



KEMENTERIAN PENDIDIKAN MALAYSIA

KURIKULUM STANDARD SEKOLAH MENENGAH

Sains

Dokumen Standard Kurikulum dan Pentaksiran

Tingkatan 2

(EDISI BAHASA INGGERIS)



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Tingkatan 2

(Edisi Bahasa Inggeris)

Bahagian Pembangunan Kurikulum

Mac 2016

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RUKUN NEGARA

BAHAWASANYA Negara kita Malaysia mendukung cita-cita hendak:
Mencapai perpaduan yang lebih erat dalam kalangan seluruh masyarakatnya;
Memelihara satu cara hidup demokratik;
Mencipta satu masyarakat yang adil di mana kemakmuran negara
akan dapat dinikmati bersama secara adil dan saksama;
Menjamin satu cara yang liberal terhadap tradisi-tradisi
kebudayaannya yang kaya dan berbagai corak;
Membina satu masyarakat progresif yang akan menggunakan
sains dan teknologi moden;

MAKA KAMI, rakyat Malaysia, berikrar akan menumpukan seluruh tenaga dan usaha
kami untuk mencapai cita-cita tersebut berdasarkan prinsip-prinsip yang berikut:

**KEPERCAYAAN KEPADA TUHAN
KESETIAAN KEPADA RAJA DAN NEGARA
KELUHURAN PERLEMBAGAAN
KEDAULATAN UNDANG-UNDANG
KESOPANAN DAN KESUSILAN**

FALSAFAH PENDIDIKAN KEBANGSAAN

“Pendidikan di Malaysia adalah suatu usaha berterusan ke arah lebih memperkembangkan potensi individu secara menyeluruh dan bersepadu untuk melahirkan insan yang seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani, berdasarkan kepercayaan dan kepatuhan kepada Tuhan. Usaha ini adalah bertujuan untuk melahirkan warganegara Malaysia yang berilmu pengetahuan, berketerampilan, berakhlak mulia, bertanggungjawab dan berkeupayaan mencapai kesejahteraan diri serta memberikan sumbangan terhadap keharmonian dan kemakmuran keluarga, masyarakat dan negara.”

Sumber: Akta Pendidikan 1996 (Akta 550)

DEFINISI KURIKULUM KEBANGSAAN

3. Kurikulum Kebangsaan

(1) Kurikulum Kebangsaan ialah suatu program pendidikan yang termasuk kurikulum dan kegiatan kurikulum yang merangkumi semua pengetahuan, kemahiran, norma, nilai, unsur kebudayaan dan kepercayaan untuk membantu perkembangan seseorang murid dengan sepenuhnya dari segi jasmani, rohani, mental dan emosi serta untuk menanam dan mempertingkatkan nilai moral yang diingini dan untuk menyampaikan pengetahuan.

Sumber: Peraturan-Peraturan Pendidikan (Kurikulum Kebangsaan) 1997.

[PU(A)531/97]

FALSAFAH PENDIDIKAN SAINS KEBANGSAAN

Selaras dengan Falsafah Pendidikan Kebangsaan, pendidikan sains di Malaysia memupuk budaya Sains dan Teknologi dengan memberi tumpuan kepada perkembangan individu yang kompetitif, dinamik, tangkas dan berdaya tahan serta dapat menguasai ilmu sains dan keterampilan teknologi.

Sumber: Kementerian Sains, Teknologi dan Inovasi (MOSTI)

KATA PENGANTAR

Kurikulum Standard Sekolah Menengah (KSSM) yang dilaksanakan secara berperingkat mulai tahun 2017 akan menggantikan Kurikulum Bersepadu Sekolah Menengah (KBSM) yang mula dilaksanakan pada tahun 1989. KSSM digubal bagi memenuhi keperluan dasar baharu di bawah Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025 agar kualiti kurikulum yang dilaksanakan di sekolah menengah setanding dengan standard antarabangsa. Kurikulum berasaskan standard yang menjadi amalan antarabangsa telah dijelmakan dalam KSSM menerusi penggubalan Dokumen Standard Kurikulum dan Pentaksiran (DSKP) untuk semua mata pelajaran yang mengandungi Standard Kandungan (SK), Standard Pembelajaran (SP) dan Standard Prestasi (SPi).

Usaha memasukkan standard pentaksiran dalam dokumen kurikulum telah mengubah landskap sejarah sejak Kurikulum Kebangsaan dilaksanakan di bawah Sistem Pendidikan Kebangsaan. Menerusinya murid dapat ditaksir secara berterusan untuk mengenalpasti tahap penguasaannya dalam sesuatu mata pelajaran, serta membolehkan guru membuat tindakan susulan bagi mempertingkatkan pencapaian murid.

DSKP yang dihasilkan juga telah menyepadukan enam tunjang Kerangka KSSM, mengintegrasikan pengetahuan, kemahiran dan nilai, serta memasukkan secara eksplisit Kemahiran Abad ke-21 dan Kemahiran Berfikir Aras Tinggi (KBAT). Penyepaduan tersebut dilakukan untuk melahirkan insan seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani sebagaimana tuntutan Falsafah Pendidikan Kebangsaan.

Bagi menjayakan pelaksanaan KSSM, pengajaran dan pembelajaran guru perlu memberi penekanan kepada KBAT dengan memberi fokus kepada pendekatan Pembelajaran Berasaskan Inkuiri dan Pembelajaran Berasaskan Projek, supaya murid dapat menguasai kemahiran yang diperlukan dalam abad ke-21.

Kementerian Pendidikan Malaysia merakamkan setinggi-tinggi penghargaan dan ucapan terima kasih kepada semua pihak yang terlibat dalam penggubalan KSSM. Semoga pelaksanaan KSSM akan mencapai hasrat dan matlamat Sistem Pendidikan Kebangsaan.

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Pengarah
Bahagian Pembangunan Kurikulum

INTRODUCTION

As articulated in the National Education Philosophy, 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. The primary and secondary school science curriculum standard is developed with the aim of producing such individuals.

Malaysia, moving towards becoming a developed nation, should foster a community that is scientific, progressive, inventive and visionary, while using latest technologies. This community must be able to contribute to the advancement of science and the sustainability of technological civilisation. To achieve this, we need to develop critical, creative, innovative and competent citizens who practice the culture of Science, Technology, Engineering and Mathematics (STEM).

The Malaysian science curriculum encompasses three core science subjects and four elective science subjects. The Core Science Subjects are Primary School Science, Lower Secondary Science and Upper Secondary Science. The Elective Science subjects offered in upper secondary are Biology, Physics, Chemistry and Additional Science.

The core science subjects for lower secondary is designed to equip pupils with science knowledge and STEM skills to be science literate and able to do science in upper secondary. Higher order thinking skill will also be developed so that the pupils will be able to apply the scientific knowledge to make decision and solve problems in real life creatively and innovatively.

Meanwhile, the upper secondary science and the elective science subjects will empower and strengthen their knowledge and skills in STEM towards preparing pupils for long-life learning experience. This group of pupils will embark on careers in science and technology which plays a role in national development.

AIMS

The science curriculum for secondary schools aims is to cultivate interest and develop creativity amongst pupil; through experience and investigation; so as to master knowledge in science, scientific skills, thinking skills and, scientific attitudes and values; enabling them to solve problems and make decisions in daily life.

OBJECTIVES

The Science Standard Curriculum (KSSM) aim for pupils to achieve the following objectives to:

1. Use the inquiry approach to fulfil their curiosity and their interest in science;
2. Acquire knowledge and understanding to explain phenomena scientifically;
3. Communicate information relating to science and technology intelligently and effectively;
4. Design and carry out scientific investigation, evaluate evidence and make conclusions;
5. Apply scientific knowledge, procedural knowledge and epistemic knowledge in posing questions, interpreting data, problem solving and decision making in context of real life;

6. Create awareness that discoveries through scientific research is a result of the ability of the human mind to understand natural phenomena towards a better life;
7. Create awareness that development of science and technology has an implication on the mores, social, economic and environment issues in the local and global context.

FRAMEWORK OF THE STANDARD CURRICULUM FOR SECONDARY SCHOOL

Standard Curriculum for Secondary School (KSSM) is built based on six strands, which are Communication; Spiritual, Attitude and Value; Humanity; Personal Development; Physical Development and Aesthetic; and Science and Technology. The six strands are the main domain that support each other and are integrated with critical, creative and innovative thinking. This integration is aimed at developing human capital that appreciate noble values based on religion, being knowledgeable, competent, think creatively, critically and innovatively as illustrated in Figure 1.

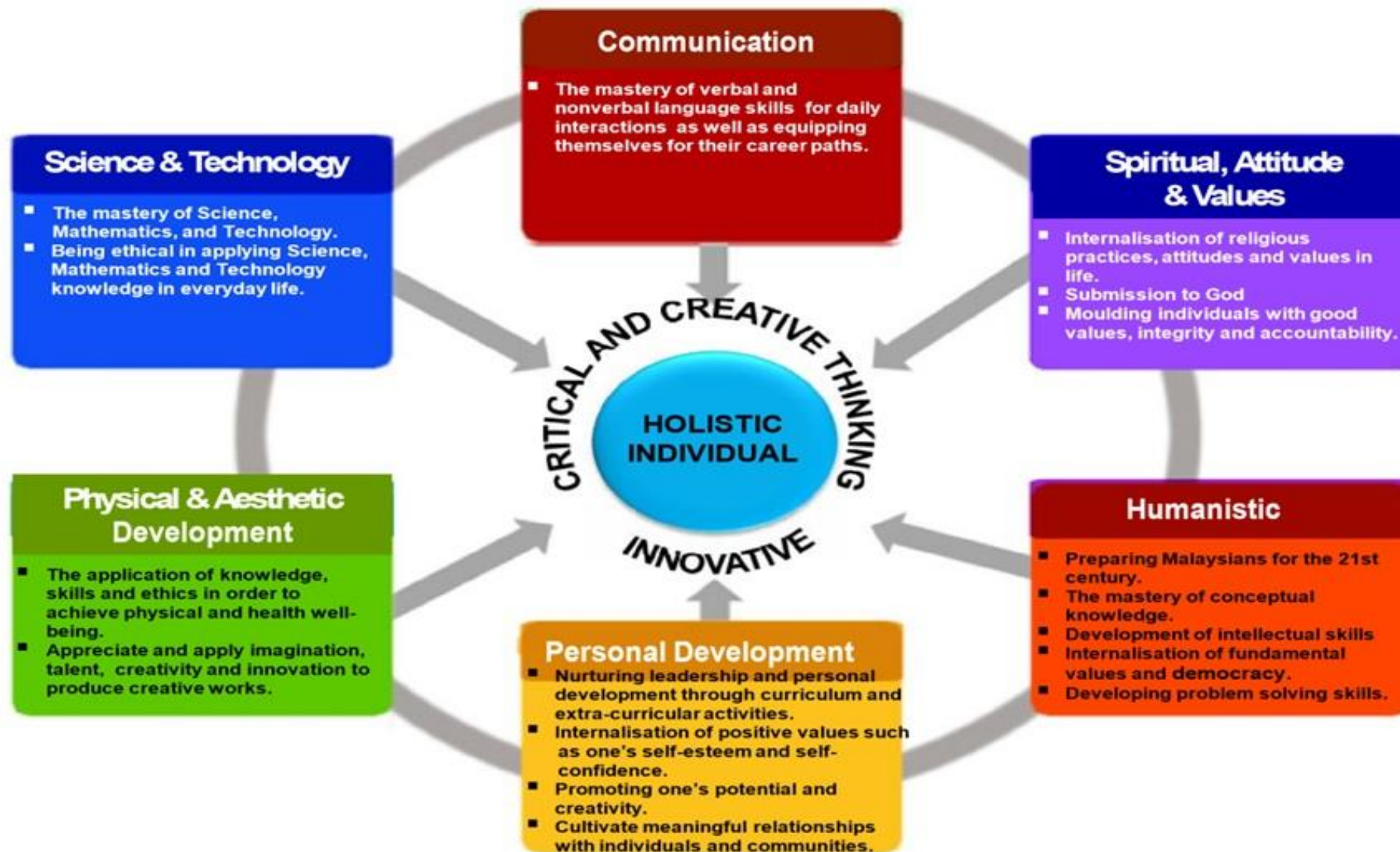


Figure 1: The Framework of Secondary School Standard-Based Curriculum

FOCUS

The science subject for secondary schools focuses on thoughtful learning involving scientific and thinking skills for the acquisition of knowledge through inquiry as the main approach in science education. The science curriculum also aims to prepare pupils to face rapid technological development and various challenges of the 21st century. The group of pupils that have gone through this curriculum will become human resource in the field of science and technology, and will contribute towards national development.

Content Standards of the Science Curriculum from Year 1 to Form 5 are developed based on the three domains which are knowledge, skills and values. The development of these domains will be experienced by pupils through the inquiry method to becoming thoughtful science learners (Figure 2). The inquiry approach includes pupil-centred learning, constructivism, contextual learning, problem-based learning, mastery learning as well as related strategies and methods.

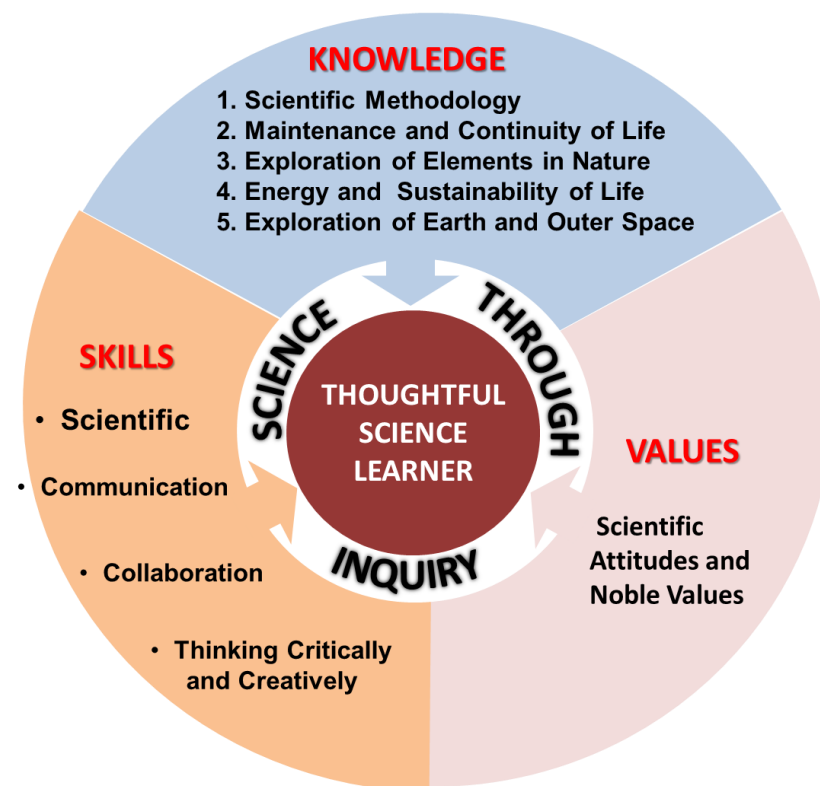


Figure 2: The Conceptual Framework for Science Curriculum

Thoughtful Science

According to the Fourth Edition (2005) of Kamus Dewan, thoughtful has the same meaning as the ability to think and reflect. In the context of science education, thoughtful science refers to the quality of pupils desired to be produced by the national science education system. Thoughtful science learner are those who can understand scientific ideas and are able to communicate using scientific language; can evaluate as well as apply scientific knowledge and skills responsibly in daily life that involves science and technology, based on attitudes and values. Thoughtful science also intends to produce creative and critical individuals to fulfil the 21st century needs, in which the country's ability is highly dependent upon the ability of human capital that can think and generate ideas.

Thoughtful Learning

Thoughtful learning can be achieved if pupils are actively involved in the teaching and learning process. In this process, the teaching and learning activities are planned to encourage pupils to think so that they are able to conceptualize, solve problems and make decisions. Thus, thinking skills should be assimilated by pupils.

Thinking skills can be categorised as critical and creative thinking. A person who thinks critically always evaluates ideas systematically before accepting them. A person who thinks creatively is highly imaginative, generates original innovative ideas, and is also able to modify existing ideas and products.

Thinking strategy is a higher level of thinking process that involves several steps where each step involves a number of critical and creative thinking skills. Thinking strategy is the main function and final aim of the thinking process.

Critical Thinking Skills

A brief description of each critical thinking skill is as in Table 1:

Table 1 : Critical Thinking Skills

CRITICAL THINKING SKILLS	DESCRIPTION
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 objects or events.
Grouping and Classifying	Separating and grouping objects or phenomena into groups based on certain criteria such as common characteristics or features.

CRITICAL THINKING SKILLS	DESCRIPTION
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 or information in order based on their importance or urgency.
Analysing	Processing information in detail by breaking it down into smaller parts to understand concepts or events as well as to find the implicit meanings.
Detecting Bias	Detecting views or opinions that have the tendency to support or oppose something.
Evaluating	Making considerations on the good and bad qualities of something based on valid evidences or propositions.
Making Conclusions	Making a statement about the outcome of an investigation based on a hypothesis or strengthening something based on an investigation.

Creative Thinking Skills

A brief description of each creative thinking skill is as in Table 2.

Table 2 : Creative Thinking Skills

CREATIVE THINKING SKILLS	DESCRIPTION
Generating Ideas	Producing ideas related to something.
Relating	Making connections in certain situations or events to find a structure or pattern of relationship.
Making Inferences	Making an initial conclusion and explaining an event using data collection and past experiences.
Predicting	Making forecast about events based on observations and previous experiences or collected data.
Making Generalisations	Making a general statement about certain matter from a group of observations on samples or some information from that group.

CREATIVE THINKING SKILLS	DESCRIPTION
Visualising	Forming perception or making mental images about a particular idea, concept, situation or vision.
Synthesising	Combining separate elements to produce an overall picture in the form of writing, drawing or artefact.
Making Hypotheses	Making a general statement about the relationship between the variables that is assumed to be true to explain an observation or event. The statement can be tested to determine its validity.
Making Analogies	Forming an understanding about a complex or abstract concept by relating it to simple or concrete concepts with similar characteristics.
Inventing	Producing something new or modifying something already in existence to overcome problems in a systematic manner.

Thinking Strategy

Description of each thinking strategy is as in Table 3.

Table 3: Thinking Strategy

THINKING STRATEGY	DESCRIPTION
Conceptualising	Making generalisations towards building of meaning, concept or model based on inter-related specific common characteristics.
Making Decisions	Selecting the best solution from several alternatives based on specific criteria to achieve the intended aims.
Problem Solving	Finding the right solutions in a systematic manner for situations that are uncertain or challenging or unanticipated difficulties.

Besides thinking skills and thinking strategies, another skill that is emphasised is reasoning. **Reasoning** is a skill used in making logical, rational, fair and just consideration. Mastery of critical and creative thinking skills and thinking strategies is made easier if an individual is able to provide reasoning in inductive and deductive manner. Figure 3 gives an overall picture of the thinking skills and thinking strategies. Mastery of TSTS through the teaching and learning of science can be developed through the following stages:

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

Further information about the stages on the implementation of TSTS can be referred to the guidebook "*Buku Panduan Penerapan Kemahiran Berfikir dan Strategi Berfikir dalam Pengajaran dan Pembelajaran Sains (Curriculum Development Centre, 1999)*"

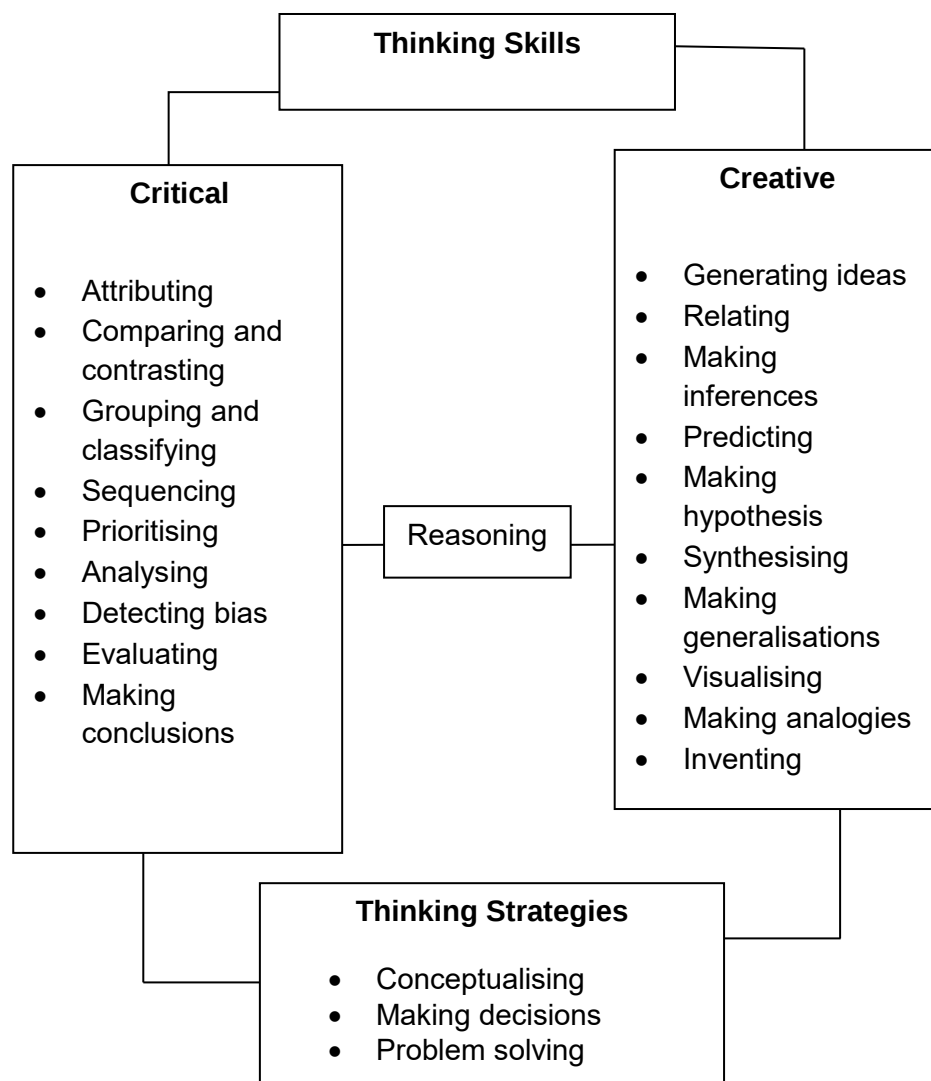


Figure 3: TSTS Model in Science

SCIENTIFIC SKILL

Science emphasizes inquiry and problem solving. In the process of inquiry and solving problem, scientific skills and thinking skills are used. Scientific skill is an important skill when carrying out activities by using scientific methods such as conducting experiments and projects.

Scientific skill consists of science process skills and manipulative skills.

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. Mastery of Science Process Skills together with attitude and appropriate knowledge to guarantee the ability of pupils to think effectively.

Description of each science process skill is as in Table 4.

Table 4: Science Process Skills

SCIENCE PROCESS SKILLS	DESCRIPTION
Observing	Using the sense of sight, hearing, touch, taste or smell to gather information about objects and phenomena.
Classifying	Using observations to group objects or phenomena according to similarities and differences.
Measuring and Using Numbers	Making quantitative observations using numbers and tools with standard units will ensure an accurate measurement.
Making Inferences	Using collected data or past experiences to draw conclusions and make explanations of events.

SCIENCE PROCESS SKILLS	DESCRIPTIONS
Predicting	Making forecast about events based on observations and previous experiences or collected data.
Communicating	Accepting, choosing, arranging, and presenting information or ideas in the form of writing, verbal, tables, graphs, figures or models.
Using Space-Time Relationship	Describing changes in parameters such as location, direction, shape, size, volume, weight and mass with time.
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.

SCIENCE PROCESS SKILLS	DESCRIPTIONS
Controlling Variables	Identifying manipulated variables, responding variables and fixed variables. In an investigation, a variable is manipulated to observe its relationship with the responding variable. At the same time, the other variables are kept the same.
Making Hypothesis	Making a general statement about the relationship between the variables that is assumed to be true to explain an observation or event. The statement can be tested to determine its validity.
Experimenting	Planning and conducting an investigation to test a hypothesis, collecting and interpreting data until a conclusion can be obtained.

Manipulative Skills

In a scientific investigation, manipulative skills are psychomotor skills that enable pupils to:

- Use and handle science apparatus and substances correctly.
- Store science apparatus and substances correctly and safely.
- Clean science apparatus correctly
- Handle specimens correctly and carefully.
- Sketch specimens, apparatus and substances accurately

Relationship between Science Process Skills and Thinking Skills

The mastery of Science Process Skills requires pupils to master the relevant thinking skills. The relevant thinking skills that are related to each science process skill are as in Table 5.

Table 5 : Science Process Skills and Thinking Skills

SCIENCE PROCESS SKILLS	DESCRIPTION
Observing	Attributing Comparing and contrasting Relating
Classifying	Attributing Comparing and contrasting Grouping and classifying
Measuring and Using Numbers	Relating Comparing and contrasting
Making Inferences	Relating Comparing and contrasting Analysing Making Inferences
Predicting	Relating Visualising
Using Space-Time Relationship	Sequencing Prioritising

SCIENCE PROCESS SKILLS	DESCRIPTION
Interpreting data	Comparing and contrasting Analysing Detecting bias Making conclusions Making Generalisations Evaluating
Defining operationally	Relating Making analogies Visualising Analysing
Controlling variables	Attributing Comparing and contrasting Relating Analysing
Making hypothesis	Attributing Relating Comparing and contrasting Generating ideas Making hypothesis Predicting Synthesising
Experimenting	All thinking skills
Communication	All thinking skills

Teaching and Learning Based on Thinking Skills and Scientific Skills

This Science Curriculum Standard emphasises thoughtful learning based on thinking skills and scientific skills. In this curriculum, the intended learning standard is written by integrating acquisition of knowledge with mastery of thinking skills and scientific skills. Thus in teaching and learning, teachers need to integrate mastery of skills together with acquisition of knowledge and the inculcation of scientific attitudes and noble values.

SPS implementation in Science exclusively encompass intended skills in the 21st century, indirectly encouraging and developing pupils' higher order thinking skills.

Science Process Skills Standard

The guide of the development of science process skills from primary school to secondary school are as shown in Table 6.

Table 6 : Science Process Skills

	SCIENCE PROCESS SKILLS	LEVEL 1 YEAR (1 - 3)	LEVEL 2 YEAR (4 - 6)	LEVEL 3 FORM (1 - 3)	LEVEL 4 FORM (4 - 5)
1	Observing	Use limbs and senses to make observations about the phenomena or changes that occur.	Use all the senses to make qualitative observations with the appropriate tools to explain phenomena or changes that occur.	- Make accurate and relevant qualitative and quantitative observations to identify patterns or sequences of objects or phenomena. - Use complex equipment suitable for making observations proficiently.	- Make qualitative and quantitative observations to make generalisations based on a pattern or sequence on an object or phenomenon. - Present further findings based on observation of objects or phenomena analytically and specifically.
2	Classifying	Collect / isolate evidens / data / objects / phenomena based on the observed characteristics.	Compare / identify similarities and differences based on categories that are based on common characteristics.	Compare / identify similarities and differences to determine the selection criteria for category evidens / data / object /the phenomenon being studied.	Identify characteristics used to differentiate, collect, select and explain the object or phenomenon in greater detail.
3	Measuring and using numbers	Measure with the correct instrument in the correct standard unit.	Measure with the correct instrument in the correct standard unit and using the right technique.	- Measure with the correct instrument in the correct standard unit, using the right technique while recording in a complete and systematic way. - Change the base unit with the correct quantity - Use the correct units.	- Demonstrate how measurements are taken with the correct instrument in the correct standard unit, using the right technique; while recording in a systematic and complete way. - Using more complex derived units in the right manner.

	SCIENCE PROCESS SKILLS	LEVEL 1 YEAR (1 - 3)	LEVEL 2 YEAR (4 - 6)	LEVEL 3 FORM (1 - 3)	LEVEL 4 FORM (4 - 5)
4	Making inferences	Give a reasonable explanation for the observations.	Concluded the initial grounds for the observation using the information obtained	Create more than one initial conclusion that is reasonable for an event or observation using the information obtained.	- Generate a variety of possibilities to explain complex situations - Explain the relationship or pattern between variables observed with measurements made for an investigation.
5	Predicting	Describe a possible outcome for an event or data.	Make a reasonable assumption of an event based on observation, past experience or data.	Students can analyse trends / the flow / simple developments based on the data obtained to predict the future state of an object or phenomenon.	- Students can analyse trends / the flow / simple developments based on the data obtained to predict the future state of an object or phenomenon. - Forecasts made can also be tested.
6	Communicating	Record information or ideas in any form.	Record information or ideas in a suitable form and present the information or the ideas systematically.	Able to present the results of an experiment or data observed in various forms such as simple graphics, pictures or tables	Able to present the results of an experiment or data observed in various forms such as graphics, pictures or tables that are more complex to show how the patterns are related.

	SCIENCE PROCESS SKILLS	LEVEL 1 YEAR (1 - 3)	LEVEL 2 YEAR (4 - 6)	LEVEL 3 FORM (1 - 3)	LEVEL 4 FORM (4 - 5)
7	Use time-space relationships		Arrange occurrences of a phenomenon or event in chronological order.	- Arrange occurrences of a phenomenon or event in chronological order. - Interpret and explain the meaning of mathematical relationships.	Use, analyse and interpret numbers and numerical relationships efficiently while solving problems and conducting investigations.
8	Interpreting data		Select relevant ideas about objects, events or patterns on the data to make an explanation.	Give information rationally by making an intrapolation or an extrapolation of the data collected.	- Analyse data and suggest improvements. - Identify and explain the anomalies in the set of data obtained
9	Define operationally		Describe an interpretation of what is carried out and observed in a situation according to particular specifications.	Describe the most appropriate interpretation of a concept by stating what is carried out and observed for a situation.	Explain the interpretation made about the selection of instruments or methods on what is observed.
10	Controlling variables		Determine the responding and constant variable after the manipulated variable is determined in an investigation.	Determine all variables i.e. responding variable, manipulated variable and constant variable.	Change the constant variable to the manipulated variable and state the new responding variable.

	SCIENCE PROCESS SKILLS	LEVEL 1 YEAR (1 - 3)	LEVEL 2 YEAR (4 - 6)	LEVEL 3 FORM (1 - 3)	LEVEL 4 FORM (4 - 5)
11	Making a hipotesis		Make a general statement that can be tested, on the relationship between the variables in an investigation.	Form a relationship between the manipulated variable and responding variable, to form a hypothesis that can be tested.	Describe expected results of the scientific investigation designed.
12	Experimenting		Conduct an experiment, collect data, interpret the data and summarise to prove the hypothesis and make a report.	Make a hypothesis, select appropriate apparatus, design the method, conduct an experiment, collect data, carry out analysis on the data, make a conclusion and prepare a report.	Identify new problems and design an experiment to test the hypothesis of these problems.

SCIENTIFIC ATTITUDES AND NOBLE VALUES

Experiences from learning science can foster positive attitudes and positive values in pupils. Positive attitudes and values fostered are as the following:

1. Interest and curiosity towards the environment
 - Inquiring from teachers, friends and others
 - Self reading
 - Collects materials or specimens for research.
 - Do their own research
2. Honest and accurate in recording and validating data.
 - Describe and record what have been observed.
 - Data that recorded is not affected by emotion or imagination.
 - Explain observations rationally.
 - Make documentation of information resources used.
3. Flexible and open-minded
 - Accept others opinion.
 - Manage to change one stand based on convinced proof.
 - Not prejudice.
4. Diligent and persevere when carrying out a task.
 - Do not give up.
 - Ready to repeat the experiment
 - Determine during carry out a task
 - Ready to accept critics and challenges.
 - Try to overcome problems and challenges.
5. Systematic, confident and ethic
 - Carry out activity in a systematic and orderly and abide to suitable time.
 - Arrange apparatus and materials in order.
 - Confident with the task given.
 - Dare to try.
 - Dare to defend what is being done.
6. Cooperative
 - Assist teachers and friends.
 - Work together in carrying out activities and experiments.
 - Selfless.
 - Fair and just.

7. Being responsible about the safety of oneself, others and the environment.

- Personal safety and partners.
- Preserve and conserve the environment .

8. Virtuous

- Love all life.
- Poise and respect.

9. Appreciating the contribution of science and technology.

- Use science and technology invention with good manners.
- Use public facilities invented through science and technology responsibly.

10. Appreciate God's gifts .

- Content with what is given by God.
- Use God's gifts wisely.
- Thankful to God.

11. Appreciate and practise clean and healthy living.

- Care for self hygiene and health.
- Be sensitive to personal hygiene and environment.

12. Realising that science is a means to understand nature.

- Stating how science is use to solve problems.
- Stating the implications of using science to solve a problem or issue.
- Communicate through correct scientific language.

The assimilation of scientific attitudes and noble values generally take place according to the following stages:

- Realise and understand the important and need for scientific attitudes and noble values.
- Give attention to attitudes and noble values.
- Appreciate and practise the scientific attitudes and noble values.

Proper planning is required to optimise the assimilation of scientific attitudes and noble values during science teaching and learning. Teachers should examine all the learning outcomes in a field related learning including learning standards on the application of scientific attitudes and values before starting a lesson.

21st CENTURY SKILLS

One of the KSSM's intentions is to produce pupils who have 21st century skills, focusing on thinking skills as well as life skills and inculcating noble values in their careers. 21st century skills aim to produce pupils who have the characteristics specified in the pupil profile as shown in Table 7 that enable them to compete globally. Acquiring the CS and LS in the Science curriculum contributes to the acquisition of 21st century skills among pupils.

Table 7: Pupils' Profile

PUPIL'S PROFILE	DESCRIPTION
Resilient	Able to face and overcome difficulties and challenges with wisdom, confidence, tolerance and empathy.
Communicator	Able to voice out and express their thoughts, ideas and information confidently and creatively in verbal and written, using a variety of media and technology.

PUPIL'S PROFILE	DESCRIPTION
Thinker	Able to think critically, creatively and innovatively; solve complex problems and make ethical decisions. Think about learning and about being learners themselves. Generate questions and are receptive towards perspective, values and individual traditions and society. Confident and creative in handling new learning areas.
Teamwork	Cooperate effectively and harmoniously with others. Share collective responsibility while respecting and appreciating the contributions of each member in the team. Acquire interpersonal skills through collaborative activities, which in turn mould them into better leaders and team members.

PUPIL'S PROFILE	DESCRIPTION
Curious	Develop natural curiosity to explore strategies and new ideas. Learn skills that are needed to carry out inquiry and research, as well as display independent traits learning. Enjoy continuous life-long learning experiences.
Principled	Honest and have integrity, equality, fair and respect the dignity of individuals, group and community. Responsible for their actions, consequences and decisions.
Informative	Knowledgeable and form wide understanding which is balanced across various disciplines. Explore knowledge on local and global issues effectively and efficiently. Understand ethical issues/laws related to the information gained.

PUPIL'S PROFILE	DESCRIPTION
Caring/ Concern	Show empathy, compassion and respect towards needs and feelings of others. Committed to serve the society and ensure sustainability of nature.
Patriotic	Portray love, support and respect towards the country.

HIGHER ORDER THINKING SKILLS

Higher Order Thinking Skills (HOTS) is explicitly stated in the curriculum to encourage teachers to incorporate them in teaching and learning, hence stimulating structured and focused thinking among pupils. Description of HOTS is focused on four levels as shown in Table 8.

Table 8: Thinking levels in HOTS

THINKING LEVEL	DESCRIPTION
Applying	Using knowledge, skills and values to take actions in different situations.
Analysing	Breaking down information into smaller parts to enhance understanding and make relationship between the parts.
Evaluating	Using knowledge, experience skills and values to consider, make decisions and give justifications.
Creating	Producing ideas, products or methods and innovatively.

HOTS are the ability to apply knowledge, skills and values for reasoning and reflecting in solving problems, making decisions, innovating and creating. HOTS includes critical thinking, creative thinking, reasoning and thinking strategy.

Critical thinking skill is the ability to evaluate an idea in a logical and rational manner to make a fair consideration by using reason and reliable evidence.

Creative thinking skill is the ability to produce or create something new and valuable by using genuine imaginative skill and unconventional thinking.

Reasoning skill is the ability of an individual to consider and evaluate logically and rationally.

Thinking strategy is a way of thinking that is structured and focused to solve problems.

HOTS can be applied in classrooms through activities in the form of reasoning, inquiry learning, problem solving and projects. Teachers and pupils need to use the thinking tools such as thinking maps and mind maps, including high level questioning to encourage pupils to think.

TEACHING AND LEARNING STRATEGIES

Teaching and learning strategies in the science curriculum emphasise on thoughtful learning. Thoughtful learning is a process that helps pupils acquire knowledge and master skills that will help them develop their minds to the optimum level. Thoughtful learning can take place through various learning approaches such as inquiry, constructivism, science, technology and society, contextual learning and mastery learning. Learning activities should therefore be geared towards activating pupils' critical and creative thinking skills and not be confined to routine method. Pupils should be made aware of the thinking skills and thinking strategies that are being used in their learning.

They should be challenged with higher order questions and problems and be required to solve problems creatively and critically. Pupils should be actively involved in the teaching and learning that integrate the acquisition of knowledge, mastery of skills and inculcation of scientific attitudes and noble values.

Inquiry Approach

Inquiry-discovery approach emphasises learning through experiences. Inquiry generally means to find information, to question and to investigate a phenomenon. Discovery is the main characteristic of inquiry. Learning through discovery occurs when

the main concepts and principles of science are investigated and discovered by pupils themselves. Through activities such as experiments, pupils investigate a phenomenon and draw conclusions by themselves. Teachers then lead pupils 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-discovery 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 or through guided inquiry-discovery to pupils.

Constructivism

Constructivism is an ideology that suggests pupils learn by building their own understanding that is meaningful to them. The important attributes of constructivism are:

- Teachers considered pupils' prior knowledge.
- Learning is the result from pupil's own effort.
- Learning occurs when pupils restructure their existing ideas by relating new ideas to old ones.
- Pupils have the opportunities to cooperate, share ideas and experiences and reflect on their learning.

Contextual Learning

Contextual learning is an approach that associates learning with pupil's everyday life. This approach involves investigative learning as in the inquiry-discovery approach. In contextual learning, the relationship between knowledge taught and everyday life is explicitly demonstrated. In this context, pupils not only learn in theory but learn to appreciate the relevance of science in their lives.

Mastery Learning

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

STEM APPROACH

STEM approach is the teaching and learning method which applies integrated knowledge, skills and values of STEM through inquiry, problem solving or project in the context of daily life, environment and local as well as global community, as shown in Diagram 4.

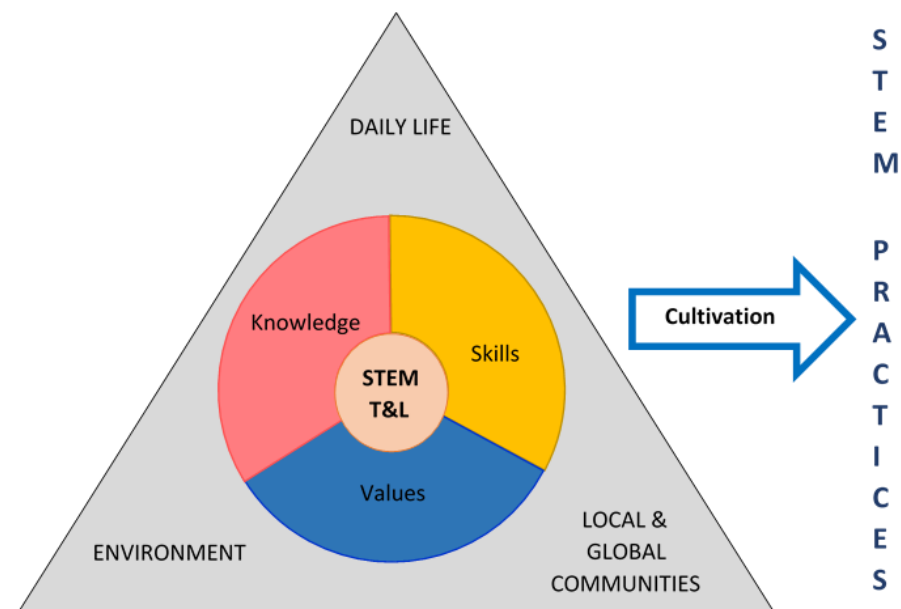


Diagram 4: STEM Teaching and Learning Approach

STEM T&L which is contextual and authentic is able to encourage in depth learning amongst pupils. Pupils can work in groups or individually according to their ability to cultivate the STEM practices, as follows:

1. Questioning and identifying problems,
2. Developing and using models,
3. Planning and carrying out investigations,
4. Analyzing and interpreting data,
5. Using mathematical and computational thinking,
6. Developing explanation and designing solutions,
7. Engaging in argument and discussion based on evidence, and
8. Acquiring information, evaluating and communicating about the information.

Various T&L methods are able to elevate pupils' interest towards science. Less interesting science lessons will not motivate pupils to study which will affect the pupils' performance. The T&L methods should be based on the curriculum content, pupil's ability and multiple intelligences, as well as resources and facilities available.

Explanation of the T&L methods in science is as follows:

Scientific Investigation/Experiment

An experiment is a method commonly used in science lessons. Pupils test hypotheses through investigations to discover specific science concepts and principles. Scientific methods are used when conducting an experiment involving thinking skills, science process skills, and manipulative skills.

In general, procedures to follow when conducting an experiment as in Figure 4:

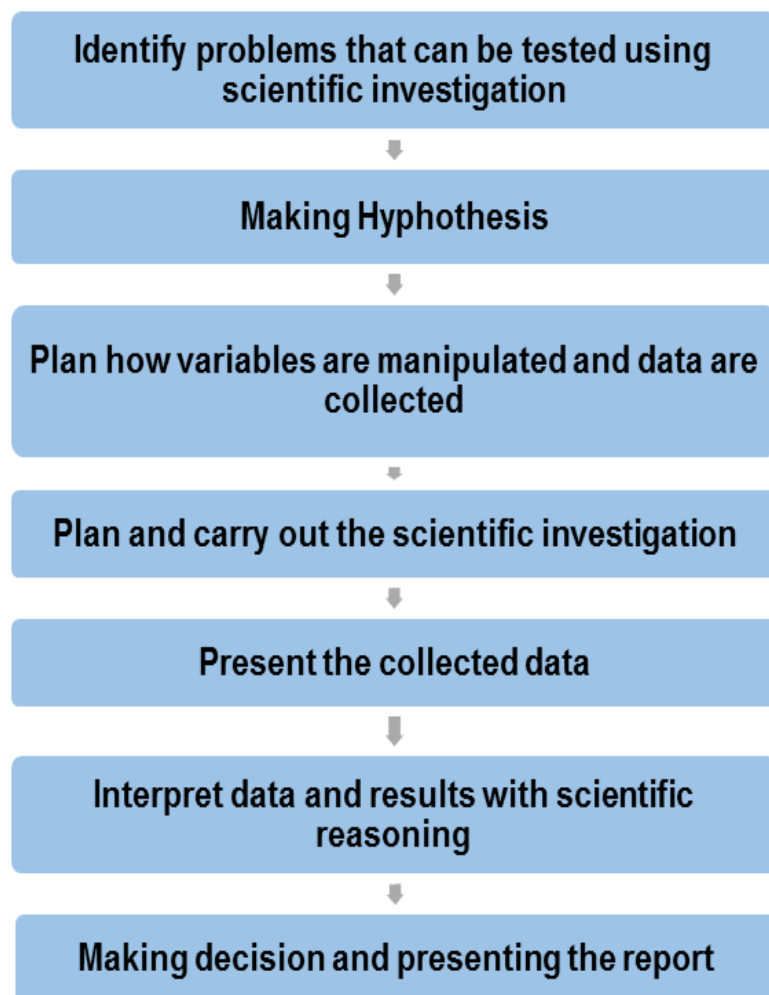


Figure 4: Steps to carry out an experiment

In this standard curriculum, it is suggested that, besides guiding pupils to carry out experiments, pupils are given the opportunity to design experiments, which involves drafting their own experimental method, the data that can be measured, how to analyse data and how to present the results of their experiments.

Simulation

Simulation is an activity that resembles the actual situation. Simulations can be carried out through role-play, games or use of model. In role-play, pupils act out a particular role spontaneously based on a certain pre-determined conditions. Games require procedures that need to be followed. Pupils play games in order to learn a particular principle or to understand the process of decision-making. Models are used to represent objects or real situations. Pupils will be able to visualise the real situation, thus understanding the concepts and principles learned.

Project (Collaborative Learning)

A project is an activity carried out individually or in groups to achieve a certain goal that takes a long time and exceeds formal teaching hours. Pupils are required to identify methods to solve the problem given and thus plan the entire project. The outcome of the project either in the form of a report, an artefact or in other forms needs to be presented. Projects encourage the development of problem solving skills, time management skills and self learning.

Visits and Use of External Resources

Learning science through visits to zoos, museums, science centres, research institutes, mangroves swamps and factories can make learning more effective, enjoyable and meaningful. Learning through visits can be optimised by careful planning whereby pupils have to carry out or perform tasks during the visit. Discussion after the visit should be held to conclude the activities carried out.

The Use of Technology

Technology is an effective tool for enhancing the learning of science. Through the use of technology such as the television, radio, video, computer, internet, computer software, courseware and computer interfaces make the teaching and learning of science more interesting and effective. Animation and computer simulation is an effective tool for learning of difficult and abstract science concepts and can be presented in the form of courseware or website. Software applications such as word processors, graphic presentation software and electronic spreadsheets are valuable tools for the analysis and presentation of data. The use of other technologies such as data loggers and computerized user interface in experiments and projects can assist effective in science teaching and learning.

ELEMENTS ACROSS THE CURRICULUM

Elements Across the Curriculum (EMK) is a value-added element applied in the teaching and learning process other than those specified in the standard content. The application of these elements is aimed at strengthening the human capital skills and competency as well as intended to prepare pupils for the challenges of the present and the future. The elements are explained below:

1. Language

- The accuracy of the language in instruction should be a priority in all subjects.
- During the teaching and learning of each subject, emphasis is given on the aspects of pronunciation, sentence structure, grammar and the terminology of the language in order to assist pupils organise ideas as well as communicate effectively.

2. Environmental Sustainability Awareness

- Developing awareness towards the love of the environment in the pupils' lives needs to be nurtured through the teaching and learning process in all subjects.
- Knowledge and awareness on the importance of the environment would help to shape pupils' ethics in appreciating nature.

3. Noble Values

- Noble values need to be emphasised in all subjects to ensure that pupils will be aware of the importance of these good principles and therefore will practise these elements in their lives.
- Noble values encompass the aspects of spirituality, humanity and citizenship will be the centre core of the pupils' daily life.

4. Science and Technology

- The increase of interest in the science and technology will help to improve scientific and technological literacy amongst pupils.
- The use of technology in teaching can help and contribute to efficient and effective learning.
- The integration of science and technology in the teaching and learning process covers four areas, namely:
 - (i) The knowledge of science and technology (facts, principles, concepts related to science and technology);
 - (ii) Scientific skills (process of thought and specific manipulative skills);

(iii) Scientific attitudes (such as accuracy, honesty, security); and the use of technology in classrooms.

(iv) The use of technology in teaching and learning activities.

5. Patriotism

- Patriotism can be nurtured through all subjects, extra-curricular activities and community services
- Patriotism develops the spirit of love for the country as well as encourages the feelings of 'truly proud to be Malaysians' amongst pupils.

6. Creativity and Innovation

- Creativity is the ability to use imagination in gathering, extracting and generating ideas or creating new or original ideas or through combination of ideas.
- Innovation is the application of creativity through the modification and practice of ideas.
- Creativity and innovation are always inter-connected. Therefore, there is a need to ensure that human capital development is able to meet the challenges of the 21st Century.
- Elements of creativity and innovation should be integrated in the teaching and learning in the classroom.

7. Entrepreneurship

- The incorporation of entrepreneurship elements aims at developing specific attributes and entrepreneurial mind-set that will become a culture amongst pupils.
- Entrepreneurial attributes can be ingrained during lessons through fostering attitude such as diligence, honesty, trustworthiness and responsibility as well as developing creative and innovative mind-set to drive ideas into the market economy.

8. Information and Communication Technology Skills (ICT)

- Information and communication technology elements are incorporated in the lessons to ensure pupils are able to apply and strengthen their basic knowledge and skills in ICT.
- The application of ICT in the lesson does not only motivate pupils to be creative but stimulates interesting and fun teaching and learning as well as improve the quality of learning.
- ICT should be integrated in the lessons based on appropriate topics to be taught to further enhance pupils' understanding of the content subject.

9. Global Sustainability

- The element of Global Sustainability aims to produce pupils with sustainable thinking, responsive towards the surrounding environment in daily life by applying knowledge, skills and values through sustainable **Consumption and Production** element, global citizenship and unity.
- The element of Global Sustainability is crucial in preparing pupils to face challenges and current issues at local, national and global level.
- This element is taught directly or indirectly in related subjects.

10. Financial Education

- Incorporation of Financial Education element aims to produce future generations capable of making wise financial decisions, practise ethical financial management and skills in managing financial affairs in a responsible manner.
- Financial Education element can be incorporated directly or indirectly into T&L. Direct incorporation of this element is through topics such as money with financial elements explicitly such as calculations of simple interest and compound interest. Indirect infusion of this element can be integrated through other topics across the curriculum. Exposure to financial management in real life is important to prepare pupils with knowledge, skills and values which can be applied effectively and meaningfully.

ASSESSMENT

Assessment or evaluation is the process of gathering information through variety of methods such as homework, presentations, projects, tests and others. Assessment is a yardstick to assess pupils' achievement in obtaining knowledge, skills and ethics besides assessing the activities carried out during teaching and learning. Assessment supports pupils' learning and provides valuable feedback to stakeholders such as administrators, teachers, pupils and parents/guardians about pupils' progress and achievement.

The main purpose of formative assessment is to monitor the pupil's learning. Therefore, it is important for teachers to design a valid, reliable and authentic assessment instruments. Information gathered through formative assessment should assist teachers to determine pupil's strengths and weaknesses in achieving the content standard for any subject. The information gathered should assist teachers in adapting teaching and learning based on the needs and weaknesses of their pupils.

Assessment in KSSM consists of four components:

- School Assessment;
- Central Assessment;

- Physical, Sports and Co-Curricular Activity Assessment; and
- Psychometric Assessment.

A summative assessment is to evaluate pupil's learning with the context standard for a particular subject.

A detailed assessment should be well planned and carried out continuously as part of the activities in classrooms. Teachers' efforts in implementing a holistic assessment assist to correct weaknesses in pupils, forming a conducive and balanced learning ecosystem.

Efforts to ensure the assessments assist pupils to increase their potentials and performances, teachers should use assessment strategies that have these following characteristics:

- Various techniques.
- Fair to all pupils.
- Consider various cognitive levels.
- Enable pupils to exhibit a variety of learning abilities.
- Consider the knowledge and skills acquired by pupils and assess the level of their understanding.

Science assessments in schools rely on three main domains, which are **knowledge, skills and values**. Knowledge assessment in certain themes includes the integration of science process skills, aimed in determining the level of pupils' understanding in specific content standard holistically. (Refer Table 10)

All experiments/ scientific investigation described in the notes **MUST** be carried out using the inquiry approach. List of experiments/scientific investigation for each theme are shown in Table 9. However the assessment of scientific skills and values and practices will be assessed only **twice a year** for any theme referring to Table 11.

Scientific attitude and moral value can be assessed any suitable time in whole year referring to Table 12

Learning based project focus on development of product to solve real life problem. Pupils are encourage to do learning at least twice a year.

Table 9: List of experiments/ scientific investigation

THEME	EXPERIMENTS
MAINTENANCE AND CONTINUITY OF LIFE	3.1.2 Test the presence of starch, glucose, protein and fat in food.
	3.4.1 Conduct experiments to explain the process of absorption of the product of digestion
EXPLORATION OF ELEMENTS IN NATURE	5.1.2 Conduct experiments to study the evaporation process in daily life.
	5.2.2 Conduct experiments to determine factor that effect the rate of solubility.
ENERGY AND SUSTAINABILITY OF LIFE	7.3.3 Conduct experiments on uses of magnets and electromagnet in daily life.
	8.2.5 Conduct experiments on pressure and their application in daily life.

The General Statement to Interpret the Achievement of Knowledge Level for Science Subject is shown in Table 10.

Table 10: Rubric for Knowledge

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the basic knowledge and science skills.
2	Understand the science knowledge and skills as well as to explain their understanding.
3	Apply knowledge and skills to perform simple science tasks.
4	Analysing science knowledge and skills in the context of problem solving
5	Evaluating the science knowledge and skills in the context of problem solving and making decision to perform a task
6	Inventing by using science knowledge and skills in the context of problem solving and making decision or in performing the tasks in a new situation creatively and innovatively

The General Statement to interpret the achievement for Scientific Investigation for Science Subject is shown in Table 11.

Table 11: Rubric for Scientific Investigation

PERFORMANCE LEVEL	DESCRIPTOR
1	- Plan the strategy and procedure that is not accurate in the scientific investigation. - Use materials and apparatus that is not suitable in the scientific investigation. - No data collected and recorded. - No explanation or the explanation is not clear.
2	- Plan the correct strategy and procedure in the scientific investigation with guidance. - Use the suitable material and apparatus. - Collect and record incomplete data or not relevant. - Made interpretation and conclusion not based on the collected data.
3	- Plan and execute the correct strategy and procedure in the scientific investigation with guidance. - Use the correct material and apparatus. - Collect and record relevant data. - Organise data in numerical form or visual with some error. - Interpret data and make conclusion based on the collected data. - Write an incomplete scientific investigation report.

PERFORMANCE LEVEL	DESCRIPTOR
4	- Plan and execute the correct strategy and procedure in the scientific investigation. - Handle and use the correct material and apparatus to get an accurate result. - Collect relevant data and record in a suitable format. - Organise the data in the numerical form or visual with no error. - Interpret the data and make an accurate conclusion based on the aim of the scientific investigation. - Write a complete report on the scientific investigation.
5	- Carry out the scientific investigation and write a complete report. - Collect, organise and present the data in the form of numerical or visual accurately and done well. - Interpret the data and make conclusion accurately with scientific reasoning. - Identify the trend, pola and making connection with the data.

PERFORMANCE LEVEL	DESCRIPTOR
6	- Justify the outcome of the scientific investigation relating to theory, principle and law of science in the reporting. - Evaluate and suggest way to improve to the scientific investigation methods and further inquiry investigation if needed. - Discuss on the validity of the data and suggest way to improve the method of collecting data.

The General Statement for Scientific Investigation for Scientific Attitude and Noble Values is shown in Table 12.

Table 12: Rubric for Scientific Attitude and Noble Values

PERFORMANCE LEVEL	DESCRIPTOR
1	Pupil is notable to: - state how science is used to solve problems. - state the implication of using science to solve problem or certain issues. - use science language to communicate - document the source of information used.
2	Pupil is less able to: - state how science is used to solve problems. - state the implication of using science to solve problem or certain issues. - use science language to communicate - document the source of information used.

PERFORMANCE LEVEL	DESCRIPTOR
3	Pupil is able to: - state how science is used to solve problems. - state the implication of using science to solve problem or certain issues. - use limited science language to communicate - document a few sources of information used.
4	Pupil is able to: - determine how science is used to solve problems or certain issues. - determine the implication of using science to solve problem or certain issues. - always use sufficient science language to communicate. - document parts of the sources of information used.
5	Pupil is able to: - Conclude how science is used to solve problems or certain issues. - conclude the implication of using science to solve problem or certain issues. - always use good science language to communicate. - document most the sources of information used.

PERFORMANCE LEVEL	DESCRIPTOR
6	Pupil is able to: - Conclude how science is used to solve problems or certain issues. - discuss and analyse the implication of using science to solve problem or certain issues. - Always use the correct science language to communicate clearly and accurately. - document all the sources of information. - become a role model to other pupil.

OVERALL PERFORMANCE LEVEL

Overall performance level must be determined to give a value of performance level to pupil at the end of the school session. This overall performance level includes content, scientific skills, scientific value and noble value. Thus, teacher needs to evaluate pupil collectively and holistically through all aspect during learning process continuously by various method such as achievement in topical test, observation, exercise, presentation, response verbally from the pupil and group work. Teacher can make professional consideration to evaluate overall performance level based on teacher experience with pupil, intelligence and discussing with other teacher.

ORGANISATION OF SCIENCE CURRICULUM STANDARD

The content for the Science Curriculum Standard Form 1 to Form 5 is built based on the four discipline of science that is Biology, Chemistry, Physics and Earth Science. All four discipline are arranged into five themes that are Scientific Methodology, Maintenance and Continuity of Life, Exploration of Elements in Nature, Energy and Sustainability of Life and Exploration of Earth and Outer Space. However, in every learning year it need not consist of all five themes.

Every theme is divided into a few learning areas.

Learning area in every theme is detailed out in the Content Standard dan Learning Standard. The Content Standard may have one or more learning standards that had been conceptualized based on the learning area.

The Content Standard is written according to the hierarchy in the cognitive and affective domains. The Content Standard statement is the general statement consisting of elements of knowledge, scientific skills, thinking skills, scientific attitude and noble value in line with the intended learning standard.

The learning standard is the learning objective written in the form of measurable behaviour. The learning standard comprised of learning

scope and scientific skills as well as the thinking skills that demands the pupils' need to do science for them to acquire the intended scientific concept. Generally, the learning standard is arranged accordingly through the hierarchy from simple to complex, however the sequence of the Learning Standard could be modified to cater to the need of learning. The Content Standard for the affective domain is normally written at the end of the cognitive domain of that particular Content Standard, however not all Content Standard cognitive domain will end with the affective domain.

The pupil's development is prescribed with one or more qualifier using a word or a phrase that signify a standard in the form of learning outcome. The teaching and learning (t&l) should be planned holistically and integrated to enable a few learning standards be achieved depending on the suitability and needs of learning. Teachers should scrutinise all learning standards and performance standard in the content standard before planning the teaching and learning activities.

The content standard for the affective domain is indirectly integrated when the content standard for the cognitive domain is being carried out. Activities can be varied to achieve one content standard to fulfil the need of learning to suit the pupils's capability and style of learning.

Teachers are encouraged to plan activities that will involve the active participation of pupils to generate thinking analytically, critically, innovatively and creatively besides using technology as a platform to achieve the content standard effectively. The implementation of teaching and learning that requires activities, investigations and experiments that can assist in achieving the learning standards should be carried out to strengthen the pupil's understanding.

The Science Curriculum Standard for Secondary Schools focuses on the achievement of knowledge, skills and values that correspond to the pupil's abilities based on Content Standards, Learning Standards and Performance Standards that are arranged in three columns as shown in Table 13.

Table 13: Organisation of the DSKP

CONTENT STANDARD	LEARNING STANDARD	PERFORMANCE STANDARD
Specific statements about what pupils should know and can do during the schooling period encompassing the knowledge, skills and values.	A predetermined criteria or indicator of the quality in learning and achievement that can be measured for each content standard.	A set of general criteria which reflects the levels of pupils' achievement that they should display as a sign that certain topic has been mastered by pupils (indicator of success).

Figure 5 represents the performance standard placed at the end of every theme in the DSKP.

PERFORMANCE STANDARD	
SCIENTIFIC METHODOLOGY	
Performance Level	Descriptor
1	Recall the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in scientific investigation.
2	Understand the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in scientific investigation.
3	Apply the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in scientific investigation.
4	Analyse the findings of the investigation and concluded that in accordance with the purpose of scientific investigation, on the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in scientific investigation.
5	Evaluate the entire scientific investigation process conducted to determine the steps that can be improved, on the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in scientific investigation.
6	Create improvements on the scientific investigation process being carried out, on the definition of science, science laboratory, physical quantities and units, the use of measuring instruments, density and steps in the scientific investigation ; in the context of problem solving and decision making; with regards to the social values/ economy / culture of the community.

There is also a Notes column that details out among others:

- the limitation and the scope for the content standard and learning standard,
- suggested teaching and learning activities.

In preparing the right and relevant activities and the learning environment to suit the pupils' abilities and interest, teachers need to use their creativity and profesional judgement.

The list of suggested activities is not compulsory and teachers are encouraged to use variety of sources like books and internet in preparing the teaching and learning activities to fulfil the pupils abilities and interest.

Figure 5: Performance Standard for Scientific Methodology

Theme 1:

MAINTENANCE AND CONTINUITY OF LIFE

This theme introduces pupils to biodiversity and the importance of biodiversity. The topic of ecosystem focuses on interdependence among organisms and the environment to create a balanced nature. The role of human in maintaining nature is focused on ensuring the sustainability of living things. The topic of nutrition focuses on digestive system, the importance of balanced diet and also practise healthy lifestyle and good eating habits. The topic of human health introduces the importance of immunisation and relates to current issues about the spreading of diseases.

Learning area:

- 1.0 Biodiversity
 - 1.1 Diversity of organisms
 - 1.2 Classification of organisms
- 2.0 Ecosystem
 - 2.1 Energy flow in ecosystem
 - 2.2 Nutrient cycle in ecosystem
 - 2.3 Interdependence among living organisms and the environment
 - 2.4 Roles of human in maintaining a balanced nature
- 3.0 Nutrition
 - 3.1 Classes of food
 - 3.2 Importance of a balanced diet
 - 3.3 Human's digestive system
 - 3.4 The absorption and transportation of digested foods and defecation
- 4.0 Human health
 - 4.1 Infectious disease and non-infectious disease
 - 4.2 Body defence system

1.0 BIODIVERSITY

CONTENT STANDARD	LEARNING STANDARD	NOTES
1.1 Diversity of organism	A student is able to:	
	1.1.1 Elaborate and communicate about biodiversity.	Carry out a multimedia presentation to discuss: • The definition of biodiversity. • How biodiversity exists. • The importance of biodiversity in terms of: - sources of food, - balanced in nature, - generating economy such as recreation, tourism, biotechnology, medicine, industrial raw materials. - ecological sources. - education. • Malaysia as one of the 12 mega-biodiversity countries in the world needs to be preserved.
	1.1.2 Justify the needs to manage biodiversity effectively.	Carry out activities to discuss: • The effects of human activities on biodiversity, • The methods to conserve and preserve biodiversity including endemic and endangered species.

CONTENT STANDARD	LEARNING STANDARD	NOTES
1.2 Classification of organisms	1.2.1 Differentiate organisms using a dichotomous key based on common characteristics.	Carry out activities to construct the dichotomous key and classify organisms based on common characteristics. Notes: Animal: Vertebrate and invertebrate, Mammal, Reptile, Fish, Bird and Amphibian. Plant: Flowering plant, Non-flowering plant, Monocotyledon and Dicotyledon.
	1.2.2 Characterise the major taxonomy group.	Students use their prior knowledge to carry out activities to identify the characteristics which differentiate the major taxonomy groups. Examples: The characteristics that differentiate between plants, animals and fungi or the differences between Mammal, Reptile, Fish, Bird and Amphibian.

**PERFORMANCE STANDARD
BIODIVERSITY**

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on biodiversity.
2	Understand and explain biodiversity.
3	Apply knowledge on biodiversity and able to carry out simple tasks.
4	Analyse knowledge on biodiversity in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of biodiversity in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on biodiversity in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

2.0 ECOSYSTEM

CONTENT STANDARD	LEARNING STANDARD	NOTES
2.1 Energy flow in ecosystem	A student is able to:	
	2.1.1 Explain with examples of producer, consumer and decomposer.	Notes: Refer to various activities in Module 1 HEBAT Science (Ecosystem). Introduce the terms of primary carnivore and secondary carnivore.
	2.1.2 Interpret food chain and food web.	Carry out activities to show the relationship between organisms in food chains and food web to show the energy transferred from the producer to the consumer.
2.2 Nutrient cycle in the ecosystem	2.2.1 Elaborate and communicate about the role of living things in the oxygen and carbon cycles in the ecosystem.	Carry out multimedia presentation that relates the roles of living things to the water, oxygen and carbon cycle.
	2.2.2 Justify the role of organisms in the water cycle of an ecosystem.	
	2.2.3 Solve problems when there are interferences to the cycles caused by human activities.	Interferences caused by human activities such as: • Uncontrolled deforestation. • Burning of fossil fuels. • Excessive use of water resources for agriculture and domestic consumption.

CONTENT STANDARD	LEARNING STANDARD	NOTES
2.3 Interdependence and interaction among organisms and, between organisms and the environment.	2.3.1 Explain with examples the interdependence among living things and the environment to maintain a balanced ecosystem.	Gather information about: - Species, population, community, habitat and ecosystem. - Balanced in nature. Carry out field studies to investigate habitat, population, community in ecosystems. Discuss interdependence between living organisms and their environment to create a balanced ecosystem.
	2.3.2 Justify the importance of adaptations of living things to the environment.	Conduct scientific investigations to study the effects of natural factors such as temperature, light and humidity on the distribution of animals and plants. Do a multimedia presentation on how animals and plants adapt to the desert, tundra and tropical climates of their habitats.
	2.3.3 Communicate examples of interactions between organisms and apply these interactions in daily life.	Interaction between organisms are: 1) Prey-predator. 2) Symbiosis: Commensalism, mutualism and parasitism. 3) Competition.

CONTENT STANDARD	LEARNING STANDARD	NOTES
		Gather information and do a multimedia presentation on how the interaction of prey-predator is used in biological control of pest. Discuss the advantages of biological control over chemical control, and the prolonged impact of biological control.
	2.3.4 Separate the factors that affect the size of population in an ecosystem.	Factors that affect the size of population are: • Diseases. • Predators. • Food resources. • Drought.
	2.3.5 Predict how the changes in ecosystem affect the existing resources and balance of the population.	Changes in ecosystem such as: • Water supply. • Migration. • Changes of population (effects of increasing and decreasing number of organisms towards a balanced nature). Refer to the Interactive problem solving in Module 1 HEBAT Science (Ecosystem) about interferences in an ecosystem.

CONTENT STANDARD	LEARNING STANDARD	NOTES
2.4 The role of human in maintaining a balanced nature	2.4.1 Justify and communicate that man needs a stable and productive ecosystem to sustain life.	Carry out a role play to discuss the importance of man in managing nature to ensure the sustainability of life. Identify several agencies or stakeholders and the public to solve local or global issues: • Causes of environmental issues. • Impact on the local community. • Proposed methods to solve the problems.

**PERFORMANCE STANDARD
ECOSYSTEM**

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on ecosystem.
2	Understand and explain ecosystem.
3	Apply knowledge on ecosystem and able to carry out simple tasks.
4	Analyse knowledge on ecosystem in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of ecosystem in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on ecosystem in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

3.0 NUTRITION

CONTENT STANDARD	LEARNING STANDARD	NOTES
3.1 Classes of food	A student is able to:	
	3.1.1 Elaborate and communicate about classes of food.	Discuss the classes of food; carbohydrates, protein, fats, vitamins, minerals, fibres and water and state their functions and sources through multimedia presentations. Only the major vitamins (A, B, C, D, E and K) and minerals (calcium, sodium, iron, iodine, phosphorus and potassium) are required. Vitamin B need not be classified into B1, B2 and so forth.
	3.1.2 Test the presence of starch, glucose, protein and fats in food.	Conduct a scientific investigation to test the presence of starch (iodine solution), glucose (Benedict solution), protein (Millon's reagent) and fats (alcohol-elmusion test).
3.2 Importance of a balanced diet	3.2.1 Elaborate and communicate about a balanced diet.	Refer balanced diet to food pyramid or plate portion. Factors affecting calorific requirement are age, size,sex, occupation, climates and state of health.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	3.2.2 Estimate calories of food intake in a meal and plan a balanced diet.	Carry out activities to estimate calorific value of food in a meal. Energy stored in food can be measured in units such as joules or calories. Identify the calorific value or the energy value per gram of carbohydrates, protein and fats. Collect food wrappers that show calorific value of food and make a list to show the calorific value for each type of food. Plan a balanced diet for a day (breakfast, lunch and dinner) based on different factors.
	3.2.3 Conduct a research and justify the importance of a balanced diet, exercise and a healthy lifestyle in order to maintain a healthy body.	Carry out activities to create awareness and emphasise the importance of maintaining health in preventing diseases such as heart disease, hypertension, diabetes, skin cancer and lung cancer. <u>Project-based learning:</u> Obesity among school children is on the rise in Malaysia. This is related to improper diet and lifestyle. Conduct research on obesity among students in school. Relate to eating processed food as well as junk food. Suggest ways to solve this problem at the school's level

CONTENT STANDARD	LEARNING STANDARD	NOTES
3.3 Human's digestive system	3.3.1 Elaborate and communicate about digestion.	Digestion is the breakdown of large food molecules into smaller soluble molecules that can be readily absorbed by the body. Compare the physical and chemical processes of digestion. The flow of food particles in the alimentary canal involved mouth, oesophagus, stomach, small intestine, large intestine and anus. The functions of pancreas, liver and gall bladder need to be explained. The end product of digestion of carbohydrates, protein and fats need to be discussed. Enzymes should only include amylase, protease and lipase. Conduct scientific investigation to show the action of enzyme in saliva on starch.
3.4 Process of absorption and transportation of digested food and defecation	3.4.1 Conduct an experiment to explain the absorption of the end products of digestion.	Study the process of absorption of digested food through a Visking tube to explain the absorption of the end products of digestion in the small intestine

CONTENT STANDARD	LEARNING STANDARD	NOTES
	3.4.2 Relate the function of digestive system, blood circulatory system and respiratory system.	Do a multimedia presentation on the transport of the end products of digestion by blood to body cells for assimilation and respiration. Emphasise on how the systems work together in the digestion process.
	3.4.3 Elaborate and communicate about defecation.	Do a multimedia presentation or simulation on the transport and reabsorption of water by large intestine and the process of defecation. Discuss the following: • The importance of good eating habits to avoid constipation. • Implication to health if unbalanced diet is practised especially without or lacking in fibre.

PERFORMANCE STANDARD
NUTRITION

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on nutrition.
2	Understand and explain nutrition.
3	Apply knowledge on nutrition and able to carry out simple tasks.
4	Analyse knowledge on nutrition in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of nutrition in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on nutrition in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

4.0 HUMAN HEALTH

CONTENT STANDARD	LEARNING STANDARD	NOTES
4.1 Infectious and non-infectious diseases	A student is able to:	
	4.1.1 Differentiate and communicate about infectious and non-infectious diseases.	Infectious diseases: 1) Water – cholera. 2) Air – Tuberculosis, H1N1, SARS, Flu. 3) Body contact - ringworm and fungal infection. 4) Vectors – leptospirosis, dengue, malaria, Zika. Non- infectious diseases: 1) Cancer. 2) Hypertension. 3) Diabetes. 4) Cardiovascular diseases. <u>Project-based learning:</u> Carry out a case study to discuss diseases among Malaysians based on statistics from the Ministry of Health: • Most common diseases in Malaysia, • Types of diseases that can be transmitted, the causes and ways to overcome the diseases.
	4.1.2 Explain how infectious diseases are spread.	
	4.1.3 Separate the cause and spread of infectious diseases.	
	4.1.4 Generate ideas on the mechanism to prevent the spread of infectious diseases.	

CONTENT STANDARD	LEARNING STANDARD	NOTES
		- Predict the progression of diseases based on the Ministry of Health statistical graph. - Suggest ways to solve the problems. http://www.moh.gov.my
4.2 Body defence system	4.2.1 Elaborate and communicate about the function of body defence system.	Carry out multimedia presentations on how body defence system fights against infections and promotes healing. Refer to Module 25 HEBAT Science (Human Health)
	4.2.2 Define antigens, antibodies and immunity.	Gather information on types of immunisation received by children. Based on the children's immunisation schedule, interpret the following: - Relationship between antigens and antibodies. - Effects of repeated immunisation against body defence (introduce the graph of primary and secondary immunisation responses).
	4.2.3 Justify the importance of immunisation.	
	4.2.4 Differentiate passive immunity and active immunity.	

CONTENT STANDARD	LEARNING STANDARD	NOTES
	4.2.5 Justify good practices towards attaining strong immune system.	List practices that can boost or weaken immunity in terms of: • Nutrition (local fruits, cooked food, vegetables). • Physical activities. • Lifestyle.
	4.2.6 Justify and communicate about the importance of immunisation and health level of individuals to the family, social, economy and nation.	Brainstorm the following: • Reccurrence of controlled diseases such as leprosy, whooping cough dan tuberculosis. • The rise in the costs of health care. • Affecting the quality of work. • Insurance purchase. • Quality of life, • Labour force (migration).

PERFORMANCE STANDARD
HUMAN HEALTH

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on human health.
2	Understand and explain human health.
3	Apply knowledge on human health and able to carry out simple tasks.
4	Analyse knowledge on human health in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of human health in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on human health in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

Theme 2:

EXPLORATION OF ELEMENTS IN NATURE

This theme provides understanding of water characteristics and its importance as a solvent in daily life. The use of organic solvent is also introduced. The study of evaporation process look at how the factors that influence the evaporation process are applied in daily life as well as in agriculture. Emphasis is given to water purification method and how clean water is supplied creatively and innovatively. The element of sustainable usage of water is emphasized on to increase pupils' awareness as consumers. The usage of acid and alkali in the context of daily life is introduced.

Learning area:

5.0 Water and solution

- 5.1 Physical characteristics of water
- 5.2 Solution and rate of solubility
- 5.3 Water purification and water supply

6.0 Acid and Alkali

- 6.1. Properties of acid and alkali
- 6.2. Neutralisation

5.0 WATER AND SOLUTION

CONTENT STANDARD	LEARNING STANDARD	NOTES
5.1 Physical characteristics of water	A student is able to:	
	5.1.1 Elaborate and communicate about water.	Collect information and create a multimedia presentation about water: • As basic resources for survival of all living things. • As a compound. • Physical state of water i.e boiling point, freezing point, colour, density, surface tension, capillary action, effect of absorption and heat release on water. Conduct a scientific investigation on water: • Carry out electrolysis to determine the composition of elements in water molecule. • Effect of impurities in the melting point and boiling point of water.
	5.1.2 Carry out experiments and communicate about the water evaporation process in daily life.	Carry out an experiment to study the factors affecting the rate of water evaporation such as humidity, surrounding temperature, surface area and the movement of air.

CONTENT STANDARD	LEARNING STANDARD	NOTES
		Create a multimedia presentation based on the following: • Relate the evaporation process to daily life activities. • How water loss through evaporation process can be reduced in agriculture. • Refrigerators uses evaporation process for cooling.
5.2 Solution and rate of solubility	5.2.1 Explain with example the meaning of solution and solubility.	Carry out a scientific investigation to define: • Solute, solvent, solution and suspension. • Diluted solution, concentrated solution and saturated solution.
	5.2.2 Carry out experiment to determine the factors affecting the rate of solubility.	Carry out an experiment on the factors affecting the rate of solubility such as temperature of solvent, rate of stirring, size of solute.
	5.2.3 Explain with examples the meaning of colloids in daily life.	Carry out activities to identify examples of colloid in daily life like emulsion and foam.
	5.2.4 Elaborate and communicate the uses of water as a universal solvent in daily life and manufacturing industry.	Gather information about water as a universal solvent and give examples on the uses of water as a universal solvent.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	5.2.5 Demonstrate examples of organic solvent and their uses in daily life.	Illustrate examples of organic solvents and their uses in daily life using thinking maps. • Alcohol. • Kerosene. • Acetone. • Turpentine. • Ether. Carry out scientific investigations such as: • Removing dirt caused by certain substance such as lubricant and paint. • Preparation of paint and cosmetics.
5.3 Water purification and water supply	5.3.1 Demonstrate the water purification method.	Carry out activities to produce clean water using the methods of: • Boiling. • Filtration. • Purification. • Chlorination. • Distillation.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	5.3.2 Solve problems in getting water supply for daily life usage.	Find information or brainstorm and create a multimedia presentation on how a country without water can provide water supply by: • Recycling water. • Collecting water from fog. • Collecting water from the sea (Reverse osmosis).
	5.3.3 Build a model and communicate about water supply system.	Find information about different stages involved in water supply system: • Filtration. • Oxidation. • Coagulation. • Sedimentation. • Filtration. • Chlorination. • Fluoridation.
	5.3.4 Justify water sustainability as a key to healthy living.	Discussion and evaluation on the following: • Awareness about water content that is safe to consume. • The effect of water pollution on living things and environment based on real cases such as mercury poisoning in Minamata Bay, Japan.

CONTENT STANDARD	LEARNING STANDARD	NOTES
		• River pollution and River Cleaning Method. • The individual role to ensure the sustainability of water. <u>Project-based learning</u> Carry out water audit activity to determine the amount of water consumed in home or school. Suggest water conservation steps or create a simple innovative method to conserve water and increase efficiency of water usage.

PERFORMANCE STANDARD

WATER AND SOLUTION

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on water and solution.
2	Understand and explain electricity and water and solution.
3	Apply knowledge on water and solution and able to carry out simple tasks.
4	Analyse knowledge on water and solution in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of water and solution in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on water and solution in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

6.0 ACID AND ALKALI

CONTENT STANDARD	LEARNING STANDARD	NOTES
6.1 Properties of acid and alkali	A student is able to:	
	6.1.1 Defining operationally acid and alkali.	Physical properties of acid and alkali - The characteristic of acid in terms of pH value, taste, corrosiveness, effect on litmus paper, reaction with metals i.e: magnesium, zinc. - The characteristic of alkali in terms of pH value, taste, corrosiveness and effect on litmus paper. The properties of acid and alkali are only shown in the presence of water.
	6.1.2 Explain with examples of acidic and alkaline substances.	Carry out activities to determine acidic and alkaline substances in daily life using: - Litmus paper. - Universal indicator. - Methyl orange. - Phenolphthalein. - pH meter.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	6.1.3 Demonstrate the technique to determine the strength of acid and alkali based on pH value.	Carry out activities to study the relationship between pH value and strength of acid and alkali.
	6.1.4 Identify the uses of acid and alkali in daily life.	Gather, interpret and present data about the uses of acid and alkali in daily life including the agricultural and industrial sectors.
6.2 Neutralisation	6.2.1 Explain the neutralization reaction.	Carry out titration experiment using acid and alkali to determine the end point using indicator. Write word equation for neutralisation.
	6.2.2 Explain with examples the use of neutralisation reaction in daily life.	Application of neutralisation in daily life such as: • The use of toothpaste. • Fabric softener and hair conditioner. • Regulate soil pH. • Neutralising industrial waste.

PERFORMANCE STANDARD**ACID AND ALKALI**

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on acid and alkali.
2	Understand and explain electricity and acid and alkali.
3	Apply knowledge on acid and alkali and able to carry out simple tasks.
4	Analyse knowledge on acid and alkali in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of acid and alkali in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on acid and alkali in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

Theme 3:

ENERGY AND SUSTAINABILITY OF LIFE

The aim of this theme is to give an understanding on the basic concepts of the generation of electricity and its uses in daily life. The topic of magnet and its properties is introduced to facilitate understanding about electromagnet and the application of its principle in the basic components of most electrical appliances. Focus is also given on force and its effects in simple machine, pressure, air pressure at different altitudes as well as float and sink. Heat energy is introduced in the form of effect of heat on matter, methods of heat transfer and heat flow in living things. The understanding of sound waves and related phenomena in daily life are also introduced.

Learning area:

7.0 Electricity and magnetism

7.1 Electricity

7.2 Flow of electric current in series circuit and parallel circuit.

7.2 Magnetism

8.0 Force and Motion

8.2 Force

8.2 Effect of force

9.0 Heat

9.1 Relationship between temperature and heat

9.2 Heat flow and heat equilibrium

9.3 Principle of expansion and contraction of matter

9.4 Relationship between types of surface of object with the heat absorption and emission

10.0 Sound waves

10.1 The characteristics of sound waves

10.2 Loudness and pitch of sound

10.3 Phenomena and applications of sound reflection

7.0 ELECTRICITY AND MAGNETISM

CONTENT STANDARD	LEARNING STANDARD	NOTES
7.1 Electricity	A student is able to:	
	7.1.1 Describe and communicate about energy.	Discuss by using multimedia presentation on the following: • Why energy is needed in daily life. • Types of energy. • Sources of energy.
	7.1.2 Explain and communicate about the existence of electrostatic charges.	Carry out activities using materials such as polythene rod, acetate rod, glass rod, balloon to show the existence of electrostatic charges. Carry out activities to determine the existence of electrostatic charges, quantity of electrical charges and types of electrostatic charges using an electroscope.
	7.1.3 Explain with examples on electrostatic in daily life.	Carry out a simulation on lightning formation using a Van de Graff generator or Wimhurst machine. Collect information and solve problems in daily life such as: • Choosing suitable fabric to be worn in low humidity weather. • Prevent vehicle from fire while filling petrol. • Looking for a shelter during thunderstorm. (Faraday's cage concept)

CONTENT STANDARD	LEARNING STANDARD	NOTES
	7.1.4 Draw a conclusion that the flow of charges produce electric current.	Carry out a scientific investigation to relate the flow of charges in an electrical conductor with electric current by using a Van de Graff generator connected to an earthed galvanometer.
	7.1.5 Characterise current, voltage and resistance and their units.	Gather information and carry out activities to discover units for current, voltage and resistance. Measure current and voltage in an electrical circuit using suitable measuring apparatus.
	7.1.6 Draw a conclusion on the relationship between current, voltage and resistance.	Design and carry out experiment to study the effects of changes in: - Resistance on current, - Voltage on current. Discussion on relationship between voltage, current and resistance using Ohm's Law.
7.2 The flow of electric current in series circuit and parallel circuit	7.2.1 Elaborate and communicate about the flow of electric current in series circuit and parallel circuit.	Carry out a scientific investigation to study: - The flow of current by building a complete series circuit and parallel circuit, - Advantages and disadvantages of series circuit and parallel circuit, - Electrical wiring at home, Solve numerical problems related to current, voltage and resistance in series circuit and parallel circuit.

CONTENT STANDARD	LEARNING STANDARD	NOTES
7.3 Magnetism	7.3.1 Draw a conclusion about the characteristics of a magnet.	Carry out the following activities: - Using iron filings to study magnetic field of a bar magnet, - Using compass to show the directions of the magnetic field. Sketch and study the pattern of the magnetic field of various types of magnets such as bar magnet, horseshoe magnet and magnadur magnet.
	7.3.2 Describe and communicate about electromagnet.	Carry out activities to show relationship between: - Magnetic field lines and the strength of magnetic field, - The strength of magnetic force and distance between magnetic field lines. Carry out investigation to study the pattern and direction of a magnetic field produced by a conductor carrying current, a coiled wire and a solenoid. Draw the pattern and mark the direction of the magnetic field produced by a conductor carrying current, a coiled wire and a solenoid.
	7.3.3 Carry out an experiment and communicate about the uses of magnet and electromagnet in daily life.	Investigate the relationship between the strength of a magnetic field with - current flow, - number of turns. Gather information and make multimedia presentation on the uses of magnet and electromagnet in daily life such as in compasses and electric bells.

**PERFORMANCE STANDARD
ELECTRICITY AND MAGNETISM**

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on electricity and magnetism.
2	Understand and explain electricity and magnetism.
3	Apply knowledge on electricity and magnetism and able to carry out simple tasks.
4	Analyse knowledge on electricity and magnetism in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of electricity and magnetism in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on electricity and magnetism in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

8.0 FORCE AND MOTION

CONTENT STANDARD	LEARNING STANDARD	NOTES
8.1 Force	A student is able to:	
	8.1.1 Elaborate and communicate about force.	Carry out an indoor or outdoor activity to show the presence of different types of forces such as gravitational force, weight, normal force, frictional force, elastic force, buoyant force. Refer to Module 12 HEBAT Science (Force).
	8.1.2 Explain that force has magnitude, direction and point of application.	Sketch a diagram to show that force has magnitude, direction and point of application.
	8.1.3 Measure force in S.I. unit.	Carry out an activity using a spring balance to measure force for example, weight of object, frictional force.
	8.1.4 Explain with examples that every action force has an equal (same magnitude) reaction force but in the opposite direction.	Discussion may involve the following situations: • A stationary object on a table, Weight (action force) is the same as normal force (reaction force), • An object floating on water, Weight (action force) is the same as buoyant force (reaction force), • Two trolleys placed on a horizontal runway with a compressed spring between them will move in opposite directions of the same distance when released.

CONTENT STANDARD	LEARNING STANDARD	NOTES
		First trolley acts on the second trolley (action force) and at the same time the second trolley exerts a force of the same magnitude but in different direction (reaction force).
8.2 Effects of force	8.2.1 Elaborate and communicate about the effects of force.	Carry out an activities to study the effects of force on change in shape, position, speed and direction such • moving a stationary toy car, • changing the speed of a moving toy car, • stopping a moving toy car, • changing the direction of a moving toy car, • changing the shape of plasticine.
	8.2.2 Explain and communicate the relationship between the differences in densities and the effects of bouyancy in daily life.	Carry out an activity to determine the buoyant force using a spring balance. (Buoyant force = actual weight – apparent weight) Carry out an investigation to prove that objects denser than water will submerge by using density cubes. Solve problems on how cargo ships are able to maintain afloat at a safe level when travelling in different oceans of different temperatures and densities using a Plimsoll line as a guidance.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	8.2.3 Classify and solve problems on levers based on the position of fulcrum, load and effort.	Discuss various examples of levers according to the classes of lever in daily life. Solve numerical problems using the following formula: $\text{Load} \times \text{Load arm} = \text{Effort} \times \text{Effort arm}$ *(Load arm – distance of load from fulcrum) *(Effort arm – distance of effort from fulcrum)
	8.2.4 Explain and communicate about the moment of force.	When opening a door or loosening a nut using a spanner, we use a force that produces a turning effect. The turning effect is known as the moment of force. Carry out activities to show the relationship between the moment of force and the lever arm length in situations such as opening a door or loosening a nut. $\text{Moment of a force} = \text{force (N)} \times \text{perpendicular distance (m)}$ Refer to Module 12 HEBAT Science(Force)
	8.2.5 Carry out an experiment and communicate about pressure and its application in daily life.	To investigate how the changes in surface area affects the pressure produced when a similar force is applied Introduce formula : $\text{Pressure} = \text{Force} / \text{Surface area}$ Make a multimedia presentation about the applications of pressure in daily life.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	8.2.6 Elaborate and communicate about gas pressure based on the kinetic theory of gas.	Carry out an activity to show that air exerts pressure. Carry out activities to show the factors that affect air pressure, that are; volume and temperature.
	8.2.7 Explain and communicate about the existence of atmospheric pressure and the effects of altitude on the magnitude of pressure.	Carry out activities to show the existence of atmospheric pressure by using Magdeburg hemisphere, suction pump, drinking straw, siphon, syringe, vacuum cleaner. Active reading, video or data analysis to show the relationship between altitude and atmospheric pressure. Solve problems related to air pressure and atmospheric pressure in daily life. Pupils need to use the term of air pressure and atmospheric pressure correctly. Refer to Module 16 HEBAT Science (Atmosphere)
	8.2.8 Explain the effects of depth on liquid pressure.	Carry out an activity to show the changes in the size of an air bubble when the depth of the liquid changes by using a (1 metre) glass tube containing water or oil. Explain with examples the effects of depth on fluid pressure in daily life such as the thickness of walls of the dam, design of the submarine.

PERFORMANCE STANDARD
FORCE AND MOTION

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on force and motion.
2	Understand and explain force and motion.
3	Apply knowledge on force and motion and able to carry out simple tasks.
4	Analyse knowledge on force and motion in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of force and motion in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on force and motion in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

9.0 HEAT

CONTENT STANDARD	LEARNING STANDARD	NOTES
9.1 Temperature and heat	A student is able to:	
	9.1.1 Make a comparison between heat and temperature.	Discuss and share about the following: • Definition of temperature. • Differences between temperature and heat. Refer to Module 7 HEBAT Science (Heat).
9.2 Heat flow and thermal equilibrium	9.2.1 Explain how heat flows from a hot region to a cold region.	Carry out activities to show heat transfer by • Conduction. • Convection. • Radiation.
	9.2.2 Explain and communicate about heat flow in natural phenomena.	Carry out group activities to discuss natural phenomena such as land breeze, sea breeze and warming of earth by the sun.
	9.2.3 Communicate about heat conductors and heat insulators and their uses in daily life.	Carry out group activities to discuss the following: • Definition of heat conductor. • Definition of heat insulator. • Various uses of heat conductors and insulators in daily life. Carry out investigations to study the uses of different materials as heat insulators.

CONTENT STANDARD	LEARNING STANDARD	NOTES
9.3 Principle of expansion and contraction of matter	9.3.1 Explain how heat can cause the expansion and contraction in solid, liquid and gas.	Carry out activities to show heat can cause solid, liquid and gas to expand and contract.
	9.3.2 Communicate about the various uses of expansion and contraction of matter in daily life.	Discuss the uses of expansion and contraction of matter: • Mercury in thermometers. • Bimetallic strip in fire alarms. • Gap between railway tracks. • Roller on steel bridges. Discuss the uses of principle of expansion and contraction of matter in solving simple problems.
9.4 Relation between the types of surfaces of objects to heat absorption and emission.	9.4.1 Demonstrate how dark, dull objects absorb heat better than white, shiny objects.	Carry out an activity to show: • Dark and dull objects absorb heat better than white and shiny objects. • Dark and dull objects radiate heat better than white and shiny objects.
	9.4.2 Demonstrate how dark, dull objects radiate heat better than white, shiny objects.	

CONTENT STANDARD	LEARNING STANDARD	NOTES
	9.4.3 Conceptualise and design using the heat concept in daily life.	<u>Project-based learning:</u> The Green House Concept fulfills a few criteria such as energy efficiency, water efficiency, sustainable construction site, construction materials, innovation, etcetera. Design a 'Green Home' which uses minimum energy to keep the house cool or vice-versa. A pupil is able to design or make innovation in the local or global context.

PERFORMANCE STANDARD

HEAT

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on heat.
2	Understand and explain heat.
3	Apply knowledge on heat and able to carry out simple tasks.
4	Analyse knowledge on heat in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of heat in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on heat in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

10.0 SOUND WAVES

CONTENT STANDARD	LEARNING STANDARD	NOTES
10.1 Characteristics of sound waves	A student is able to:	
	10.1.1 communicate about the basic characteristics of sound waves.	Carry out an activity to explain that sound waves: • Need a medium to travel. • Can be reflected. • Can be absorbed by different types of Surface. • Have different speed in different médium. Refer to Module 28 HEBAT Science (Sound).
10.2 Loudness and pitch of sound	10.2.1 Explain frequency and its unit, and amplitude of vibration.	Carry out scientific investigations using audio generator, oscilloscope and amplifier to study the characteristics of sound waves where the oscilloscope shows the different patterns of sound waves (amplitude and frequency) and loudness of sound (amplitude).
	10.2.2 Relate frequency to pitch.	
	10.2.3. Relate amplitude to loudness.	
	10.2.4 Explain with examples loudness and pitch using musical instruments.	Carry out activities to show loudness and pitch using musical instruments such as piano, recorder, drum and guitar.

CONTENT STANDARD	LEARNING STANDARD	NOTES
10.3 Phenomena and applications of reflection of sound waves	10.3.1 Explain with example phenomena related to reflection of sound waves such as echo and Doppler effect	Explain with example/video on echo phenomena in daily life. Carry out an activity to compare the pitch of an ambulance siren/air horn/ a fast moving motorcycle engine passes an observer. An increase (or decrease) in the frequency of sound as the moving source and observer move towards (or away from) each other is known as Doppler Effect.
	10.3.2 Explain with example the applications of reflection of sound waves	Conduct video simulation to show the uses of sonar in shipping industry and fisheries, sonogram in medical field and how bats estimate distance while flying.
	10.3.3 Elaborate and communicate about limitations of hearing for humans and animals	Make a multimedia presentation on the following: • The limitations of hearing for human and animals. • Ways to overcome human limitations of hearing.
	10.3.4 Explain with examples ways to overcome human limitations of hearing	

PERFORMANCE STANDARD
SOUND WAVES

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on sound waves.
2	Understand and explain sound waves.
3	Apply knowledge on sound waves and able to carry out simple tasks.
4	Analyse knowledge on sound waves in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of sound waves in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on sound waves in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

Theme 4:

EARTH AND SPACE EXPLORATION

This theme aims to give understanding about the Universe, Stars and Solar System. Emphasis is given to the existence of various types of galaxies and how the stars are classified. The planets in the Solar System are studied to create awareness that only planet Earth can support life and continuity of life. The main focus is also given to other objects in the Solar System and how they influence life on Earth. To encourage pupils' critical and creative thinking, hypothetical questions or anomalies are introduced.

Learning area:

11.0 Stars and Galaxies in the Universe

12.0 Solar System

13.0 Meteoroid, Asteroid, Comet

11.0 STARS AND GALAXIES IN THE UNIVERSE

CONTENT STANDARD	LEARNING STANDARD	NOTES
11.1 Stars and galaxies in the universe	A student is able to:	
	11.1.1 Communicate about the characteristics of objects in space.	Gather information from technology devices such as the telescope to expand ideas about objects in space, for example: - galaxies including the Milky Way, - nebula, - life cycle of stars (Nebula Hypothesis). Galaxies and types of galaxies, such as, elliptical, spiral and irregular galaxies. State the position of the Solar System in the Milky Way Galaxy. Compare the relative sizes between Earth , planets, Solar System, Milky Way Galaxy and the Universe. Amazed by the universe that God has created.
	11.1.2 Compare and contrast the characteristics of stars (including the Sun) and relate them to the observation of stars on the Earth.	Characteristics of stars include temperature, size, distance, colour and brightness. Surf Skychart, Stellarium (free astronomy software), and Earth Centred Universe (ECU) to get information about the similarities and differences on the characteristics of stars. Visit an Observatory or planetarium to observe objects in the sky during the day and night.

PERFORMANCE STANDARD
STARS AND GALAXIES IN THE UNIVERSE

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on stars and galaxies in the universe.
2	Understand and explain stars and galaxies in the universe.
3	Apply knowledge on stars and galaxies in the universe and carry out simple tasks.
4	Analyse knowledge on stars and galaxies in the universe in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of stars and galaxies in the universe in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on stars and galaxies in the universe in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community

12.0 SOLAR SYSTEM

CONTENT STANDARD	LEARNING STANDARD	NOTES
12.1 Solar System	A student is able to:	
	12.1.1 Compare distances between the Sun and the planets in the Solar System using astronomical units (a.u.) and light years.	Astronomical unit and light years as measures of distance in space. Carry out calculations by converting units between a.u or light years to kilometres. Refer to Modul 17 HEBAT Sains (Solar System).
	12.1.2 Construct a table to compare and contrast the planets in the Solar System with the Earth.	Characteristics used for comparisons: Size, distance, temperature, density, relative gravitational pull to the Earth, atmospheric layers, surface condition, direction and speed of planet rotation and revolvment of planets in their own orbits including natural satellites of each planet.
	12.1.3 Explore the possible relationship based on the planets' characteristics and explain the relationship including anomalies that may arise.	Examples of relationships between characteristics: • Temperature and distance from the Sun, • Density and gravitational pull, • Distance, time and speed, • Direction of rotation.

CONTENT STANDARD	LEARNING STANDARD	NOTES
	12.1.4 Reason and make analogies in hypothetical situations related to the Solar System.	<u>Problem-based learning:</u> Rotations, action forces and movement can be predicted from data collected based on understanding of the Solar System. Discuss the example of hypothetical situations as follows: • What will happen if the Earth stops rotating? Rotates at a slower pace? • Why are there planets with two or more moons? • If you are on the Moon, explain your observation on the shape of the Earth? • Will you see phases of the Earth if you are on the Moon?
	12.1.5 Justify the Earth as the most ideal planet for life based on data collected.	Conduct brainstorming session on the following: Whether other planets can sustain life if natural sources on Earth have depleted – discussion is focused on sustainable living. Realise the role of each individual as a prudent consumer in managing nature and the importance of reducing ecological footprint.

PERFORMANCE STANDARD

SOLAR SYSTEM

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on the solar system.
2	Understand and explain the solar system.
3	Apply knowledge on the solar system and able to carry out simple tasks.
4	Analyse knowledge on the solar system in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of the solar system in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on the solar system in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

13.0 METEOROID, ASTEROID, COMET

CONTENT STANDARD	LEARNING STANDARD	NOTES
13.1 Other objects in the Solar System: Meteoroids, Asteroids and Comets	A student is able to:	
	13.1.1 Communicate on other objects in the solar system, such as meteoroids, asteroids and comets.	Prepare and share a multimedia presentation to: (a) compare and contrast between meteoroid, asteroid and comet, (b) predict what will happen to the Earth if it is hit by meteoroid, asteroid and comet.
	13.1.2 Discuss the movements of meteoroids, asteroids and comets and their effects on the Earth based on data.	Make observations on meteors at night or visit a planetarium. Use multimedia presentations on the movements of meteoroids.
	13.1.3 Generate ideas on how to reduce or prevent the possibility of asteroids colliding with the Earth.	Collect information and carry out multimedia presentation on the phenomena of asteroids and other objects colliding with the Earth. Meteorites is introduced.

PERFORMANCE STANDARD
METEOROID, ASTEROID, COMET

PERFORMANCE LEVEL	DESCRIPTOR
1	Recall the knowledge and science skills on meteoroid, asteroid and comet.
2	Understand and explain meteoroid, asteroid and comet.
3	Apply knowledge on meteoroid, asteroid and comet and able to carry out simple tasks.
4	Analyse knowledge on meteoroid, asteroid and comet in context of problem solving on events or natural phenomena.
5	Evaluate knowledge of meteoroid, asteroid and comet in context of problem solving and decision making to carry out a task.
6	Design a task using knowledge and science skills on meteoroid, asteroid and comet in a creative and innovative way in the context of problem solving and decision making or carry out a task in a new situation with regards to the social values/economy/culture of the community.

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