Science

Syllabus

Primary

Implementation starting with

2014 Primary Three Cohort

Ministry of Education
SINGAPORE

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CONTENTS

PREAMBLE

This Primary Science Syllabus is a foundation for scientific studies at higher levels. The syllabus has also taken into consideration the desired outcomes of education for our primary students as well as the national education emphasis.

This syllabus is based on the ***Science Curriculum Framework*** and emphasises the need for a balance between the acquisition of science knowledge, process and attitudes. In addition, as and where the topics lend themselves, the technological applications, social implications and the value aspects of science are also considered. It also emphasises the broad coverage of fundamental concepts in the natural and physical world.

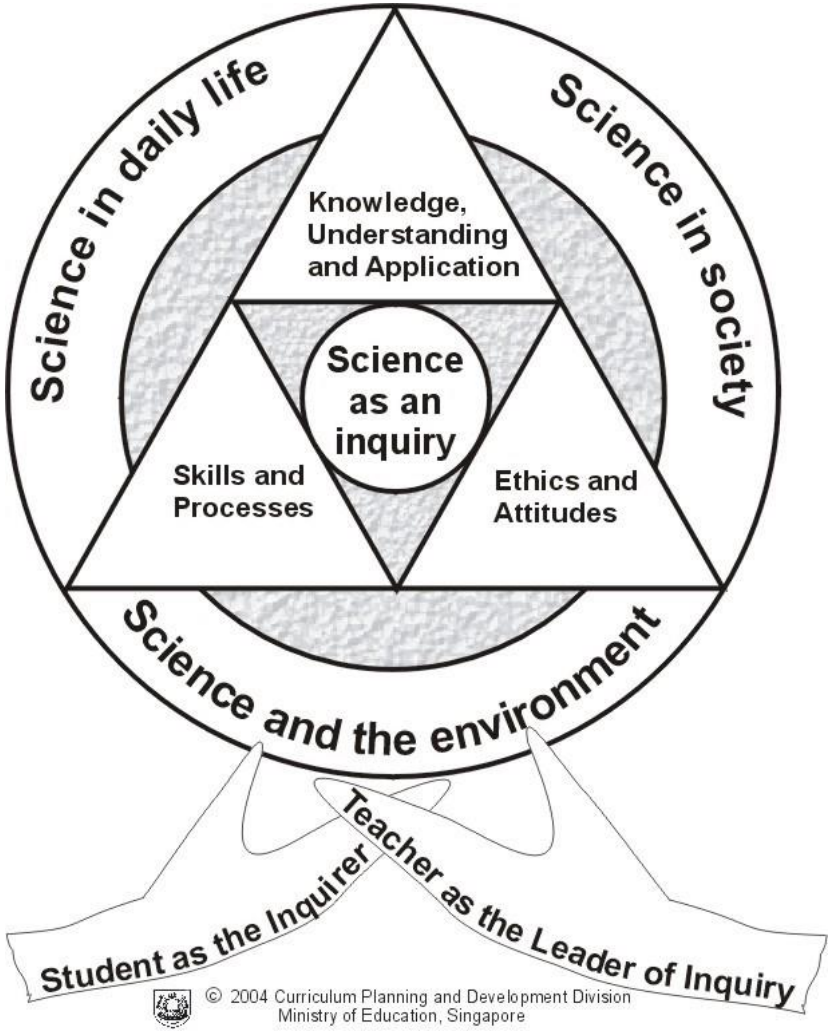
The aims spelt out in the syllabus provide the guiding principles for the suggested teaching approaches and evaluation methods. Teachers are advised not to follow the syllabus too rigidly but to exercise their professional judgement in implementing it. Schemes of work should be developed with the interests and abilities of the students uppermost in mind. Teachers are encouraged to use a variety of approaches in their teaching and to incorporate ideas and materials from various sources, in order to enhance the learning of science.

SCIENCE CURRICULUM FRAMEWORK

1 SCIENCE CURRICULUM FRAMEWORK

The Science Curriculum Framework is derived from the *Policy Framework for the Teaching and Learning of Science*. It encapsulates the thrust of science education in Singapore to prepare our students to be sufficiently adept as effective citizens, able to function in and contribute to an increasingly technologically-driven world.

Central to the curriculum framework is the inculcation of the spirit of scientific inquiry. The conduct of inquiry is founded on three integral domains of (a) Knowledge, Understanding and Application, (b) Skills and Processes and (c) Ethics and Attitudes. These domains are essential to the practice of science. The curriculum design seeks to enable students to view the pursuit of science as meaningful and useful. Inquiry is thus grounded in knowledge, issues and questions that relate to the roles played by science in daily life, society and the environment.



The science curriculum seeks to nurture the student as an inquirer. The starting point is that children are curious about and want to explore the things around them. The science curriculum leverages on and seeks to fuel this spirit of curiosity. The end goal is students who enjoy science and value science as an important tool in helping them explore their natural and physical world.

The teacher is the leader of inquiry in the science classroom. Teachers of science impart the excitement and value of science to their students. They are facilitators and role models of the inquiry process in the classrooms. The teacher creates a learning environment that will encourage and challenge students to develop their sense of inquiry. Teaching and learning approaches centre around the student as an inquirer.

The following table shows the description of each domain which frames the practice of science:

Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
• Scientific phenomena, facts, concepts and principles • Scientific vocabulary, terminology and conventions • Scientific instruments and apparatus including techniques and aspects of safety • Scientific and technological applications	*Skills* • Observing • Comparing • Classifying • Using apparatus and equipment • Communicating • Inferring • Formulating hypothesis • Predicting • Analysing • Generating possibilities • Evaluating *Processes* • Creative problem solving • Decision-making • Investigation	• Curiosity • Creativity • Integrity • Objectivity • Open-mindedness • Perseverance • Responsibility

The domains are contextually linked to the roles played by science to establish its relevance and relationship to modern-day living:

Science in daily life - Personal perspective focusing on the individual	**Science in society** - Social perspective focusing on human interactions	**Science and the environment** - Naturalistic perspective focusing on man-nature relationship
• Using scientific skills in everyday life, e.g. observing trends and patterns, analysing data from media reports etc • Adaptable to scientific and technological advances • Able to make informed decisions that are related to science and technology e.g. consumption of GM food, health choices	• Engaging in meaningful scientific discourse with others • Understanding role and impact of science and technology in society • Contributing to the progress of science knowledge	• Understanding place of humanity in the universe • Awareness of safety and biological issues, e.g. SARS, AIDS, damage from pollution etc • Care and concern for the environment

21ST CENTURY COMPETENCIES AND SCIENTIFIC LITERACY

The 21st Century Competencies

The *21st Century Competencies Framework* encapsulates the thrust of education for the future, to prepare our students to be confident people, self-directed learners, concerned citizens, and active contributors – outcomes of individuals able to thrive in and contribute to a world where change is the only constant.

The competency domains gaining prominence in the 21st century are Civic Literacy, Global Awareness and Cross-cultural Skills, Critical and Inventive Thinking, and Information and Communication Skills. The competencies encompassed in these domains have been termed the *21st Century Competencies.*

Scientific Literacy

Science education for the future involves teaching students more than just the basic concepts of science. Students need to be equipped with the *skills* to be able to use scientific knowledge to identify questions, and to draw evidence-based conclusions in order to understand and make decisions about the natural world and the changes made to it through human activity. They also need to *understand* the characteristic features of science as a form of human knowledge and inquiry, and be aware of how science and technology shape our material, intellectual and cultural environments. Lastly, they need to be equipped with *ethics and attitudes* to engage in science-related issues as a reflective citizen[1].

A strong foundation in scientific knowledge and methodologies will include the development of reasoning and analytical skills, decision and problem solving skills, flexibility to respond to different contexts and possessing an open and inquiring mind that is willing to explore new territories and learn new things. These are skills and habits of mind that are aligned to the desired 21st century competencies.

[1] Adapted from Assessing Scientific, Reading and Mathematical Literacy, a Framework for PISA 2006, OECD.

AIMS

2 AIMS

The Primary Science Syllabus aims to:

- provide students with experiences which build on their interest in and stimulate their curiosity about their environment
- provide students with basic scientific terms and concepts to help them understand themselves and the world around them
- provide students with opportunities to develop skills, habits of mind and attitudes necessary for scientific inquiry
- prepare students towards using scientific knowledge and methods in making personal decisions
- help students appreciate how science influences people and the environment

SYLLABUS FRAMEWORK

3 SYLLABUS FRAMEWORK

The Primary Science Syllabus comprises:

- The knowledge, skills and attitudes that all students should acquire.
- The freed up curriculum time, known as the white space, to enable teachers to use more engaging teaching and learning approaches, and/or to implement customised school-based programmes as long as the aims of the syllabus are met. This enables teachers to make learning more meaningful and enjoyable for their students.

i. KNOWLEDGE, UNDERSTANDING AND APPLICATION

The approach in this revised syllabus towards the learning of science is based on themes that students can relate to in their everyday experiences, and to the commonly observed phenomena in nature. The aim is to enable students to appreciate the links between different themes/topics and thus allow the integration of scientific ideas. The five themes chosen are: ***Diversity, Cycles, Systems, Energy*** *and* ***Interactions***. These themes encompass a core body of concepts in both the life and physical sciences. This body of concepts has been chosen because it provides a broad based understanding of the environment, and it will help build a foundation upon which students can rely on for further study.

Although the content of the syllabus is organised into 5 themes, the topics under each theme are not to be viewed as compartmentalised blocks of knowledge. In general, there are no clear boundaries between these themes. There may be topics common to different themes. Hence, a conscious effort is needed to demonstrate the relationship between themes whenever possible. To help teachers and students appreciate and understand the themes, essential takeaways and key inquiry questions [2] are included for each theme. These essential takeaways and questions can guide teachers and engage students in uncovering the important ideas at the heart of each theme. They can also use these questions to raise more specific questions for the respective topics under each theme.

Another feature of the syllabus is the spiral approach. This is characterised by the revisiting of concepts and skills at different levels and with increasing depth. The spiral approach allows the learning of scientific concepts and skills to match students' cognitive development. It therefore helps students build upon their existing understanding of concepts and facilitates the gradual mastery of skills.

The focus of each theme is given below.

Diversity

There is a great variety of living and non-living things in the world. Man seeks to organise this great variety of living and non-living things to better understand the world in which he lives. There are common threads that connect all living things and unifying factors in the diversity of non-living things that help Man to classify them. This theme brings across the importance of maintaining diversity. The essential takeaways and key inquiry questions for "Diversity" are:

[2] Reference: Wiggins, J and Mctighe, J. (1998). *Understanding by Design*. Alexandria, Va.: Association for Supervision and Curriculum Development.

Essential Takeaways	Key Inquiry Questions
• There is a great variety of living and non-living things around us. • Man can classify living and non-living things based on their similarities and differences to better understand them. • Maintaining the diversity of living things around us ensures their continual survival.	• What can we find around us? • How can we classify the great variety of living and non-living things? • Why is it important to maintain diversity?

Cycles

There are repeated patterns of change in nature. Examples of these cycles are the life cycles of living things and the water cycle. Understanding these cycles helps Man to predict events and processes and to appreciate the Earth as a self-sustaining system. The essential takeaways and key inquiry questions for "Cycles" are:

Essential Takeaways	Key Inquiry Questions
• There are repeated patterns of change around us. • Observing cycles helps us to make predictions and understand things around us.	• What makes a cycle? • Why are cycles important to life?

Systems

A system is a whole consisting of parts that work together to perform a function(s). There are systems in nature as well as man-made systems. Examples of systems in nature are the digestive and respiratory systems. Examples of man-made systems are electrical systems. Understanding these systems allows Man to understand how they operate and how parts influence and interact with one another to perform a function. The essential takeaways and key inquiry questions for "Systems" are:

Essential Takeaways	Key Inquiry Questions
• A system is made of different parts. Each part has its own unique function. • Different parts / systems interact to perform function(s).	• What is a system? • How do parts / systems interact to perform function(s)?

Interactions

Studying the interactions between and within systems enhances understanding of the environment and Man's role in it. Interactions occur within an organism, between organisms as well as between organisms and the environment. The interaction of Man with the environment drives the development of Science and Technology. At the same time, Science and Technology influences the way Man interacts with the environment. By understanding the interactions between Man and the environment, students can better appreciate the consequences of their actions and be responsible for their actions. The essential takeaways and key inquiry questions for "Interactions" are:

Essential Takeaways	Key Inquiry Questions
• There are interactions among Man, living and non-living things in the environment. • Man can interact with the environment and make positive or negative impacts. • Man plays an important role in conservation to ensure continuity of life and availability of resources.	• How does Man better understand the environment? • What are the consequences of Man's interactions with the environment?

Energy

Energy makes changes and movement possible in everyday life. Man uses various forms of energy for many different purposes. Man is not the only animal that needs energy; all living things obtain energy and use it to carry out life processes. Understanding this theme will allow students to appreciate the importance and uses of energy and the need to conserve it. The essential takeaways and key inquiry questions for "Energy" are:

Essential Takeaways	Key Inquiry Questions
• Energy is required to enable things to work or move. • There are different forms of energy and they can be converted from one form to another. • Some sources of energy can be depleted and Man plays an important role in energy conservation.	• Why is energy important? • How is energy used in everyday life? • Why is it important to conserve energy?

ii. SKILLS AND PROCESSES

In this syllabus, teachers are encouraged to provide opportunities for students to use concepts and integrate skills and processes to inquire things and phenomena around them.

The skill sets identified are aligned to that of Lower Secondary Science and the essential features of inquiry as shown in the table below.

<table>
<tr><th>Skills and Processes</th><th>Engaging with an event, phenomenon or problem through:</th><th>Collecting and presenting evidence through:</th><th>Reasoning; making meaning of information and evidence through:</th></tr>
<tr><td rowspan="2">Skills</td><td>• Formulating hypothesis
• Generating possibilities
• Predicting</td><td>• Observing
• Using apparatus and equipment</td><td>• Comparing
• Classifying
• Inferring
• Analysing
• Evaluating</td></tr>
<tr><td colspan="3">Communicating</td></tr>
<tr><td>Processes</td><td colspan="3">Creative problem-solving, investigation and Decision-making</td></tr>
<tr><td rowspan="2">Essential Features of Inquiry</td><td>Question</td><td>Evidence</td><td>Explain Connect</td></tr>
<tr><td colspan="3">Communication</td></tr>
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Skills

Engaging with an event, phenomenon or problem through:

- **Formulating hypothesis**
  This is the skill of making a general explanation for a related set of observations or events. It is an extension of inferring.

- **Generating possibilities**
  This is the skill of exploring all the alternatives, possibilities and choices beyond the obvious or preferred one.

- **Predicting**
  This is the skill of assessing the likelihood of an outcome based on prior knowledge of how things usually turn out.

Collecting and presenting evidence through:

- **Observing**
  This is the skill of using our senses to gather information about objects or events. This also includes the use of instruments to extend the range of our senses.

- **Using apparatus and equipment**
  This is the skill of knowing the functions and limitations of various apparatus, and developing the ability to select and handle them appropriately for various tasks.

Reasoning; making meaning of information and evidence through:

- **Comparing**
  This is the skill of identifying the similarities and differences between two or more objects, concepts or processes.

- **Classifying**
  This is the skill of grouping objects or events based on common characteristics.

- **Inferring**
  This is the skill of interpreting or explaining observations or pieces of data or information.

- **Analysing**
  This is the skill of identifying the parts of objects, information or processes, and the patterns and relationships between these parts.

- **Evaluating**
  This is the skill of assessing the reasonableness, accuracy and quality of information, processes or ideas. This is also the skill of assessing the quality and feasibility of objects.

Communicating:

This is the skill of transmitting and receiving information presented in various forms – written, verbal, pictorial, tabular or graphical.

Processes

Processes are complex operations which call upon the use of several skills. At the primary level, the processes expected of students are:

- **Creative Problem Solving**
  This is a process of analysing a problem and choosing an innovative and relevant solution in order to remedy or alter a problem situation.

- **Decision-Making**
  Decision-making is the process of establishing and applying criteria to select from among seemingly equal alternatives. The process of establishing criteria involves consideration of the consequences and values.

- **Investigation**
  This involves formulating questions or hypotheses, devising fair methods and carrying out those methods to find out answers to the questions or to verify the hypotheses.

It must be pointed out that there is also no one definite sequence of priority among the skills and processes listed above. For example, observation may lead to hypothesising but at other times a hypothesis can lead to observation. All the skills and processes listed above are seen as part of the total process of scientific inquiry. In science teaching and learning, effort should initially be directed at teaching explicitly each of the skills through the use of appropriate activities. Later, effort should be directed to helping students integrate some or all of the skills in scientific inquiry.

The skills and processes can be introduced from primary three in an age-appropriate manner. Once introduced, these skills and processes should continue to be developed at the higher levels.

iii. ATTITUDES AND ETHICS

In all scientific inquiry, the adoption of certain mental attitudes such as *Curiosity, Creativity, Integrity, Objectivity, Open-mindedness, Perseverance and Responsibility* is advocated.

- **Curiosity**
  Desire to explore the environment and question what they find.

- **Creativity**
  Suggest innovative and relevant ways to solve problems.

- **Integrity**
  Handle and communicate data and information with integrity.

- **Objectivity**
  Seek data and information to validate observations and explanations objectively.

- **Open-mindedness**
  Accept all knowledge as tentative and willing to change their view if the evidence is convincing.

- **Perseverance**
  Pursue a problem until a satisfactory solution is found.

- **Responsibility**
  Show care and concern for living things and awareness of the responsibility they have for the quality of the environment.

Opportunities should be provided in the classroom for students to ask questions. Students should be encouraged to ask both closed and open questions. From the type of questions asked by the students, teachers could gather information on their 'frame of mind' and the quality of their understanding.

Table 1 shows an overview of the Primary Science Syllabus.

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Table 1: An Overview of the Primary Science Syllabus

Syllabus Requirement			White Space
Themes	*** Lower Block (Primary 3 and 4)**	****Upper Block (Primary 5 and 6)**	The freed up curriculum time is to enable teachers to use more engaging teaching and learning approaches, and/or to implement customised school-based programmes as long as the aims of the syllabus are met. This enables teachers to make learning more meaningful and enjoyable for their students.
Diversity	• Diversity of living and non-living things (General characteristics and classification) • Diversity of materials		
Cycles	• Cycles in plants and animals (Life cycles) • Cycles in matter and water (Matter)	• Cycles in plants and animals (Reproduction) • Cycles in matter and water (Water)	
Systems	• Plant system (Plant parts and functions) • Human system (Digestive system)	• Plant system (Respiratory and circulatory systems) • Human system (Respiratory and circulatory systems) • <u>Cell system</u> • Electrical system	
Interactions	• Interaction of forces (Magnets)	• Interaction of forces (Frictional force, gravitational force, <u>force in springs</u>) • Interaction within the environment	
Energy	• Energy forms and uses (Light and heat)	• Energy forms and uses (Photosynthesis) • <u>Energy conversion</u>	

Topics which are underlined are not required for students taking Foundation Science.

TEACHING AND LEARNING THROUGH INQUIRY

4 TEACHING AND LEARNING THROUGH INQUIRY

What is scientific inquiry?

Scientific inquiry may be defined as the activities and processes which scientists and students engage in to study the natural and physical world around us. In its simplest form, scientific inquiry may be seen as consisting of two critical aspects: the *what* (content) and the *how* (process*)* of understanding the world we live in[3].

Teaching science as inquiry must therefore go beyond merely presenting the facts and the outcomes of scientific investigations. Students need to be shown how the products of scientific investigations were derived by scientists and be provided opportunities to: ask questions about knowledge and issues that relate to their daily lives, society and the environment; be actively engaged in the collection and use of evidence; formulate and communicate explanations based on scientific knowledge.

Through inquiry learning, students will be able to acquire knowledge and understanding of their natural and physical world based on investigations, apply the skills and processes of inquiry and develop attitudes and values that are essential to the practice of science.

What are some characteristics of teaching and learning of science as inquiry?

Inquiry-based learning may be characterised by the degree of responsibility students have in posing and responding to questions, designing investigations, and evaluating and communicating their learning (*student-directed inquiry*) compared to the degree of involvement the teacher takes (*teacher-guided inquiry*). Students will best benefit from experiences that vary between these two inquiry approaches.

[3] Reference: Chiappetta, E.L., Koballa, T., Collette, A.T. (2002). *Science Instruction in the Middle and Secondary schools*. Upper Saddle River, NJ: Merrill/Prentice Hall.

Essential features of science as inquiry	More ← Amount of Student Self-Direction → Less Less ← Amount of Guidance from Teacher or Material → More			
1. Question Students engage with an event, phenomenon or problem when they …	pose a question	select among questions	sharpen or clarify question provided	accept given question
2. Evidence Students give priority to evidence when they …	determine what constitutes evidence and collect it	are directed to collect certain data	are given data and asked to analyse	are given data and told how to analyse
3. Explanation Students construct explanations when they …	formulate their own explanation after summarising evidence	are guided in process of formulating explanation from evidence	are given possible ways to use evidence to formulate explanation	are provided with evidence
4. Connections Students evaluate their explanations when they …	examine other resources and form links to explanations	are directed toward sources of knowledge	are given possible connections	are provided with connections
5. Communication Students communicate and justify their explanations when they …	form reasonable and logical argument to communicate explanations	are coached in development of communication	are provided guidelines for communication	are given steps and procedures for communication

Adapted from *Inquiry and the National Science Education Standards,* National Research Council (2000).

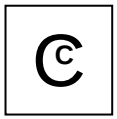
What are some strategies for conducting inquiry-based learning and teaching?

A primary purpose for inquiry-based instruction is for students to learn fundamental science concepts, principles, and theories as well as to develop science process skills and attitudes that are essential for scientific inquiry. Science teachers are already using a variety of teaching strategies in their lessons.

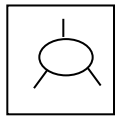
To further emphasise the learning of science as inquiry, teachers can incorporate in these strategies the essential features of *Question, Evidence, Explanation, Connections* and *Communication* and provide students with experiences that varies between guided (partial) and open (full) inquiry.

To meet the learning styles of students offering Foundation Science, teachers should carry out the inquiry-based approach through hands-on learning, from concrete to abstract. Hands-on learning experiences should also be situated in realistic contexts so that students can make connections with their own lives and the environment in which they live. In this way, students become engaged and excited about what they are studying and they then become motivated to learn.

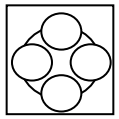
Teachers are also encouraged to use a variety of strategies to facilitate the inquiry process. Selected strategies are highlighted below to help teachers plan and deliver lessons that will engage students in meaningful learning experiences and cultivate their interest and curiosity in science. These strategies can be mixed and matched. A brief description of each of these strategies is given on the next page:



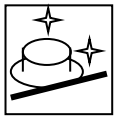
Concept Cartoon
In concept cartoons, minimal language is used. Visual images are utilised to present concepts or questions relating to one central idea or word.



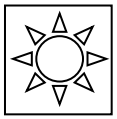
Concept Mapping
Concept mapping is a strategy to present meaningful relationships among concepts. Concept maps are useful in organising and linking concepts or ideas.



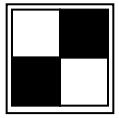
Cooperative Learning
In cooperative learning, activities are structured such that each student assumes certain responsibilities and contributes to the completion of tasks. In working with others, students are exposed to different points of views and solutions in accomplishing a common goal.



Demonstration
Demonstration is commonly used to scaffold the learning process. This approach is recommended when the learning activity is not safe or too complex for students to set up on their own.



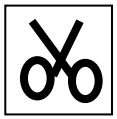
Field Trip
A field trip is any learning activity outside the school. It provides opportunities for students to explore, discover and experience science in everyday life.



Games
Games engage students in play or simulations for the learning of concepts or skills. This is useful in helping students to visualise or illustrate objects or processes in the real world.

Investigation
In scientific investigation, students engage in activities that mirror how scientists think and what they do in a decision making process, such as asking or posing questions and planning or designing investigations.

Problem Solving
Problem solving engages students in finding solutions to problems by applying scientific knowledge and skills.



Projects
Projects are learning activities that require students to find out about an object, event, process or phenomenon over a few weeks.

Questioning
Questions are useful tools in the scientific inquiry process. Both teachers and students should engage in cycles of questions-answers-questions throughout the learning process.

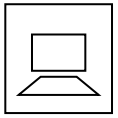
Role Play, Drama, Dance and Movement
Role play, drama, dance and movement allow students to express their understanding of scientific concepts and processes in a creative way.

Stories
Stories of science in everyday life and of scientists can capture students' interest and engage them in talking about science. Either the teacher or students can be the story creator or teller.

Strategies for Active and Independent Learning (SAIL)

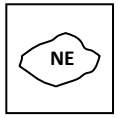
The SAIL approach emphasises learning as a formative and developmental process in which instruction and assessment point the way for students to continuously learn and improve. Learning expectations and rubrics are used to describe what students should know and be able to do. This would help students know where they are in the learning process and how they can improve.

Teachers are also encouraged to leverage on the planned learning activities to infuse Information Technology and National Education.



Information and Communication Technologies

ICT supports the inquiry process and also facilitates student collaboration and self-directed learning. For example, online collaborative tools allow students to share and discuss their ideas or findings within the school, and also extend their learning through consulting field experts. Internet-enabled devices could be used to facilitate data collection and analysis in situated learning. Students can also explore and visualise abstract concepts using simulations tools to manipulate the variables to deduce a relationship between the variables.



National Education

National Education is infused into the curriculum to allow students to see how scientific phenomena and developments can contribute to or affect the nation.

Where appropriate, students should have opportunities to develop attitudes which are relevant to the study of science. Teachers are also encouraged to incorporate the ethical aspect of science wherever possible throughout the syllabus.

Ethics and Attitudes

In scientific inquiry, the adoption of certain mental attitudes such as Curiosity, Creativity, Objectivity, Integrity, Open-mindedness, Perseverance and Responsibility is advocated. Students can also discuss the ethical implications of science and technology.

What are some features of an inquiry classroom?

An inquiry classroom is visibly different from a traditional classroom in the following ways:

Traditional	Inquiry
Students often work alone	Students often work in groups
Emphasis on mastery of facts	Emphasis on understanding of concepts
Follows a fixed curriculum closely	Allows for pursuit of student questions
Activities rely mainly on textbooks and workbook materials	Activities rely on a variety of sources
Students are viewed as "blank slates"	Students are viewed as thinkers with their own theories about the world
Teachers tend to disseminate information to students	Teachers facilitate an interactive learning environment
Teachers tend to seek correct answers	Teachers seek to understand student learning
Assessment tends to be separate from teaching	Assessment is interwoven with teaching

Adapted from *In Search of Understanding: The Case for Constructivist Classrooms,* Brooks & Brooks (1993).

What are some misconceptions about inquiry-based learning and teaching?

1: *All science subject matter should be taught through student-directed inquiry*.

Whereas student-directed inquiry will provide the best opportunities for cognitive development and scientific reasoning, teacher-guided inquiry can best focus learning on the development of particular science concepts. Thus, students will best benefit from experiences that vary between these two inquiry approaches.

2: *Inquiry cannot be carried out by students effectively as they will not be able to discover anything worthwhile.*

Although it is important that students are provided with opportunities to pursue their own questions and discover some things for themselves, scientists and students often engage in inquiry to solve problems or understand events by reading relevant materials (print and online resources) and seeking advice from experts in the specific field. They may be engaged in inquiry without actually making their own discoveries.

3: *Inquiry teaching occurs whenever students are provided with hands-on activities*.

Although participation by students in hands-on activities is desirable, it is equally important that they are mentally engaged with scientific reasoning and methods. Research indicates that science process skills are best learnt when used to understand specific scientific content. Understanding content without process or vice versa is insufficient to nurture students as inquirers.

ASSESSING TEACHING AND LEARNING

5 ASSESSING TEACHING AND LEARNING

Assessment is an integral part of the teaching and learning process. It involves gathering information through various assessment techniques and making sound decisions. Assessment provides information to the teacher about students' achievement in relation to the learning objectives. With this information, the teacher makes informed decisions about what should be done to enhance the learning of the students and to improve teaching methods.

Why Assess?

Assessment measures the extent to which desired knowledge, skills and attitudes are attained by students. While it complements the teaching and learning process, it also provides formative and summative feedback to students, teachers, schools and parents.

- Assessment provides feedback to ***students***, allows them to understand their strengths and weaknesses. Through assessment, students can monitor their own performance and progress. It also points them in the direction they should go to improve further.

- Assessment provides feedback to ***teachers***, enables them to understand the strengths and weaknesses of their students. It provides information about students' achievement of learning outcomes as well as the effectiveness of their teaching.

- Assessment provides feedback to ***schools***. The information gathered facilitates the placement of students in the appropriate stream or course, and the promotion of students from one level to the next. It also allows the schools to review the effectiveness of their instructional programme.

- Assessment provides feedback to ***parents***, allows them to monitor their children's progress and achievement through the information obtained.

What to Assess?

The aims of the Primary Science Syllabus are the acquisition of knowledge, understanding and application of the science concepts, the ability to use process skills, and the development of attitudes important to the practice of science. The assessment objectives of the syllabus are aligned to the three domains in the curriculum framework as shown below:

i. Assessment of Knowledge, Understanding and Application of Science Concepts
ii. Assessment of Skills and Process
iii. Assessment of Ethics and Attitudes

How to Assess?

Assessment measures the extent to which desired knowledge, skills and attitudes are attained by students. As it serves many purposes, it is important to match the type of assessment to the specific purpose for which it is intended. Before making an assessment about a certain aspect of students' performance, the teacher should ensure that the assessment mode used will generate information that reflect accurately the particular aspect of performance the teacher intends to assess.

In an inquiry-based classroom, the assessment can take many forms. In addition to the written tests, teachers can also conduct performance-based assessment using the following modes:

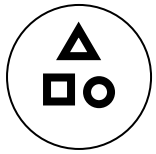
- Practicals
- Projects
- Teacher observations
- Checklists
- Reflections / Journals
- Model-making
- Posters
- Games and quizzes
- Debates
- Drama / Show and Tell
- Learning Trails

Teachers can also assess students through the use of portfolio. It is a systematic collection of students' work and provides a comprehensive picture of their achievement. The work collected provides a continuous record of the students' development and progress in the acquisition of knowledge, understanding of scientific concepts, application of process skills, and development of attitudes. It also provides opportunity for the students to have self-evaluation and reflections by revisiting their own portfolio.

The assessment modes listed above are by no means exhaustive. Adopting a variety of assessment modes enables the teachers to assess different aspects of teaching and learning.

SYLLABUS CONTENT

6 SYLLABUS CONTENT (P3 and P4)



About Diversity:

There is a great variety of living and non-living things in the world. Man seeks to organise this great variety of living and non-living things to better understand the world in which he lives. There are common threads that connect all living things and unifying factors in the diversity of non-living things that help him to classify them. This theme brings across the importance of maintaining diversity.

Note: * Lower Block
**** Upper Block**

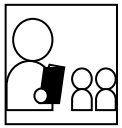
Essential Takeaways:

- *There is a great variety of living and non-living things around us.*
- *Man can classify living and non-living things based on their similarities and differences to better understand them.*
- *Maintaining the diversity of living things around us ensures their continual survival.*

Key Inquiry Questions:

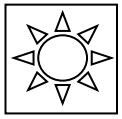
- *What can we find around us?*
- *How can we classify the great variety of living and non-living things?*
- *Why is it important to maintain diversity?*

Introducing the theme Diversity:



Things Around Us:

Based on the story of Carl Linnaeus and his classification as well as field trips to the school garden, students can observe and classify the diversity of living things and non-living things around them. Students can also be encouraged to give reasons and criteria for their groupings. Students can appreciate the importance of grouping when they are looking for a particular item in the supermarket or a certain resource in the library.



Idea from Mother Nature:

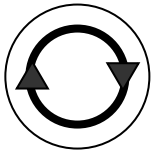
Based on the story of how George de Mestral and his dog's nature hike led to the invention of hook and loop fasteners, students can appreciate how careful observation and curiosity can lead to the invention of products, making use of properties of different materials.

Seizing the Opportunity:

Based on the invention of sticky note pads, students can appreciate how scientists have creatively turned weak adhesives into making useful paper products.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Diversity of Living and Non-Living Things (P3 and P4)		
• *Describe the characteristics of living things. - need water, food and air to survive - grow, respond and reproduce • *Recognise some broad groups of living things. - plants (flowering, non-flowering) - animals (amphibians, birds, fish, insects, mammals, reptiles) - fungi (mould, mushroom, yeast) - bacteria *Note:* *- Recall of names of specific living things (e.g. guppy) and their characteristics (e.g. give birth to young alive) is not required.*	• *Observe a variety of living and non-living things and infer differences between them. • *Classify living things into broad groups (in plants and animals) based on similarities and differences of common observable characteristics.	• *Show curiosity in exploring the surrounding living and non-living things by asking questions. • *Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Diversity of Materials (P3 and P4)		
• *Relate the use of various types of materials (ceramic, fabric, glass, metal, plastics, rubber, wood) to their physical properties.	• *<u>Compare</u> physical properties of materials based on: - strength - flexibility - waterproof - transparency - ability to float/sink in water *Note:* *- The focus is on how the properties of materials are used.* *- The "strength" of a material is its ability to be subjected to loads without breaking.* *- The "flexibility" of a material is its ability to bend without breaking.* *- A material is "waterproof" when it does not absorb water.* *-The "transparency" of a material refers to whether the material allows most/some or no light to pass through. (The use of terms – transparent/ translucent/opaque is not required).*	*Show <u>objectivity</u> by using data and information to validate observations and explanations about the properties and uses of materials.



About Cycles:

There are repeated patterns of change in nature. Examples of these cycles are the life cycles of living things and the water cycle. Understanding these cycles helps Man to predict events and processes and to appreciate the Earth as a self-sustaining system.

Note:

*** Lower Block**

**** Upper Block**

Essential Takeaways:

- *There are repeated patterns of change around us.*
- *Observing cycles helps us to make predictions and understand things around us.*

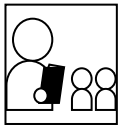
Key Inquiry Questions:

- *What makes a cycle?*
- *Why are cycles important to life?*

Introducing the theme Cycles:

Travel Story:

Get students to share their personal stories of day and night in different countries. This will help them recognise that people living in some countries experience longer/shorter days or nights. These countries have four seasons – summer, autumn, winter and spring.



A Leader in Clean Water:

Olivia Lum, our very own Singapore's entrepreneur, not only proposed a solution to our pursuit of clean water but also brought her research and development of water technology to the world. Her innovative problem solving and entrepreneurship have benefited not just Singapore but the world.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Plants and Animals (P3 and P4)		
• *Show an understanding that different living things have different life cycles. - Plants - Animals	• *Observe and compare the life cycles of plants grown from seeds over a period of time. • *Observe and compare the life cycles of animals over a period of time (butterfly, beetle, mosquito, grasshopper, cockroach, chicken, frog).	• *Show curiosity in exploring the surrounding plants and animals and question what they find. • *Show concern by being responsible towards plants and animals such as their own pets. • *Value individual effort and team work.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Plants and Animals (P5 and P6 Standard)		
• ** Show an understanding that living things reproduce to ensure continuity of their kind and that many characteristics of an organism are passed on from parents to offspring. • ** Recognise processes in the sexual reproduction of flowering plants. - pollination - fertilisation (seed production) - seed dispersal - germination *Note:* - *The use of specific terms ("self-pollination" and "cross- pollination") to describe the pollination process is not required.* • ** Recognise the process of fertilisation in the sexual reproduction of humans. *Note:* - *Students should know that ovaries produce eggs and the testes produce sperms.* - *Fertilisation occurs when a sperm fuses with an egg.* - *The fertilised egg develops in the womb.*	• **Investigate the various ways in which plants reproduce and communicate findings. - spores - seeds *Note:* - *Vegetative propagation methods such as stem cutting, grafting, marcotting are not required.*	• **Show curiosity in exploring the surrounding plants and animals by asking questions. • **Show concern by being responsible towards plants and animals such as their own pets. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Plants and Animals (P5 and P6 Standard)		
• **Recognise the similarity in terms of fertilisation in the sexual reproduction of flowering plants and humans.		

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Plants and Animals (P5 and P6 Foundation)		
• **State the processes in the sexual reproduction of flowering plants. - pollination - fertilisation (seed production) - seed dispersal - germination *Note:* - *The use of specific terms ("self-pollination" and "cross- pollination") to describe the pollination process is not required.* • **State the process of fertilisation in the sexual reproduction of humans. *Note:* - *Students should know that ovaries produce eggs and the testes produce sperms.* - *Fertilisation occurs when a sperm fuses with an egg.* - *The fertilised egg develops in the womb.*	• **Observe and compare the various ways in which plants reproduce and communicate findings. - spores - seeds *Note:* - *Vegetative propagation methods such as stem cutting, grafting, marcotting are not required.*	• **Show curiosity in exploring the surrounding plants and animals by asking questions. • **Show concern by being responsible towards plants and animals such as their own pets. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Matter and Water (P3 and P4)		
• *State that matter is anything that has mass and occupies space. • *Differentiate between the three states of matter (solid, liquid, gas) in terms of shape and volume.	• *Measure mass and volume using appropriate apparatus.	• *Show curiosity in exploring matter in the surroundings and question what they find.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Matter and Water (P5 and P6 Standard)		
• **Recognise that water can exist in three interchangeable states of matter. • **Show an understanding of how water changes from one state to another. - Melting (solid to liquid) - Evaporation/Boiling (liquid to gas) - Condensation (gas to liquid) - Freezing (liquid to solid) • **Show an understanding of the terms melting point of ice (or freezing point of water) and boiling point of water. • **Show an understanding of the roles of evaporation and condensation in the water cycle. • **Recognise the importance of the water cycle. • **Recognise the importance of water to life processes. • **Describe the impact of water pollution on Earth's water resources.	• **Compare water in 3 states. • **Investigate the effect of heat gain or loss on the temperature and state of water and communicate findings. - when ice is heated, it melts and changes to water at 0^oC - when water is cooled, it freezes and changes to ice at 0^oC - when water is heated, it boils and changes to steam at 100^oC - when steam is cooled, it condenses to water • **Investigate the factors which affect the rate of evaporation and communicate findings. - wind - temperature - exposed surface area	• **Show concern for water as a limited natural resource and the need for water conservation.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cycles in Matter and Water (P5 and P6 Foundation)		
• **Recognise that water can exist in three interchangeable states of matter. • **State how water changes from one state to another. - Melting (solid to liquid) - Evaporation/Boiling (liquid to gas) - Condensation (gas to liquid) - Freezing (liquid to solid) • **State the melting point of ice (or freezing point of water) and boiling point of water. • **Recognise the changes in states of water in the water cycle. • **Recognise the importance of the water cycle.	• **<u>Compare</u> water in 3 states.	• **Show <u>concern</u> for water as a limited natural resource and the need for water conservation.

About Systems:

A system is a whole consisting of parts that work together to perform a function(s). There are systems in nature as well as man-made systems. Examples of systems in nature are the digestive and respiratory systems. Examples of man-made systems are electrical systems. Understanding these systems allows Man to understand how they operate and how parts influence and interact with one another to perform a function.

Note:

*** Lower Block**

**** Upper Block**

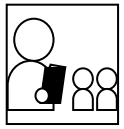
Essential Takeaways:

- *A system is made of different parts. Each part has its own unique function.*
- *Different parts/systems interact to perform function(s).*

Key Inquiry Questions:

- *What is a system?*
- *How do parts/systems interact to perform function(s)?*

Introducing the theme Systems:



The Cell Story:

Students can find out more about scientists such as Anton Leewenhoek, Robert Hooke who have contributed to the discovery and study of cells.

Frightening Lightning:

Using the story of how Benjamin Franklin invented the lightning rod, students can appreciate how Man comes to understand the world around him and protect themselves against lightning.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Human System (P3 and P4)		
• *Identify the organ systems and state their functions in human (digestive, respiratory, circulatory, skeletal and muscular). *Note:* - *This learning outcome introduces students to an overview of organ systems. Detailed knowledge of the muscular and skeletal systems (such as names of the bones/muscles in the body and descriptions of how they work) are not required.* • *Identify the organs in the human digestive system (mouth, gullet, stomach, small intestine and large intestine) and describe their functions.		• *Show curiosity in exploring their own body and questioning about the structures or functions of the body.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Human System (P5 and P6 Standard)		
• **Recognise that air is a mixture of gases such as nitrogen, carbon dioxide, oxygen and water vapour. • **Identify the organs of the human respiratory and circulatory systems and describe their functions. *Note:* - *Detailed knowledge of respiratory system (e.g. alveoli) and circulatory system (e.g. heart chambers and valves) is not required.* • **Recognise the integration of the different systems (digestive, respiratory and circulatory) in carrying out life processes.	• **Compare how plants, fish and humans take in oxygen and give out carbon dioxide. • **Compare the ways in which substances are transported within plants and humans. - plants: tubes that transport food and water - humans: blood vessels that transport digested food, oxygen and carbon dioxide *Note:* - *The use of names of specific tubes (xylem, phloem) and blood vessels (artery, vein, capillaries) is not required.*	• **Show objectivity by seeking data and information to validate observations and explanations about their body.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Human System (P5 and P6 Foundation)		
• **Recognise that air is a mixture of gases such as nitrogen, carbon dioxide, oxygen and water vapour. • **Identify the organs of the human respiratory and circulatory systems and state their functions. *Note:* - *Detailed knowledge of respiratory system (e.g. alveoli) and circulatory system (e.g. heart chambers and valves) is not required.*	• **<u>Compare</u> how plants and humans take in oxygen and give out carbon dioxide. *Note:* - *The use of names of specific tubes (xylem, phloem) and blood vessels (artery, vein, capillaries) is not required.*	• **Show <u>objectivity</u> by seeking data and information to validate observations and explanations about their body.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Plant System (P3 and P4)		
• *Identify the different parts of plants and state their functions. - leaf - stem - root	• *Observe plant parts.	• *Show curiosity in exploring the surrounding plants and question what they find. • *Show concern by being responsible towards plants.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Plant System (P5 and P6 Standard)		
• **Identify the parts of the plant transport system and describe their functions. *Note:* - *Recall of the relative positions of water and food carrying tubes is not required.* - *The use of specific terms ("xylem" and "phloem") is not required.*	• **Investigate the functions of plant parts and communicate findings. - leaf - stem - root	• **Show objectivity by seeking data and information to validate observations and explanations about plant parts and functions.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Plant System (P5 and P6 Foundation)		
• **Recognise how water is transported from the roots to other parts of the plant and how food is transported from the leaves to other parts of the plant. *Note:* *- Recall of the relative positions of water and food carrying tubes is not required.* *- The use of specific terms ("xylem" and "phloem") is not required.*	• **Observe and recognise the functions of plant parts and communicate findings. - leaf - stem - root	• **Show objectivity by seeking data and information to validate observations and explanations about plant parts and functions.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Cell System (P5 and P6 Standard)		
• **Show an understanding that a cell is a basic unit of life. • **Identify the different parts of a typical plant cell and animal cell and relate the parts to the functions. - parts of plant cell: cell wall, cell membrane, cytoplasm, nucleus and chloroplasts - parts of animal cell: cell membrane, cytoplasm, nucleus *Note:* - *Knowledge of specialised cells such as blood cells, muscle cells and nerve cells is not required.*	• **<u>Compare</u> a typical plant and animal cell.	• **Show <u>curiosity</u> in exploring the microscopic world and questioning what they find. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Electrical System (P5 and P6 Standard)		
• **Recognise that an electric circuit consisting of an energy source (battery) and other circuit components (wire, bulb, switch) forms an electrical system. • **Show an understanding that a current can only flow in a closed circuit. • **Identify electrical conductors and insulators.	• **Construct simple circuits from circuit diagrams. • **Investigate the effect of some variables on the current in a circuit and communicate findings. - number of batteries (arranged in series) - number of bulbs (arranged in series and parallel)	• **Show concern for the need to conserve and to have proper use and handling of electricity. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Electrical System (P5 and P6 Foundation)		
• **Recognise that an electric circuit consisting of an energy source (battery) and other circuit components (wire, bulb, switch) forms an electrical system. • ** State that a current can only flow in a closed circuit. • **Identify electrical conductors and insulators.	• **Construct simple circuits from circuit diagrams. • **Investigate the effect of some variables on the current in a circuit and communicate findings. - number of batteries (arranged in series) - number of bulbs (arranged in series)	• **Show concern for the need to conserve and to have proper use and handling of electricity. • **Value individual effort and team work by respecting different perspectives.

About Interactions:

Studying the interactions between and within systems enhances understanding of the environment and Man's role in it. Interactions occur within an organism, between organisms as well as between organisms and the environment. The interaction of Man with the environment drives the development of Science and Technology. At the same time, Science and Technology influences the way Man interacts with the environment. By understanding the interactions between Man and the environment, students can better appreciate the consequences of their actions and be responsible for their actions.

Note: *Lower Block
**** Upper Block**

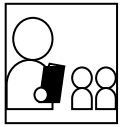
Essential Takeaways:

- *There are interactions among Man, living and non-living things in the environment.*
- *Man can interact with the environment and make positive or negative impacts.*
- *Man plays an important role in conservation to ensure continuity of life and availability of resources.*

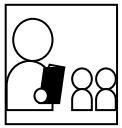
Key Inquiry Questions:

- *How does Man better understand the environment?*
- *What are the consequences of Man's interactions with the environment?*

Introducing the theme Interactions:



Did you see the apple fall?:
Based on the story of Newton and how he first discovered gravity, students can appreciate how discoveries and inventions may come about through careful observations and inferences on interactions within or between different things in everyday life.



Hello… :
Based on the story of Alexander Graham Bell, whose mother and wife were deaf, students can appreciate how Bell's research into hearing and speech led him to experiment with hearing devices which eventually resulted in the invention of the telephone.

Mouldy Discovery:
Based on the story of how Alexander Fleming's accidental discovery of how penicillin in moulds could kill bacteria, students can appreciate how careful observations of happenings around them can lead to useful discoveries that could benefit generations to come.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions of Forces (P3 and P4)		
• *Recognise that a magnet can exert a push or a pull. • *Identify the characteristics of magnets. - magnets can be made of iron or steel - magnets have two poles. A freely suspended bar magnet comes to rest pointing in a North-South direction - unlike poles attract and like poles repel - magnets attract magnetic materials *Note:* - *Recall of other magnetic materials such as nickel and cobalt is not required.* • *List some uses of magnets in everyday objects.	• *<u>Compare</u> magnets, non-magnets and magnetic materials. • *<u>Make</u> a magnet by the 'Stroke' method and the electrical method.	• *Show <u>curiosity</u> in exploring uses of magnets in everyday life and question what they find.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions of Forces (P5 and P6 Standard)		
• **Identify a force as a push or a pull. • **Show an understanding of the effects of a force. - A force can move a stationary object - A force can speed up, slow down or change the direction of motion - A force can stop a moving object - A force may change the shape of an object • **Recognise and give examples of the different types of forces. - magnetic force - gravitational force - elastic spring force - frictional force *Note:* - *Direction of friction for "rolling objects" such as wheels and balls is not required.* • **Recognise that objects have weight because of the gravitational force acting on the object.	• **<u>Investigate</u> the effect of friction on the motion of objects and <u>communicate</u> findings. • **<u>Investigate</u> the effects of forces on springs and <u>communicate</u> findings.	• **Show <u>objectivity</u> by using data and information to validate observations and explanations about forces. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions of Forces (P5 and P6 Foundation)		
• **Identify a force as a push or a pull. • **State the effects of a force. - A force can move a stationary object - A force can speed up, slow down or change the direction of motion - A force can stop a moving object - A force may change the shape of an object • **Recognise and give examples of the different types of forces. - magnetic force - gravitational force - frictional force *Note:* - *Direction of friction for "rolling objects" such as wheels and balls is not required.* • **Recognise that objects have weight because of the gravitational force acting on the object.	• **<u>Investigate</u> the effect of friction on the motion of objects and <u>communicate</u> findings.	• **Show <u>objectivity</u> by using data and information to validate observations and explanations about forces. • **Value individual effort and team work by respecting different perspectives.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions within the Environment (P5 and P6 Standard)		
• **Identify the factors that affect the survival of an organism. - physical characteristics of the environment (temperature, light, water) - availability of food - types of other organisms present (producers, consumers, decomposers) • **Discuss the effect on organisms when the environment becomes unfavourable (organisms adapt and survive; move to other places or die). • **Trace the energy pathway from the Sun through living things and identify the roles of various organisms (producers, consumers, predators, prey) in a food chain and a food web. • **Differentiate among the terms organism, population and community. - An organism is a living thing. - A population is defined as a group of plants and animals of the same kind, living and reproducing at a given place and time. - A community consists of many populations living together in a particular place. • **Show an understanding that different habitats support different communities (garden, field, pond, seashore, tree, mangrove swamp).	• **Observe, collect and record information regarding the interacting factors within an environment.	• **Show concern by being respectful and responsible towards the environment and the organisms living in it. • **Show concern for Man's impact on the environment. • **Value individual effort and team work.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions within the Environment (P5 and P6 Standard)		
• **Recognise that adaptations serve to enhance survival and can be structural or behavioural. - cope with physical factors - obtain food - escape predators - reproduce by finding and attracting mates or dispersing seeds/fruits *Note:* - *Students are introduced to the types of dispersal methods and physical characteristics of different fruits and seeds in the theme of Cycles. The focus in this theme is to help students recognise that physical characteristics are the "structural adaptations" which help fruits and seeds in their dispersal.* • **Give examples of man's impact, (both positive and negative) on the environment. *Note:* - *Positive impact: e.g. Conservation, Reforestation* - *Negative impact: e.g. Depleting natural resources, deforestation, pollution (land/water/air), global warming*		

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions within the Environment (P5 and P6 Foundation)		
• **Identify the factors that affect the survival of an organism. - physical characteristics of the environment (temperature, light, water) - availability of food - types of other organisms present (producers, consumers, decomposers) • **Trace the energy pathway from the Sun through living things and identify the roles of various organisms (producers, predators, prey) in a food chain. • **Recognise that different habitats support different organisms (garden, field, pond, seashore, tree, mangrove swamp). • **Recognise that adaptations serve to enhance survival and can be structural or behavioural. - cope with physical factors - obtain food - escape predators - reproduce by finding and attracting mates or dispersing seeds/fruits	• **Observe, collect and record information regarding the interacting factors within an environment.	• **Show concern by being respectful and responsible towards the environment and the organisms living in it. • **Show concern for Man's impact on the environment. • **Value individual effort and team work.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Interactions within the Environment (P5 and P6 Foundation)		
Note: - *Students are introduced to the types of dispersal methods and physical characteristics of different fruits and seeds in the theme of Cycles. The focus in this theme is to help students recognise that physical characteristics are the "structural adaptations" which help fruits and seeds in their dispersal.* • **Give examples of man's impact, (both positive and negative) on the environment. *Note:* - *Positive impact: e.g. Conservation, Reforestation* - *Negative impact: e.g. Depleting natural resources, deforestation, pollution (land/water/air), global warming*		

About Energy:

Energy makes changes and movement possible in everyday life. Man uses various forms of energy for many different purposes. Man is not the only animal that needs energy; all living things obtain energy and use it to carry out life processes. Understanding this theme will allow students to appreciate the importance and uses of energy and the need to conserve it.

Note:

*** Lower Block**

**** Upper Block**

Essential Takeaways:

- *Energy is required to enable things to work or move.*
- *There are different forms of energy and they can be converted from one form to another.*
- *Some sources of energy can be depleted and Man plays an important role in energy conservation.*

Key Inquiry Questions:

- *Why is energy important?*
- *How is energy used in everyday life?*
- *Why is it important to conserve energy?*

Introducing the theme Energy:

The Light Bulb Story:

Using the story of Thomas Edison and his invention of the light bulb, students can appreciate how creativity and perseverance have led to an invention that brings light to Mankind.

The Thermometer Story:

Since the first mercury thermometer by Daniel Gabriel Fahrenheit, students can appreciate how scientists have built on each others' creations and tap on advances in technology to make a range of thermometers to quantify heat in different contexts.

The SARS Story:

A group of scientists and engineers in Singapore responded quickly to help detect people with fever by developing the infrared fever screening system. This has helped combat the SARS (Severe Acute Respiratory Syndrome) outbreak.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Forms and Uses (P3 and P4)		
• *Recognise that an object can be seen when it reflects light or when it is a source of light. *Note:* - *The laws of reflection are not required.* • *Recognise that a shadow is formed when light is completely or partially blocked by an object.	• *<u>Investigate</u> the variables that affect shadows formed and <u>communicate</u> findings. - shape, size and position of object(s) - distance between light source-object and object-screen *Note:* - *The use of terms – transparent/translucent/ opaque is not required.*	• *Show <u>objectivity</u> by using data and information to validate observations and explanations about light.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Forms and Uses (P3 and P4)		
• *List some common sources of heat. • *State that the temperature of an object is a measurement of its degree of hotness. • *Differentiate between heat and temperature. - heat is a form of energy - temperature is a measurement of the degree of hotness of an object • *Show an understanding that heat flows from a hotter to a colder object/region/place until both reach the same temperature. • *Relate the change in temperature of an object to the gain or loss of heat by the object. • *List some effects of heat gain/loss in our everyday life. - contraction / expansion of objects (solid, liquid and gas) - change in state of matter • *Identify good and poor conductors of heat. - good conductors: metals - poor conductors: wood, plastics, air	• *Measure temperature using a thermometer and a datalogger with temperature/heat sensors.	• *Show objectivity by seeking data and information to validate observations and explanations about heat.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Forms and Uses (P3 and P4)		
Note: - *Recall of the rate of heat transfer of specific materials (such as different types of metals) is not required.*		

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Forms and Uses (P5 and P6 Standard)		
• **State that living things need energy to carry out life processes. • **Recognise that the Sun is our primary source of energy (light and heat). • **Differentiate the ways in which plants and animals obtain energy.	• **Investigate the requirements (water, light energy and carbon dioxide) for photosynthesis (production of sugar and oxygen) and communicate findings.	• **Show objectivity by using data and information to validate observations and explanations about photosynthesis.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Forms and Uses (P5 and P6 Foundation)		
• **Recognise that the Sun is our primary source of energy (light and heat).	• **Investigate the requirements (water, light energy and carbon dioxide) for photosynthesis (production of sugar and oxygen) and communicate findings.	• **Show objectivity by using data and information to validate observations and explanations about photosynthesis.

Learning Outcomes		
Knowledge, Understanding and Application	**Skills and Processes**	**Ethics and Attitudes**
Energy Conversion (P5 and P6 Standard)		
• **Recognise that energy from most of our energy resources is derived in some ways from the Sun. • **Recognise and give examples of the various forms of energy. - kinetic energy - potential energy - light energy - electrical energy - sound energy - heat energy *Note:* - *The use of specific terms ("chemical energy", "gravitational potential energy" and "elastic potential energy") is not required.*	• **<u>Investigate</u> energy conversion from one form to another and <u>communicate</u> findings.	• **Show <u>concern</u> for the need to conserve energy usage in our everyday life.

GLOSSARY OF TERMS

GLOSSARY OF TERMS

	Term	Description of meaning
1.	classify	to group things based on common characteristics
2.	compare	to identify similarities and differences between objects, concepts or processes
3.	construct	to put a set of components together, based on a given plan
4.	describe	to state in words (using diagrams where appropriate) the main points of a topic
5.	discuss	to reflect on and explore a topic in speech or writing
6.	differentiate	to identify the differences between objects, concepts or processes
7.	identify	to select and/or name the object, event, concept or process
8.	infer	to draw a conclusion based on observations
9.	investigate	to find out by carrying out experiments
10.	list	to give a number of points or items without elaboration
11.	manipulate	to control an object in order to explore and discover its behaviour
12.	measure	to obtain a reading from a suitable measuring instrument
13.	observe	to obtain information through the use of the senses
14.	recognise	to identify facts, characteristics or concepts that are critical to the understanding of a situation, event, process or phenomenon
15.	relate	to identify and explain the relationships between objects, concepts or processes
16.	show an understanding	to recall information (facts, concepts, models, data), translate information from one form to another, explain information and apply information
17.	state	to give a concise answer with little or no supporting argument
18.	trace	to follow a path

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