--|---|-------|---|
|  | Students make presentations on drug abuse through public speaking, exhibiting folio or multimedia PowerPoint presentation.   |   |       |   |
| 1.9<br>Analysing the effects of excessive consumption of alcohol on body coordination and health | Gather information from books, newspapers, magazines or Internet and discuss the following:<br>a) examples of alcoholic drinks,<br>b) effects of excessive consumption of alcohol on body coordination (effect on reaction times) and health.<br>c) the importance of avoiding excessive consumption of alcohol.<br><br>Present and exhibit the collected information. | A student is able to: <ul style="list-style-type: none"> <li>• list examples of alcoholic drinks,</li> <li>• describe the effects of excessive consumption of alcohol on body coordination,</li> <li>• describe the effects of excessive consumption of alcohol on health,</li> <li>• justify the importance of avoiding excessive consumption of alcohol.</li> </ul> |       | alcoholic drinks – <i>minuman beralkohol</i><br><br>excessive consumption – <i>pengambilan berlebihan</i><br><br>reaction time – <i>masa tindak balas</i> |
| 1.10<br>Realising the importance of a sound and healthy mind                                     | Gather information from books, magazines, newspapers and Internet and discuss the following:<br>a) the meaning of mind,<br>b) factors that affect the mind, which include, hormone imbalance, excessive consumption of alcohol, drug abuse, mental stress and brain injury,  | A student is able to: <ul style="list-style-type: none"> <li>• state what mind is,</li> <li>• identify factors that affect the mind,</li> <li>• explain how substance abuse can affect the mind,</li> </ul>   |       | hormonal imbalance – <i>ketidakseimbangan hormon</i><br><br>mind – <i>minda</i><br><br>mental stress – <i>tekanan mental</i>                              |

| Learning Objectives | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary   |
|---------------------|---|---|-------|--|
|                     | <p>c) how hormone imbalance, excessive consumption of alcohol and drug abuse can affect the mind,</p> <p>d) the importance of a healthy and sound mind.</p> | <ul style="list-style-type: none"> <li>justify the importance of a sound and healthy mind.</li> </ul> |       | <p>healthy and sound mind – <i>minda yang sihat dan baik</i></p> |

**THEME: MAINTENANCE AND CONTINUITY OF LIFE**

**LEARNING AREA: 2. HEREDITY AND VARIATION**

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes   | Notes   | Vocabulary   |
|--|--|---|---|--|
| <p>2.1<br/>Understanding cell division</p>                               | <p>View videos, computer simulations or charts to study the following:<br/>a) gene, DNA and chromosome,<br/>b) mitosis and meiosis.</p> <p>Simulate the process of mitosis and meiosis.</p> <p>Carry out an activity to compare and contrast mitosis with meiosis and present the similarities and differences in a graphic organiser.</p> <p>Discuss the importance of mitosis and meiosis.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what genes, deoxyribonucleic acids (DNA) and chromosomes are,</li> <li>• describe the relationship between gene, DNA and chromosome,</li> <li>• state what mitosis is,</li> <li>• describe the process of mitosis,</li> <li>• state what meiosis is,</li> <li>• describe the process of meiosis,</li> <li>• compare and contrast mitosis with meiosis,</li> <li>• explain the importance of mitosis and meiosis.</li> </ul> | <p>Names of the phases in mitosis and meiosis are not required.</p> <p>Only a brief discussion is required for the following:<br/>a) separation and polarisation of chromosomes,<br/>b) functions of spindle fibres and centromeres,<br/>c) formation of new cells.</p> | <p>cell division – <i>pembahagian sel</i></p> <p>centromeres – <i>sentromer</i></p> <p>chromosome – <i>kromosom</i></p> <p>deoxyribonucleic acid – <i>asid deoksiribonukleik</i></p> <p>gene – <i>gen</i></p> <p>polarisation – <i>pengutuban</i></p> <p>spindle fibres – <i>gentian spindel/gelendung</i></p> |
| <p>2.2<br/>Understanding the principles and mechanism of inheritance</p> | <p>Observe and identify dominant and recessive traits among students and their family members.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain what dominant genes and recessive genes are,</li> </ul>   |   | <p>dominant – <i>dominan</i></p> <p>genotype – <i>genotip</i></p> <p>inheritance – <i>pewarisan</i></p>  |

| Learning Objectives | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary   |
|---------------------|---|---|-------|--|
|                     | <p>Discuss the following:</p> <p>a) dominant genes and dominant traits,<br/>b) recessive genes and recessive traits.</p> <p>View videos or computer simulations on genetic experiments carried out by Gregor Mendel to study the mechanism of trait inheritance.</p> <p>Use schematic diagrams to illustrate monohybrid crosses and predict the following using Mendel's law:</p> <p>a) genotype ratio of the 'first filial' or F<sub>1</sub> generation and the 'second filial' or F<sub>2</sub> generation,<br/>b) phenotype ratio of the 'first filial' or F<sub>1</sub> generation and the 'second filial' or F<sub>2</sub> generation.</p> | <ul style="list-style-type: none"> <li>• identify dominant traits and recessive traits in human,</li> <li>• illustrate the mechanism of inheritance of traits using a schematic diagram,</li> <li>• predict the genotype and phenotype ratios of a monohybrid cross.</li> </ul> |       | <p>Mendel's law – <i>hukum Mendel</i></p> <p>monohybrid cross – <i>kacukan monohybrid</i></p> <p>phenotype – <i>fenotip</i></p> <p>recessive traits – <i>sifat resesif</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary   |
|--|--|--|-------|--|
| <p>2.3<br/>Understanding sex determination and the occurrence of twins in human beings</p> | <p>View computer simulations, videos or charts and discuss the following:</p> <ul style="list-style-type: none"> <li>a) sex chromosomes,</li> <li>b) determination of sex,</li> <li>c) the occurrence of identical and non-identical twins,</li> <li>d) the occurrence of siamese twins.</li> </ul> <p>Use schematic diagrams to illustrate the following :</p> <ul style="list-style-type: none"> <li>a) how sex is determined,</li> <li>b) how identical and non-identical twins are formed.</li> </ul> <p>Carry out an activity to compare and contrast identical twins with non-identical twins and illustrate the similarities and differences in a graphic organiser.</p> <p>Read and interpret data from books, articles, magazines or Internet on siamese twins.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain what sex chromosomes are,</li> <li>• explain how sex is determined,</li> <li>• explain the formation of identical and non-identical twins,</li> <li>• compare and contrast identical with non-identical twins,</li> <li>• explain what siamese twins are.</li> </ul> |       | <p>identical twins – <i>kembar seiras</i></p> <p>non-identical twins – <i>kembar tak seiras</i></p> <p>sex chromosomes – <i>kromosom seks</i></p> <p>sex determination – <i>penentuan seks</i></p> <p>siamese twins – <i>kembar siam</i></p> |

| Learning Objectives                   | Suggested Learning Activities  | Learning Outcomes   | Notes  | Vocabulary  |
|---------------------------------------|--|---|--|---|
| <p>2.4<br/>Understanding mutation</p> | <p>View videos, computer simulations or charts and discuss the following:</p> <p>a) mutation and types of mutation such as chromosome mutations and gene mutations,</p> <p>b) consequences of chromosome mutations in humans such as Down's syndrome, Klinefelter's syndrome, and Turner's syndrome,</p> <p>c) consequences of gene mutations in humans such as colour blindness, albinism and thalassaemia.</p> <p>Carry out an activity to test colour blindness among pupils</p> <p>Discuss the advantages and disadvantages of mutation.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what mutation is,</li> <li>• state the types of mutation,</li> <li>• list examples of mutation,</li> <li>• identify causes of mutation,</li> <li>• state the advantages and disadvantages of mutation.</li> </ul> | <p>Change in genes and chromosomes at the molecular level is not required.</p> | <p>albinism – <i>albinisme</i></p> <p>colour blindness – <i>buta warna</i></p> <p>Down's syndrome – <i>sindrom Down</i></p> <p>Klinefelter's syndrome – <i>sindrom Klinefelter</i></p> <p>Mutation – <i>mutasi</i></p> <p>Turner's syndrome – <i>sindrom Turner</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|---|---|---|-------|---|
| <p>2.5<br/>Evaluating the effects of genetic research on human life</p> | <p>Search the Internet, read books, magazines and newspapers for informations on genetic research and discuss the following:</p> <p>a) genetic research in the field of medicine, such as the discovery of various types of hereditary diseases and the latest techniques for treating specific diseases, and Human Genome Project.</p> <p>b) genetic research in the field of agriculture such as genetically - modified food (GMF), cloning, selective breeding in plants such as paddy, oil palm, papaya, durian, chilli, and livestock such as dairy cow and chicken.</p> <p>Discuss the following:</p> <p>a) selective breeding in plants and livestock,</p> <p>b) the importance of selective breeding in plants and livestock,</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• list the contributions of genetic research in various fields,</li> <li>• explain selective breeding in plants and livestock,</li> <br/> <li>• state the importance of selective breeding in plants and livestock,</li> <br/> <li>• describe the technology used for selective breeding,</li> <li>• present arguments for and against genetic research.</li> </ul> |       | <p>livestock – <i>ternakan</i></p> <p>selective breeding – <i>pembiakbakaan pilihan</i></p> |

| Learning Objectives                                    | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary   |
|--|--|---|-------|--|
|  | <p>View videos or computer simulations on the technology used for selective breeding.</p> <p>Debate on genetic research and its effects.</p> <p>Compile materials on genetic research in a scrap book.</p>   |   |       |  |
| <p>2.6<br/>Analysing variation among living things</p> | <p>Carry out activities to identify and classify variation among students in a class.<br/>Discuss the following:</p> <ol style="list-style-type: none"> <li>continuous variation and discontinuous variation,</li> <li>examples of continuous variation and discontinuous variation,</li> <li>factors which cause variation,</li> <li>the importance of variation.</li> </ol> <p>Carry out an activity to compare and contrast continuous variation with discontinuous variation and illustrate the similarities and differences in a graphic organiser.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>state what variation is,</li> <li>list variation in humans,</li> <li>classify variation into continuous and discontinuous variation,</li> <li>compare and contrast continuous and discontinuous variation,</li> <li>identify factors that cause variation,</li> <li>explain the importance of variation.</li> </ul> |       | <p>continuous variation – <i>variasi selanjar</i></p> <p>discontinuous variation – <i>variasi tak selanjar</i></p> <p>family tree – <i>salasilah</i></p> <p>left-handed – <i>kidal</i></p> <p>variation – <i>variasi</i></p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary |
|---|--|--|-------|------------|
|   | <p>Construct a family tree based on variation among family members such as having straight or curly hair, being right-handed or left-handed, the presence or absence of ear lobes, and the ability to roll the tongue.</p>   |  |       |            |
| <p>2.7<br/>Realising the need to adhere to a code of ethics in genetic research</p> | <p>Read books, articles, magazines or search the Internet and discuss how misuse of knowledge in the field of genetics can endanger life.</p> <p>Discuss the importance of establishing and adhering to ethics and morals in scientific research for the benefit of mankind.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain how the misuse of knowledge in the field of genetics can endanger life,</li> <li>• describe the importance of establishing and adhering to ethics and morals in scientific research for the benefit of mankind.</li> </ul> |       |            |

**THEME: MATTER IN NATURE**

**LEARNING AREA: 1. MATTER AND SUBSTANCE**

| Learning Objectives                                      | Suggested Learning Activities   | Learning Outcomes   | Notes  | Vocabulary  |
|--|---|---|--|---|
| <p>1.1<br/>Analysing changes in the states of matter</p> | <p>Carry out an activity to observe changes in the states of matter when heat is absorbed or released.</p> <p>View videos or computer simulations and discuss the following:</p> <p>a) the kinetic theory of matter,<br/>           b) changes in kinetic energy of particles in matter during heat change,<br/>           c) changes in the states of matter involving the absorption or release of heat,<br/>           d) changes in matter during melting, boiling, condensation, freezing and sublimation based on the kinetic theory of matter.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain the kinetic theory of matter,</li> </ul> <p>a) relate changes in heat to changes in kinetic energy of the particles in matter,<br/>           b) explain the interconversion of the three states of matter based on the kinetic theory of matter.</p> | <p>The kinetic theory of matter should be explained in terms of particle movement.</p> | <p>absorbed – <i>diserap</i></p> <p>boiling – <i>pendidihan</i></p> <p>condensation – <i>kondensasi</i></p> <p>freezing – <i>pembekuan</i></p> <p>interconversion – <i>perubahan dari satu keadaan ke keadaan lain dan sebaliknya</i></p> <p>kinetic energy – <i>tenaga kinetik</i></p> <p>kinetic theory of matter – <i>teori kinetik jirim</i></p> <p>melting – <i>peleburan</i></p> <p>particle movement – <i>pergerakan zarah</i></p> <p>particles in matter – <i>zarah-zarah dalam jirim</i></p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes   | Vocabulary   |
|---|--|--|---|--|
| <p>1.2<br/>Understanding the structure of an atom</p>                                     | <p>Examine models , view computer simulations and discuss the following:<br/> a) the structure of an atom,<br/> b) the subatomic particles namely proton, electron, and neutron.</p> <p>Draw a labelled diagram of a model of an atom.</p> <p>Carry out an activity to compare and contrast the subatomic particles in terms of location, relative mass and charge. Illustrate the similarities and differences of subatomic particles in a graphic organiser.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe the structure of an atom,</li> <li>identify the subatomic particles,</li> <li>compare and contrast the subatomic particles.</li> </ul>  |   | <p>released – <i>dibebaskan</i></p> <p>states of matter – <i>keadaan jirim</i></p> <p>sublimation – <i>pemejalwapan</i></p> <p>charge – <i>cas</i></p> <p>relative mass – <i>jisim relatif</i></p> <p>subatomic particles – <i>zarah-zarah subatom</i></p> |
| <p>1.3<br/>Applying the idea of proton number and nucleon number in atoms of elements</p> | <p>Collect and interpret data on the following:<br/> a) proton number,<br/> b) nucleon number,<br/> c) isotopes.</p> <p>Construct a table to show the relationship between the number of protons, neutrons and electrons in an atom and its proton number and nucleon number.</p>  | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>state what proton number is,</li> <li>state what nucleon number is,</li> <li>relate the number of protons, neutrons and electrons in an atom to its proton number and nucleon number,</li> <li>deduce the number of protons, electrons and neutrons in atoms of different elements,</li> </ul> | <p>Only elements with proton numbers in the range of 1 – 10 are required.</p> | <p>isotopes – <i>isotop-isotop</i></p> <p>make generalisation – <i>membuat pengitlakan</i></p> <p>nucleon number – <i>nombor nukleon</i></p> <p>proton number – <i>nombor proton</i></p>   |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary  |
|---|---|--|-------|---|
|   | <p>Discuss and make a generalisation that atoms of different elements consist of different numbers of protons and electrons.</p> <p>Discuss the following:</p> <p>a) isotopes,<br/>b) examples of isotopes such as isotopes of hydrogen and carbon.</p>   | <ul style="list-style-type: none"> <li>• make a generalisation on the numbers of protons and electrons in atoms of different elements,</li> <li>• state what isotopes are,</li> <li>• give examples of isotopes.</li> </ul>  |       |   |
| <p>1.4 Understanding the classification of elements in the Periodic Table</p> | <p>View computer simulations or charts and discuss the following aspects of the Periodic Table:</p> <p>a) arrangement of elements based on increasing proton number,<br/>b) group as vertical column containing elements with similar chemical properties,<br/>c) period as horizontal row containing elements that change their chemical and physical properties gradually from those reflecting metal to those reflecting non-metal,<br/>d) locations of metals, non-metals and semimetals.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• describe the arrangement of elements in the Periodic Table,</li> <li>• describe what is meant by groups and periods in the Periodic Table,</li> <li>• identify the locations of metals, non-metals and semimetals in the Periodic Table,</li> <li>• state the importance of the Periodic Table.</li> </ul> |       | <p>card game – <i>permainan kad</i></p> <p>chemical properties – <i>sifat kimia</i></p> <p>group – <i>kumpulan</i></p> <p>horizontal rows – <i>baris mendatar</i></p> <p>metals – <i>logam</i></p> <p>non-metals – <i>bukan logam</i></p> <p>period – <i>kala</i></p> <p>Periodic Table – <i>Jadual Berkala</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary  |
|--|--|--|-------|---|
|  | <p>Carry out a card game to fill up the missing elements in the Periodic Table. The cards contain the following details:</p> <ol style="list-style-type: none"> <li>proton number,</li> <li>nucleon number,</li> <li>metal, non-metal and semimetal.</li> </ol> <p>Discuss the importance of the Periodic Table in terms of:</p> <ol style="list-style-type: none"> <li>assisting in an orderly and systematic approach to the study of elements,</li> <li>knowing the properties of the elements,</li> <li>predicting the properties and uses of elements.</li> </ol> |  |       | <p>semimetals – <i>separuh logam</i></p> <p>vertical columns – <i>turus menegak</i></p>   |
| <p>1.5<br/>Understanding the properties of substances based on the particles present in them</p> | <p>View computer simulations or charts to study the following:</p> <ol style="list-style-type: none"> <li>atoms, molecules and ions,</li> <li>substances which are made of atoms, molecules and ions,</li> <li>physical properties of substances made of atoms, molecules and ions such as: <ol style="list-style-type: none"> <li>physical state at room temperature,</li> <li>melting point,</li> <li>boiling point,</li> <li>electrical conductivity.</li> </ol> </li> </ol>  | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe what atoms, molecules and ions are,</li> <li>identify the particles in substances as atoms, molecules and ions,</li> <li>state examples of substances made of atoms, molecules and ions,</li> </ul> |       | <p>boiling point - <i>takat didih</i></p> <p>electrical conductivity – <i>kekonduksian elektrik</i></p> <p>forces of attraction – <i>daya tarikan</i></p> <p>melting point – <i>takat lebur</i></p> <p>room temperature – <i>suhu bilik</i></p> |

| Learning Objectives | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary |
|---------------------|---|--|-------|------------|
|                     | <p>d) arrangement of particles and the forces of attraction between particles in substances made of atoms, molecules and ions.</p> <p>Carry out an activity to study the melting point and electrical conductivity of substances made up of:</p> <p>a) atoms such as lead,<br/> b) molecules such as sulphur,<br/> c) ions such as lead bromide.</p> <p>Carry out an activity to compare and contrast substances that are made of atoms, molecules and ions based on their physical properties. Illustrate the similarities and differences in a graphic organiser.</p> <p>Discuss the arrangement of particles and the forces of attraction between particles in relation to the physical properties of substances made up of atoms, molecules and ions.</p> | <ul style="list-style-type: none"> <li>• compare and contrast substances that are made of atoms, molecules and ions based on their physical properties,</li> <li>• relate the physical properties of substances made up of atoms, molecules and ions to the arrangement of particles and the forces of attraction between them.</li> </ul> |       |            |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary  |
|---|--|--|-------|---|
| <p>1.6 Understanding the properties and uses of metals and non-metals</p> | <p>Carry out an activity to identify objects in the classroom which are made of metals and non-metals.</p> <p>Collect and interpret data on the properties and uses of metals such as iron, aluminium, zinc, copper, lead, tin, gold and non-metals such as carbon, sulphur and chlorine.</p> <p>Carry out an activity to compare and contrast the properties of things made of metal and non-metal and illustrate the similarities and differences in a graphic organiser.</p> <p>Carry out an activity to study the physical properties of metals and non-metals such as:</p> <ol style="list-style-type: none"> <li>luminosity,</li> <li>ductility,</li> <li>malleability,</li> <li>tensile strength,</li> <li>electrical and heat conductivity.</li> </ol> <p>Discuss the physical properties of metals and non-metals relating to their uses in daily life.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>list examples of metals and non-metals,</li> <li>list the properties of metals and non-metals,</li> <li>list the uses of metals and non-metals in daily life,</li> <li>compare and contrast metals and non-metals based on their physical properties,</li> <li>relate the physical properties of metals and non-metals to their uses in daily life.</li> </ul> |       | <p>chlorine – <i>klorin</i></p> <p>copper – <i>kuprum</i></p> <p>ductility – <i>kemuluran</i></p> <p>electrical and heat conductivity – <i>kekonduksian elektrik dan haba</i></p> <p>gold – <i>emas</i></p> <p>iron – <i>besi</i></p> <p>lead – <i>plumbum</i></p> <p>luminosity – <i>kekilauan</i></p> <p>malleability – <i>ketertempaan</i></p> <p>sulphur – <i>sulfur</i></p> <p>tensile strength – <i>kekuatan regangan</i></p> <p>tin – <i>timah</i></p> |

| Learning Objectives                                      | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary  |
|--|--|---|-------|---|
| <p>1.7<br/>Analysing methods of purifying substances</p> | <p>Collect and interpret data on the following:</p> <ol style="list-style-type: none"> <li>a) characteristics of pure substances,</li> <li>b) different methods of purification of substances.</li> </ol> <p>Carry out activities to study the following:</p> <ol style="list-style-type: none"> <li>a) how the presence of impurities such as salts affects the boiling point of water,</li> <li>b) purification of substances by the following methods:               <ol style="list-style-type: none"> <li>i. distillation, e.g. purifying alcohol from a mixture of alcohol and water,</li> <li>ii. crystallisation, e.g. purifying salt from a saturated solution of common salt.</li> </ol> </li> </ol> <p>Gather information and discuss the following:</p> <ol style="list-style-type: none"> <li>a) factors to be considered when selecting the methods of purification. Examples are as follow:               <ol style="list-style-type: none"> <li>i. separating a liquid from a solution of a solid in a liquid, such as producing pure water from sea water,</li> </ol> </li> </ol> | <p>A student is able to</p> <ul style="list-style-type: none"> <li>• state the characteristics of pure substances,</li> <li>• describe the different methods of purification of substances,</li> <li>• relate the characteristics of substances to the methods of purification used,</li> <li>• explain with examples the methods of purification used to produce substances used in daily life.</li> </ul> |       | <p>cystallisation – <i>penghabluran</i></p> <p>distillation – <i>penyulingan</i></p> <p>distilled water – <i>air suling</i></p> <p>impurities – <i>bendasing</i></p> <p>petroleum fractions – <i>pecahan petroleum</i></p> <p>pure substances – <i>bahan tulen</i></p> <p>purification of substances – <i>penulenan bahan</i></p> <p>saturated solutions – <i>larutan tepu</i></p> <p>solutes – <i>zat-zat terlarut</i></p> <p>miscible – <i>larut campur</i></p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary |
|---|--|--|-------|------------|
|   | <p>ii. separating a liquid from a mixture of miscible liquids such as removing ethanol from a mixture of ethanol and water,</p> <p>iii. separating insoluble impurities from a soluble substance such as removing sand and other impurities from salt.</p> <p>b) methods of purification used in producing substances needed daily such as salt, sugar, petroleum fractions and distilled water.</p> |  |       |            |
| <p>1.8<br/>Appreciating the existence and uses of various substances of different characteristics</p> | <p>Discuss the following:</p> <p>a) how various substances of different characteristics can be utilised to benefit mankind,</p> <p>b) the importance of the existence of various substances of different characteristics.</p>  | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe how man uses various substances of different characteristics and states in everyday life,</li> <li>justify the importance of the existence of various substances of different characteristics and states that benefit mankind.</li> </ul> |       |            |

**THEME: ENERGY IN LIFE**

**LEARNING AREA: 1. ENERGY AND CHEMICAL CHANGES**

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary   |
|--|--|--|-------|--|
| <p>1.1<br/>Understanding physical and chemical changes</p> | <p>Discuss the following in terms of physical and chemical changes:</p> <ol style="list-style-type: none"> <li>burning of paper,</li> <li>melting of ice,</li> <li>change in colour of sliced apples,</li> <li>evaporation of water.</li> </ol> <p>Carry out the following activities to study physical and chemical changes:</p> <ol style="list-style-type: none"> <li>heating iron with sulphur,</li> <li>burning magnesium in air,</li> <li>mixing zinc with copper sulphate solution,</li> <li>soaking clean iron nails in water until they rust,</li> <li>heating copper carbonate,</li> <li>mixing potassium iodide with lead nitrate,</li> <li>dissolving sugar in water,</li> <li>crystallising sodium chloride from its saturated solution,</li> <li>heating iodine crystals in a closed container,</li> <li>slow heating of wax.</li> </ol> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>explain what physical change is,</li> <li>explain what chemical change is,</li> <li>give examples of physical changes in daily life,</li> <li>give examples of chemical changes in daily life,</li> <li>compare and contrast physical changes and chemical changes.</li> </ul> |       | <p>chemical changes – <i>perubahan kimia</i></p> <p>copper carbonate salt – <i>garam kuprum karbonat</i></p> <p>copper sulphate solution - <i>larutan kuprum sulfat</i></p> <p>evaporation of water – <i>penyejatan air</i></p> <p>lead nitrate – <i>plumbum nitrat</i></p> <p>physical changes – <i>perubahan fizik</i></p> <p>potassium iodide – <i>kalium iodida</i></p> <p>reaction – <i>tindak balas</i></p> <p>rust – <i>karat</i></p> |

| Learning Objectives                                | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary  |
|--|--|---|-------|---|
|  | Carry out an activity to compare and contrast physical change and chemical change and illustrate the similarities and differences in a graphic organiser.  |   |       | saturated solution – <i>larutan tepu</i><br>sodium chloride – <i>natrium klorida</i><br>wax – <i>lilin</i>  |
| 1.2<br>Analysing heat change in chemical reactions | Carry out the following activities to study heat changes in chemical reactions:<br>a) dissolving ammonium chloride in water,<br>b) dissolving sodium hydroxide in water.<br><br>Discuss the following:<br>a) the relationship between heat loss or heat gain and changes in temperature,<br>b) exothermic and endothermic reactions based on changes in heat.<br><br>View computer simulations then gather and interpret data on heat changes that occur during industrial chemical reactions, such as:<br>a) the production of ammonia from ammonium products<br>b) the production of sulphuric acid. | A student is able to: <ul style="list-style-type: none"> <li>state that chemical reactions involve heat change,</li> <li>identify reactions involving heat loss,</li> <li>identify reactions involving heat gain,</li> <li>relate changes in temperature of reactants to exothermic reactions,</li> <li>relate changes in temperature of reactants to endothermic reactions,</li> <li>explain through examples heat changes that occur during industrial chemical reactions.</li> </ul> |       | ammonium chloride – <i>ammonium klorida</i><br>chemical reaction – <i>tindak balas kimia</i><br>endothermic – <i>serap haba</i><br>exothermic – <i>buang haba</i><br>heat change – <i>perubahan haba</i><br>reactant – <i>bahan tindak balas</i><br>sodium hydroxide – <i>natrium hidroksida</i><br>sulphuric acid – <i>asid sulfurik</i> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes   | Notes   | Vocabulary   |
|---|---|---|---|--|
| <p>1.3<br/>Synthesising the reactivity series of metals</p> | <p>Carry out activities to study the following reactions:</p> <p>a) sodium, calcium, magnesium, aluminium, zinc and copper with water.</p> <p>b) magnesium, aluminium, zinc and copper with dilute acids.</p> <p>c) magnesium, aluminium, zinc, copper with oxygen.</p> <p>Carry out activities to compare and contrast the reactivity of metals with water, acids and oxygen. Illustrate the similarities and differences in a graphic organiser.</p> <p>Discuss and arrange metals in order of reactivity.</p> <p>Collect and interpret data on the reactivity of metals with oxygen to construct the reactivity series of metals.</p> <p>Carry out an experiment to determine the position of carbon in the reactivity series.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe the reactivity of metals with water,</li> <li>describe the reactivity of metals with acids,</li> <li>describe the reactivity of metals with oxygen,</li> <li>compare and contrast the reactivity of metals with water, acids and oxygen,</li> <li>arrange metals in order of reactivity,</li> <li>construct the reactivity series of metals based on reactivity of metals with oxygen,</li> <li>identify the position of carbon in the reactivity series.</li> </ul> | <p>Sodium should be used in very small quantity only.</p> | <p>dilute acids – <i>asid cair</i></p> <p>reactivity series – <i>siri kereaktifan</i>.</p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes   | Notes   | Vocabulary  |
|---|--|---|---|---|
| 1.4<br>Applying the concepts of reactivity series of metals | <p>View computer simulations or videos on methods of extracting metals from their ores and then carry out the following activities:</p> <p>a) relate the position of metals in the reactivity series to the method of extracting metals from their ores, such as using carbon and by electrolysis,</p> <p>b) discuss the process of extracting tin from its ore.</p> <p>Discuss the importance of the reactivity series.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>relate the position of metals in the reactivity series to the method of extraction of metals from their ores,</li> <li>explain with examples the process of extraction of a metal from its ore using carbon,</li> <li>state the importance of the reactivity series.</li> </ul> |   | <p>electrolysis – <i>elektrolisis</i></p> <p>extraction – <i>pengekstrakan</i></p> <p>ore – <i>bijih</i></p> <p>tin – <i>timah</i></p>  |
| 1.5<br>Understanding electrolysis                           | <p>Carry out activities on electrolysis and discuss the following:</p> <p>a) definition of electrolysis,</p> <p>b) what anode, cathode, anion, cation and electrolyte are,</p> <p>c) the process and product of electrolysis of an electrolyte using carbon electrodes,</p> <p>d) use of electrolysis in electroplating metal objects.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>state what electrolysis is,</li> <li>state what anode, cathode, anion, cation and electrolyte are,</li> <li>describe the electrolysis of an electrolyte using carbon electrodes,</li> <li>explain the uses of electrolysis in industry.</li> </ul>                              | <p>Chemical equations for reactions occurring at electrodes are not required.</p> | <p>anode – <i>anod</i></p> <p>cathode – <i>katod</i></p> <p>electrode – <i>elektrod</i></p> <p>electrolyte – <i>elektrolit</i></p> <p>electroplating – <i>penyaduran elektrik</i></p> <p>lead bromide – <i>plumbum bromida</i></p> <p>molten – <i>lebur</i></p> |

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes  | Notes   | Vocabulary  |
|--|---|--|---|---|
|  | <p>View computer simulations and study the following processes:</p> <p>a) electrolysis of molten lead bromide using carbon electrodes,</p> <p>b) electroplating objects made of iron with copper.</p> <p>View videos or computer simulations and discuss the uses of electrolysis in industry, including the extraction of metals, purification of metals and electroplating.</p> |  |   |   |
| <p>1.6 Understanding the production of electrical energy from chemical reactions</p> | <p>Carry out an activity to study the production of electrical energy by a simple cell.</p> <p>Examine various types of cells such as dry cells, lead-acid accumulators, alkaline batteries, silver oxide-mercury batteries and nickel-cadmium batteries and discuss:</p> <p>a) their uses,</p> <p>b) the advantages and disadvantages in using each of these types of cells.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe how a simple cell works,</li> <li>list the various types of cells and their uses,</li> <li>state the advantages and disadvantages of various types of cells.</li> </ul> | <p>Equations to show the reactions at the positive and negative terminals of a simple cell are not required</p> | <p>alkaline batteries – <i>bateri alkali</i></p> <p>lead-acid accumulators – <i>akumulator asid-plumbum</i></p> <p>nickel cadmium batteries – <i>bateri nikel-kadmium</i></p> <p>silver oxide-mercury batteries – <i>bateri argentum oksida-merkuri</i></p> <p>simple cell – <i>sel ringkas</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes  | Notes   | Vocabulary   |
|---|---|--|---|--|
| <p>1.7<br/>Understanding chemical reactions that occur in the presence of light</p>   | <p>Discuss the following:</p> <p>a) chemical reactions which require light for example photosynthesis in green plants,<br/>b) the effect of light on photosensitive chemicals.</p> <p>Carry out an activity to study the effect of light on photographic paper and silver chloride.</p> <p>Discuss how photosensitive chemicals are stored by relating to the effect of light on these chemicals.</p>               | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• give examples of chemical reactions which require light,</li> <li>• explain the effect of light on photosensitive chemicals,</li> <li>• explain why certain chemicals are stored in dark bottles.</li> </ul>   | <p>Only a brief description of splitting of water molecules by light energy in photosynthesis is required. Chemical equations are not required.</p> | <p>photographic paper – <i>kertas fotografi</i></p> <p>photosensitive chemicals – <i>bahan kimia yang peka cahaya</i></p> <p>photosynthesis – <i>fotosintesis</i></p> <p>silver chloride – <i>argentum klorida</i></p> |
| <p>1.8<br/>Appreciating the innovative efforts in the design of equipment using chemical reactions as sources of energy</p> | <p>Prepare folio and scrap book on the following topics:</p> <p>a) how energy obtained from chemical reactions should be used efficiently to prevent wastage,<br/>b) how equipment utilising chemical reactions as sources of energy should be disposed to reduce environmental pollution,</p> <p>Carry out a brainstorming session on new ways of using chemical reactions as sources of energy for equipment.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• describe how energy obtained from chemical reactions should be used efficiently to prevent wastage,</li> <li>• describe how equipment utilising chemical reactions as sources of energy should be disposed to reduce environmental pollution,</li> <li>• give suggestions on new ways of using chemical reactions as sources of energy for equipment,</li> </ul> |   |  |

| Learning Objectives | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary |
|---------------------|---|---|-------|------------|
|                     | <p>Carry out activities to illustrate good habits of using and disposing equipment that uses chemical reaction as a source of energy.</p> | <ul style="list-style-type: none"> <li>• put into practise good habits when using and disposing equipment that uses chemical reaction as a source of energy.</li> </ul> |       |            |

**THEME : ENERGY IN LIFE**

**LEARNING AREA: 2. NUCLEAR ENERGY**

| Learning Objectives                                 | Suggested Learning Activities  | Learning Outcomes  | Notes                             | Vocabulary   |
|---|--|--|-----------------------------------|--|
| <p>2.1<br/>Understanding radioactive substances</p> | <p>View computer simulations, videos or charts and study:<br/>a) radioactive substances,<br/>b) radioactive radiations,<br/>c) radioisotopes.</p> <p>Discuss the following:<br/>a) radioactive substances,<br/>b) radioisotopes of carbon, cobalt and iodine,<br/>c) the process of radioactive decay and the emission of alpha particles, beta particles and gamma radiation.</p> <p>Carry out an activity to compare and contrast the characteristics of the three types of radioactive radiations i.e. alpha, beta and gamma radiation in terms of:<br/>a. type of particles,<br/>b. charge,<br/>c. penetrating powers.<br/>Illustrate the similarities and differences in a graphic organiser.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what radioactive substances are,</li> <li>• give examples of radioactive substances,</li> <li>• describe the process of radioactive decay,</li> <li>• name the three types of radioactive radiations,</li> <li>• describe the characteristics of each type of radioactive radiation,</li> <li>• compare and contrast radioactive radiations,</li> <li>• explain what radioisotopes are,</li> <li>• give examples of radioisotopes,</li> <li>• explain the uses of radioactive substances.</li> </ul> | <p>Half-life is not required.</p> | <p>penetration power – <i>kuasa penembusan</i></p> <p>radiation – <i>sinaran</i></p> <p>radioactive decay – <i>pereputan radioaktif</i></p> <p>radioisotope – <i>radioisotop</i></p> |

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes   | Notes   | Vocabulary  |
|--|---|---|---|---|
|  | <p>View computer simulations, videos or charts and discuss the uses of radioactive substances in the following fields:</p> <ol style="list-style-type: none"> <li>agriculture,</li> <li>medicine,</li> <li>archaeology,</li> <li>industry,</li> <li>food preservation.</li> </ol> <p>Access websites or visit Malaysian Institute of Nuclear Technology (MINT) to collect information on radioactive substances and nuclear energy.</p>   |   |   |   |
| <p>2.2 Understanding the production of nuclear energy and its uses</p> | <p>View computer simulations, videos and charts and discuss the production of nuclear energy through the following:</p> <ol style="list-style-type: none"> <li>fission,</li> <li>fusion.</li> </ol> <p>Discuss the process of generating electricity from nuclear energy.</p> <p>Read articles and do a group presentation on the following:</p> <ol style="list-style-type: none"> <li>the uses of nuclear energy,</li> <li>the effects of nuclear energy production.</li> </ol> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>describe the production of nuclear energy through fission,</li> <li>describe the production of nuclear energy through fusion,</li> <li>state the uses of nuclear energy,</li> <li>describe the process of generating electricity from nuclear energy,</li> <li>explain the effects of nuclear energy production.</li> </ul> | <p>The concept of chain reaction is not required.</p> | <p>fission – <i>pembelahan</i></p> <p>fusion – <i>pelakuran</i></p> <p>nuclear energy – <i>tenaga nuklear</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary   |
|--|--|---|-------|--|
| <p>2.3<br/>Awareness of the need for proper handling of radioactive substances</p> | <p>Read articles, view videos or charts and discuss the following:</p> <ol style="list-style-type: none"> <li>a. Chernobyl nuclear disaster and other nuclear disasters,</li> <li>b. handling of radioactive substances and radioactive waste.</li> </ol> <p>Discuss the following:</p> <ol style="list-style-type: none"> <li>(i) the short term and long term effects of radioactive substances on living things,</li> <li>(ii) the need for proper handling of radioactive substances and radioactive waste.</li> </ol> <p>Debate on the need to have nuclear power stations.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state the effects of radioactive radiations on living things,</li> <li>• describe the correct way of handling radioactive substances and radioactive waste,</li> <li>• explain the need for proper handling of radioactive substances and radioactive waste.</li> </ul> |       | <p>radioactive wastes – <i>sisa bahan radioaktif</i></p> <p>nuclear power station – <i>stesen tenaga nuklear</i></p> |

**THEME : ENERGY IN LIFE**

**LEARNING AREA: 3. LIGHT, COLOUR AND SIGHT**

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|--|---|---|-------|---|
| <p>3.1<br/>Synthesising the formation of image by plane mirrors and lenses</p> | <p>Carry out activities to observe the following:<br/>a) Images formed by a plane mirror,<br/>b) Images formed by convex and concave lenses.</p> <p>Carry out an activity to compare and contrast images of distant objects formed by convex lenses and concave lenses. Illustrate the similarities and differences in a graphic organiser.</p> <p>Use computer simulations, videos or charts to demonstrate the construction of ray diagrams.</p> <p>Draw ray diagrams for light passing through:<br/>a) convex lens with objects located at various distances,<br/>b) concave lens.</p> <p>Label the following on the ray diagrams:<br/>a) principal axis,<br/>b) optical centre,</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>state the characteristics of images formed by a plane mirror,</li> <li>state the characteristics of images formed by a convex lens,</li> <li>state the characteristics of images formed by a concave lens,</li> <li>compare and contrast images of distant objects formed by convex lenses and concave lenses,</li> <li>draw a labelled ray diagram to show the formation of image by light rays passing through a convex lens,</li> <li>draw a labelled ray diagram to show the formation of image by light rays passing through a concave lens,</li> <li>draw ray diagrams to explain how characteristics of images formed by convex lenses vary with object distance,</li> </ul> |       | <p>concave lens – <i>kanta cekung</i></p> <p>convex lens – <i>kanta cembung</i></p> <p>distant object – <i>objek jauh</i></p> <p>focal length – <i>panjang fokus</i></p> <p>focal point – <i>titik fokus</i></p> <p>image – <i>imej</i></p> <p>image distance – <i>jarak imej</i></p> <p>object distance – <i>jarak objek</i></p> <p>optical centre – <i>pusat optik</i></p> <p>plane mirror – <i>cermin satah</i></p> <p>principle axis – <i>paksi utama</i></p> <p>ray diagram – <i>rajab sinar</i></p> |

| Learning Objectives   | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary  |
|---|--|--|-------|---|
|   | <p>c) focal point,<br/>d) focal length,<br/>e) object distance,<br/>f) image distance.</p> <p>Discuss how characteristics of images formed by convex lenses vary with object distance,</p> <p>Plan and carry out an activity to determine the focal length of a convex lens.</p>   | <ul style="list-style-type: none"> <li>determine the focal length of a convex lens.</li> </ul>   |       |   |
| <p>3.2<br/>Synthesising the formation of image by optical instruments</p> | <p>Investigate the image formed in a camera using a pin-hole camera with and without lens.</p> <p>Construct a simple periscope and telescope. Discuss the formation of image by these optical instruments.</p> <p>Use computer simulations to demonstrate construction of ray diagrams for the light rays passing through the eye and optical instruments.</p> <p>Based on the simulations, draw and label ray diagrams to show the formation of images in the following optical instruments:<br/>a) camera,<br/>b) periscope,</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>identify the parts of optical instruments involved in image formation,</li> <li>draw ray diagrams for light rays passing through an optical instrument,</li> <li>compare and contrast the mechanisms in focusing and controlling the amount of light that enters human eyes and a camera,</li> <li>explain the structure and function of various parts of the eye using a camera as an analogy.</li> </ul> |       | <p>image formation – <i>pembentukan imej</i></p> <p>magnifying glass – <i>kanta pembesar</i></p> <p>optical instruments – <i>alatan optik</i></p> <p>pin-hole camera – <i>kamera lubang jarum</i></p> |

| Learning Objectives                       | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary   |
|---|---|--|-------|--|
|   | <p>c) telescope.<br/>d) eye</p> <p>Discuss the similarities and differences between camera and eye in terms of focusing and controlling the amount of light.</p> <p>Examine a model camera and relate its structure and functions to those of the eyes.</p>   |  |       |  |
| <p>3.3<br/>Analysing light dispersion</p> | <p>Carry out activities to investigate the following :</p> <p>a) light dispersion using a prism,<br/>b) rainbow formation.</p> <p>Discuss what light dispersion is.</p> <p>Use computer simulations to demonstrate light dispersion.</p> <p>Draw a labelled diagram to show dispersion of light.</p> <p>Discuss light dispersion in a phenomenon, such as the formation of rainbow.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what light dispersion is,</li> <li>• explain through examples how dispersion of light occurs.</li> </ul> |       | <p>light dispersion – <i>penyebaran cahaya</i></p> <p>phenomenon – <i>fenomena</i></p> <p>rainbow – <i>pelangi</i></p> |

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes  | Notes | Vocabulary  |
|--|---|--|-------|---|
| <p>3.4<br/>Analysing light scattering</p>                                | <p>Carry out an activity to study light scattering and its effects.</p> <p>Use computer simulations to demonstrate the process of light scattering.</p> <p>Discuss light scattering in phenomena such as blue skies and red sunset.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what light scattering is,</li> <li>• give examples of phenomena related to light scattering,</li> <li>• explain through examples how scattering of light occurs in natural phenomena.</li> </ul> |       | <p>light scattering – <i>penyerakan cahaya</i></p>  |
| <p>3.5<br/>Analysing the addition and subtraction of coloured lights</p> | <p>Carry out an activity to introduce primary and secondary colours.</p> <p>Carry out activities to:</p> <p>a) investigate the addition of primary colours to form secondary colours,</p> <p>b) investigate the effects of primary and secondary coloured filters on white and coloured light.</p> <p>Use computer simulations to demonstrate the addition and subtraction of coloured lights.</p> <p>Discuss the following:</p> <p>a) how secondary colours are obtained from the addition of primary colours,</p> <p>b) subtraction of coloured lights by coloured filters.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• identify primary and secondary colours,</li> <li>• explain how addition of primary colours produces secondary colours,</li> <li>• explain the subtraction of colours by coloured filters.</li> </ul>   |       | <p>coloured filter – <i>penapis warna</i></p> <p>primary colour – <i>warna primer</i></p> <p>secondary colour – <i>warna sekunder</i></p> <p>subtraction of coloured light – <i>penolakan cahaya berwarna</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes   | Notes | Vocabulary   |
|--|--|---|-------|--|
| <p>3.6<br/>Applying the principle of subtraction of coloured light to explain the appearance of coloured objects</p> | <p>Carry out activities to observe and study the colour of objects under white and coloured lights.</p> <p>View computer simulations and discuss the subtraction of coloured lights by coloured objects.</p> <p>Discuss the following:<br/>a) functions of rod and cone cells,<br/>b) the appearance of coloured objects under white and coloured light.</p>   | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• explain subtraction of coloured lights by coloured objects,</li> <li>• explain the appearance of coloured objects under white light.</li> <li>• explain the appearance of coloured objects under coloured lights,</li> <li>• state the function of rod and cone cells in the eye.</li> </ul>          |       | <p>cone cell – <i>sel kon</i></p> <p>rod cell – <i>sel rod</i></p>                   |
| <p>3.7<br/>Analysing the effect of mixing pigments</p>   | <p>Carry out activities to observe and study pigment and the effect of mixing pigments.</p> <p>View computer simulations and discuss the mixing of pigments and the effects of pigments on light.</p> <p>Carry out an activity to compare and contrast the mixing of pigments with the addition of coloured lights. Illustrate the similarities and differences in a graphic organiser.</p> <p>Based on the above activities make conclusions about the mixing of pigments and discuss the uses of pigments.</p> | <p>A student is able to :</p> <ul style="list-style-type: none"> <li>• state what pigment is,</li> <li>• list the uses of pigments,</li> <li>• compare and contrast the mixing of pigments with the addition of coloured lights,</li> <li>• explain through examples the effects of pigments on light,</li> <li>• make conclusions about the mixing of pigments.</li> </ul> |       | <p>mixing of pigments – <i>pencampuran pigmen</i></p> <p>pigment – <i>pigmen</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|---|---|---|-------|---|
| <p>3.8<br/>Evaluating the importance of colour in daily life</p>                            | <p>View computer simulations or videos to gather information and discuss the following:</p> <p>a) the uses of colour in printing, electrical wiring, traffic lights, symbols and signals,<br/>b) the importance of colour to humans, animals and plants.</p> <p>Discuss what life is like without colour.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• list the uses of colour in daily life,</li> <li>• state with examples the importance of colour to living things,</li> <li>• justify the importance of colour to living things.</li> </ul> |       |   |
| <p>3.9<br/>Appreciating the benefits of various types of optical instruments to mankind</p> | <p>Discuss the advantages of having various kinds of optical instruments such as:</p> <p>a) to overcome the limitation of the sense of sight,<br/>b) extending the capability or power of vision,<br/>c) increasing human knowledge and understanding about nature.</p>                                       | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• relate the inventions of various types of optical instruments to their contributions to mankind.</li> </ul>   |       | <p>optical instruments –<br/><i>peralatan optik</i></p> |

**THEME : TECHNOLOGICAL AND INDUSTRIAL DEVELOPMENT IN SOCIETY**

**LEARNING AREA : 1. CHEMICALS IN INDUSTRY**

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary   |
|--|---|---|-------|--|
| <p>1.1<br/>Understanding the properties of alloys and their uses in industry</p> | <p>Examine things made of alloys and discuss their composition, properties and uses.</p> <p>Collect and interpret data on the following:<br/>                     a) what an alloy is,<br/>                     b) examples of alloys,<br/>                     c) composition, properties and the uses of various alloys including steel, pewter, bronze, brass and duralumin.</p> <p>View videos or computer simulations and discuss:<br/>                     a) how formation of alloys can change the properties of metals, such as to increase hardness, prevent corrosion and improve appearance,<br/>                     b) what superconductor alloys are.</p> <p>Discuss the importance of alloys in industry.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• state what an alloy is,</li> <li>• give examples of alloys,</li> <li>• explain how the formation of alloy can change the properties of metals,</li> <li>• relate the changes in the properties of metals when they are converted to alloys to the arrangement of particles in the alloys,</li> <li>• relate the properties of alloys to their uses in daily life,</li> <li>• describe the importance of alloys in industry,</li> <li>• state what superconductor alloys are.</li> </ul> |       | <p>alloy – <i>aloi</i></p> <p>brass – <i>loyang</i></p> <p>bronze – <i>gangsa</i></p> <p>corrosion – <i>pengkakistan</i></p> <p>steel – <i>keluli</i></p> <p>superconductor alloy – <i>aloi superkonduktor</i></p> |

| Learning Objectives   | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|---|---|---|-------|---|
| <p>1.2<br/>Analysing the production and uses of ammonia in industry</p> | <p>Collect and study product labels to identify the ammonium compounds present.</p> <p>Discuss the uses of ammonia and its compounds in the making of substances such as fertilisers, nitric acid, colouring, cleaning agents and explosives.</p> <p>View videos or computer simulations to gather and interpret data on the following:<br/>a) the process of producing ammonia in industry,<br/>b) factors which affect the optimum production of ammonia such as temperature, pressure and catalysts.</p> <p>Draw a flow chart to show the production of ammonia.</p> <p>Collect and interpret data on the large scale uses of ammonia in industry such as manufacturing fertilisers and nitric acid.</p> <p>Carry out an activity to prepare ammonium fertiliser such as ammonium sulphate, ammonium nitrate and ammonium phosphate.</p> | <p>A student is able to</p> <ul style="list-style-type: none"> <li>• list the uses of ammonia and its compounds in daily life,</li> <li>• describe how ammonia is produced in industry,</li> <li>• state the factors which affect the production of ammonia in industry,</li> <li>• state the industrial uses of ammonia,</li> <li>• describe how ammonia is used to produce ammonium salt fertilisers and urea.</li> </ul> |       | <p>ammonium salt – <i>garam ammonium</i></p> <p>catalyst – <i>mangkin</i></p> <p>cleaning agents – <i>agen pencuci</i></p> <p>colouring – <i>pewarna</i></p> <p>explosives – <i>bahan letupan</i></p> <p>fertilisers – <i>baja</i></p> <p>flow chart – <i>carta aliran</i></p> <p>pressure – <i>tekanan</i></p> |

| Learning Objectives  | Suggested Learning Activities  | Learning Outcomes  | Notes | Vocabulary  |
|--|--|--|-------|---|
| <p>1.3<br/>Analysing the effects of industrial waste disposal on the environment</p> | <p>View videos or computer simulations to gather and interpret data on environmental pollution arising from:</p> <ul style="list-style-type: none"> <li>a) burning of fossil fuels,</li> <li>b) disposal of industrial waste such as toxic substances from the chemical industry, radioactive waste, oil palm and rubber waste from the agricultural industry,</li> <li>c) effects of improper industrial waste disposal on the environment,</li> <li>d) methods of controlling industrial waste disposal to avoid environmental pollution.</li> </ul> <p>Discuss and relate the effects of improper disposal of industrial waste to the survival of living things.</p> <p>Select an industry and do a presentation on how wastes are managed in the industry.</p> | <p>A student is able to</p> <ul style="list-style-type: none"> <li>• identify manufacturing activities which are sources of pollution,</li> <li>• explain the effects of improper industrial waste disposal,</li> <li>• relate the effects of industrial waste disposal to the survival of living things,</li> <li>• state with examples the methods of controlling industrial waste disposal to avoid pollution.</li> </ul> |       | <p>environmental pollution – <i>pencemaran alam sekitar</i></p> <p>fossil fuels – <i>bahan api fosil</i></p> <p>industrial waste – <i>bahan sisa industry</i></p> |

| Learning Objectives  | Suggested Learning Activities   | Learning Outcomes   | Notes | Vocabulary  |
|--|---|---|-------|---|
| <p>1.4<br/>Realising the need for preservation and conservation of the environment from industrial waste pollution for the well-being of mankind</p> | <p>View videos or computer simulations on industrial waste pollution and its effects on environment.</p> <p>Discuss:</p> <p>a) consequences of uncontrolled and haphazard disposal of industrial waste,</p> <p>b) the need to treat industrial pollution seriously in order to preserve and conserve the environment,</p> <p>c) the importance of practising responsible way of disposing industrial waste.</p> | <p>A student is able to:</p> <ul style="list-style-type: none"> <li>• describe the consequences of uncontrolled and haphazard disposal of industrial waste,</li> <li>• explain the importance of practising responsible way of disposing industrial waste.</li> </ul> |       | <p>environmental pollution – <i>pencemaran alam sekitar</i></p> <p>conservation – <i>pemuliharaan</i></p> <p>preservation – <i>pemeliharaan</i></p> |

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