NCCA
An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

Draft Science, Technology and Engineering Education Specification

For primary and special schools

For consultation

March 2024

Contents

1. Introduction

The primary curriculum supports high-quality learning, teaching, and assessment for all children attending primary and special schools. The *Primary Curriculum Framework*[1] recognises primary education as a time of 'being' and 'becoming'– highlighting the importance of interesting, relevant, and appropriately challenging experiences for children. It is important that children enjoy and feel empowered through their engagement with these experiences in the present, whilst simultaneously equipping them for learning in the years ahead.

Science, technology and engineering are continually evolving. Science, Technology and Engineering Education provides children with opportunities to explore, investigate and interpret our world and beyond. Children learn that in light of new discoveries and technological advancements, problems can be solved, enabling rapid adaptability and changes to how we live in this world. Science, Technology and Engineering Education supports children in developing the knowledge, skills and dispositions required to make informed decisions about local, national and global challenges. The wider benefits of learning in Science, Technology and Engineering Education include building resilience, nurturing creativity and the ability to engage in child-led critical inquiry and design.

When published, the Science, Technology and Engineering Education specification will sit alongside the *Primary Mathematics Curriculum*[2] to comprise the new primary Science, Technology, Engineering and Mathematics (STEM) curriculum area. STEM education can provide children with purposeful, integrated learning experiences enabling children to apply, reinforce and consolidate their disciplinary knowledge across both Science, Technology and Engineering Education and Mathematics.

The curriculum acknowledges that from birth, children begin their educational journey through interactions and experiences with the world around them. In primary and special schools, children have playful and engaging learning experiences that build upon the knowledge, skills and dispositions they have acquired at home and in preschool settings through *Aistear: The Early Childhood Curriculum Framework*[3]. As children move through primary and special school their learning connects with, and is further progressed through, the learning experiences provided in Junior Cycle. Each child's learning journey is different, and so the curriculum provides agency and choice to teachers and school leaders as they support children in their holistic development, ensuring equality of opportunity, participation and outcome for all.

[1] Department of Education (2023). Primary Curriculum Framework. Dublin: Department of Education. Accessed at https://www.curriculumonline.ie/Primary/The-Primary-Curriculum-Framework/

[2] Department of Education (2023). Primary Mathematics Curriculum. Dublin: Department of Education. Accessed at https://www.curriculumonline.ie/Primary/Curriculum-Areas/Mathematics/

[3] National Council for Curriculum and Assessment (2009). Aistear: The Early Childhood Curriculum Framework. Dublin: National Council for Curriculum and Assessment. Accessed at https://curriculumonline.ie/Early-Childhood/

Principles of learning, teaching and assessment

Eight overarching principles underpin and guide schools in pursuing the vision of the Primary Curriculum Framework. These principles convey what is valued in primary and special education and what lies at the heart of high-quality learning, teaching, and assessment in the primary curriculum. They are broad in nature to reflect varied school contexts and children's different circumstances, experiences, and abilities. Table 1 presents a set of examples of the principles in action within Science, Technology and Engineering Education.

Table 1: Principles of learning, teaching and assessment

Principles of learning, teaching and assessment	Examples within Science, Technology and Engineering Education
Partnerships	• Inviting members of families and the local community to speak about STEM in their lives and to be an audience for displays and presentations of learning. • Creating links or clusters with neighbouring primary, special, pre-primary and post-primary schools to collaborate on projects or tasks. • Collaborating with scientists, engineers and people working with technology, locally or online.
Learning environments	• Using the physical and immediate environment around the children to facilitate learning experiences. • Attending exhibitions and tours to encounter different perspectives and deeper learning experiences. • Fostering learning environments that encourage exploration, investigation and creativity.
Inclusive education and diversity	• Fostering child-led learning. • Facilitating inclusive and appropriately challenging tasks. • Challenging stereotypes and nurturing empathy, respect, collaboration and children's unique contributions to discussions and tasks.
Engagement and participation	• Facilitating hands-on and minds-on learning. • Encouraging participation by using children's lived experiences. • Promoting engagement in pair work, group-work, whole class contexts and across the wider school community.
Assessment and progression	• Using a selection of assessment methodologies, including teacher observation, work samples, photographs and portfolios to monitor progress. • Using assessment to inform and shape future learning foci and learning experiences. • Engaging children in the assessment process to inform and support progression.
Transitions and continuity	• Building on how children make sense of the world around them through engineering activities and scientific inquiry, connecting with the Aistear theme of Exploring and Thinking. • Fostering children's sense of self-identity as scientists, engineers and technologists. • Drawing awareness to the subjects of Biology, Physics, Chemistry, Engineering and creating with Technology that children will encounter at post-primary school.

Relationships	• Presenting projects and learning with others in the school community to increase engagement and to support learning. • Fostering collaboration across the school community through STEM investigations and problem-solving tasks. • Designing and creating solutions for the benefit of the school community; showing empathy and care to build positive relationships with others.
Pedagogy	• Using a range of pedagogies including playful, sensory and creative approaches to learning. • Providing opportunities for inquiry-focused, active and practical learning experiences where children can apply existing learning and acquire new knowledge and skills. • Encouraging children to investigate situations and solve problems that are closely related to their everyday lives, circumstances and interests.

Overview of the Science, Technology and Engineering Education curriculum

The opening chapters of the Science, Technology and Engineering Education curriculum present the Rationale, Aims, Strands and Elements, and Learning Outcomes. Chapter 6 provides guidance on the curriculum in practice, while the final chapters provide an overview of the Science, Technology and Engineering Education Online Toolkit and glossary of terms.

The curriculum area is supported by the Science, Technology and Engineering Education Online Toolkit. It contains a range of supports for enacting the curriculum such as support materials and examples of children's learning.

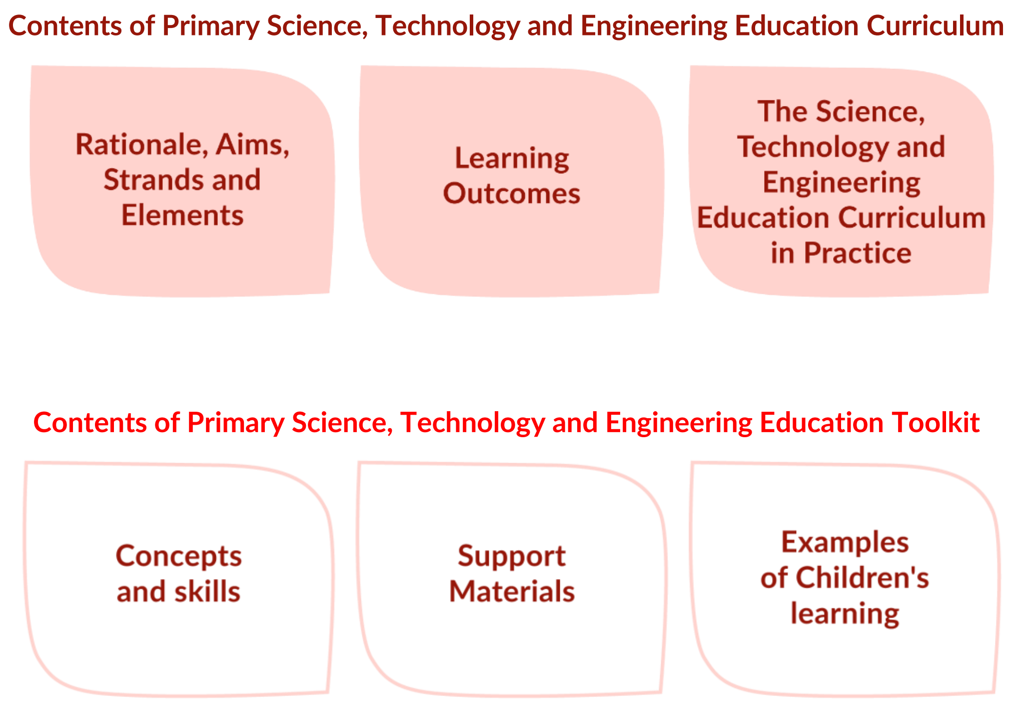

Figure 1: Overview of the Primary Science, Technology and Engineering Education curriculum and Online Toolkit

2. Rationale

Science, Technology and Engineering Education enables an understanding and appreciation of our local environments and the wider world. It supports children's learning about nature, materials, the living world, energy and forces, human endeavours to design and create, and the rapidly changing advancements in digital technologies - all of which impact our daily lives.

Learning in Science, Technology and Engineering Education benefits from multiple perspectives and skill sets which support decision-making, problem solving and facilitates richer learning experiences. Science, technology and engineering are intrinsically linked and facilitate the development of each of the seven key competencies of the *Primary Curriculum Framework*.

Children are instinctively curious and are natural investigators, designers and creators
Science, Technology and Engineering Education evokes children's innate curiosity and develops their ability to investigate, design, construct and communicate effectively. Through hands-on and minds-on engagement in Science, Technology and Engineering Education, children can experience and investigate the world around them first hand. Through these learning opportunities, children can develop individual interests and key competencies, learn important life skills and build confidence and resilience.

Science, technology and engineering provide us with a greater understanding of our world
Science, technology and engineering enhance our ability to interpret the world; it plays a mitigating role in responding to significant global challenges. Learning about science, technology and engineering empowers children to become responsible citizens who respect nature and value their local and wider environments. Science, technology and engineering creates possibilities to address human needs and realise opportunities. When scientific knowledge and skills are applied to engineering and technology tasks, this helps children to see the true nature of our interconnected world, while enriching the value of their learning.

Science, Technology and Engineering nurtures real-world problem-solving skills
Problem-solving is central to Science, Technology and Engineering Education. In working with real-world and imagined problems, children are asked to identify challenges, break them down into manageable components and develop possible solutions. Problem-solving requires creative thinking skills and critical inquiry as well as perseverance. Problem-solving fosters a sense of empowerment and demonstrates to children that they have the capacity to make a positive impact on their own lives and the lives of others.

Science, technology and engineering connects with children's experiences and interests
Science, technology and engineering have relevance in all children's lives, connecting their learning experiences with their interests. The exploratory nature of science, technology and engineering makes it a natural space to engage in play and playful learning with traditional materials such as toys and everyday equipment found in schools, as well as with contemporary and emerging technologies. It also offers a route into developing children's awareness of environmental issues, and the need for design solutions that protect resources and enable sustainable living. It can provide limitless opportunities to cultivate and nurture children's imagination, creativity and innovation.

Science, technology and engineering fosters agency in children

Science, Technology and Engineering Education provides children with opportunities to engage in decision-making about how to conduct scientific inquiry, how to design for a purpose and how to create with technology. Children are encouraged to act independently, make informed choices, take calculated risks and demonstrate resilience and adaptability where obstacles are encountered, or plans need to be modified. Nurturing agency through open-ended, child-led science, technology and engineering learning experiences can build competent and confident decision-makers and problem-solvers.

3. Aims

Science, Technology and Engineering Education supports children's capacity to understand and engage fully with the world around them.

The following aims describe a vision for children's learning in Science, Technology and Engineering Education.

Curious Disposition

To explore the world with curiosity and playfulness and develop an appreciation for the endless possibilities that science, technology and engineering offer us as human beings

Skills Development

To develop, use and adapt a variety of science, technology and engineering skills in effective ways

Conceptual and Procedural Understanding

To comprehend key science, technology and engineering concepts and procedures

Creative Innovation

To use imagination and creativity to generate ideas, make discoveries and explore possible solutions to real-life and imagined problems in science, technology and engineering

Critical Engagement

To be open-minded whilst questioning, discussing and making judgements using evidence

Communication and the use of Disciplinary Language

To use and apply science, technology and engineering language in order to communicate, evaluate and reflect on learning experiences

4. Strands and Elements

Strands

Strands describe the main categories of learning in Science, Technology and Engineering Education, and include:

- Nature of STEM
- Living things
- Materials
- Energy and Forces
- Technology
- Engineering.

Elements

Elements describe the main categories of processes (how children learn) that children engage in as they learn about and work with science, technology and engineering. Four elements have been identified for Science, Technology and Engineering Education:

- Exploring and understanding
- Creative and critical thinking
- Problem-Solving and applying
- Evaluating and communicating.

Table 2: Elements of Science, Technology and Engineering Education Curriculum

Element	Description
Exploring and understanding	Children are natural explorers and enjoy opportunities to ask and explore questions of interest; engage in active learning; and construct their understanding through collaboration with others. Through focused exploration, children's natural curiosities and interests can be sparked, leading to discoveries and a deeper understanding of the intrinsically linked nature of science, technology and engineering.
Creative and critical thinking	Science, Technology and Engineering Education provide a natural space for play and playful learning. Children make innovative discoveries and solutions in response to real and imagined situations and problems where they can think creatively and critically; experiment, design and take calculated risks; and lead their own learning experiences.

Problem-Solving and applying	Problem-solving and investigating are integral to learning in Science, Technology and Engineering Education. Children apply their knowledge, skills and dispositions to solve problems of interest in creative and meaningful ways. They work collaboratively to use a range of strategies where they can apply and test their ideas and designs; plan, observe and record their findings; refine their understanding through analysis, reflection and evaluation; and importantly, where they can build perseverance and resilience as learners.
Evaluating and communicating	Children use appropriate language and/or means of communication to convey ideas and perspectives, present their thinking, justify pathways and draw conclusions from evidence. Through inquiry and collaboration, children develop their ability to communicate and presents their ideas to others; analyse and critically evaluate the effectiveness of a proposed or complete solution; and give and receive feedback on their ideas, strategies and contributions.

5. Learning Outcomes

Learning Outcomes are used to describe the expected learning and development for all learners at the end of a two-year stage, when due account is taken of individual abilities and varying circumstances. They encompass the knowledge, skills, concepts, dispositions, attitudes and values that children develop within Science, Technology and Engineering Education. The Learning Outcomes reflect the learning that is most appropriate for each stage in Science, Technology and Engineering Education.

Reflecting the principles and pedagogical approaches in the *Primary Curriculum Framework*, the 'stem' '*Through appropriately playful and engaging learning experiences*' is used to introduce Learning Outcomes across all stages. A playful and engaging approach to learning and teaching serves to present Science, Technology and Engineering Education as an open and accessible learning space. This stem aims to fosters a learning environment that facilitates rich learning experiences, as outlined in Chapter 6, 'The *Primary Science, Technology and Engineering Education Curriculum* in Practice'.

The Science, Technology and Engineering Education curriculum recognises that children learn and teachers teach in a variety of contexts. Learning Outcomes in Science, Technology and Engineering Education are broad and balanced in nature to facilitate teacher agency and flexibility in schools. When shared with children, Learning Outcomes can support them to have clear expectations and to be active agents in their own learning.

The draft concepts for the Technology strand are included in Appendix 1. These key ideas may provide useful reference points when planning, teaching and assessing and may serve to remind teachers of key technological knowledge at each stage.

Key Competencies

The primary curriculum has seven key competencies which overlap and combine to support the curriculum's vision. As outlined in the *Primary Curriculum Framework*, the competencies build on the capabilities children acquire through their early childhood education experiences with *Aistear: The Early Childhood Curriculum Framework*; and are further strengthened in post-primary school in Junior Cycle. Rich leaning experiences in Science, Technology and Engineering Education nurture children's curiosity to make connections with the world around them, and to explore pathways and solutions to potential problems. As children work towards the Learning Outcomes in the Science, Technology and Engineering Education curriculum and engage in meaningful learning experiences, they simultaneously build and develop the key competencies.

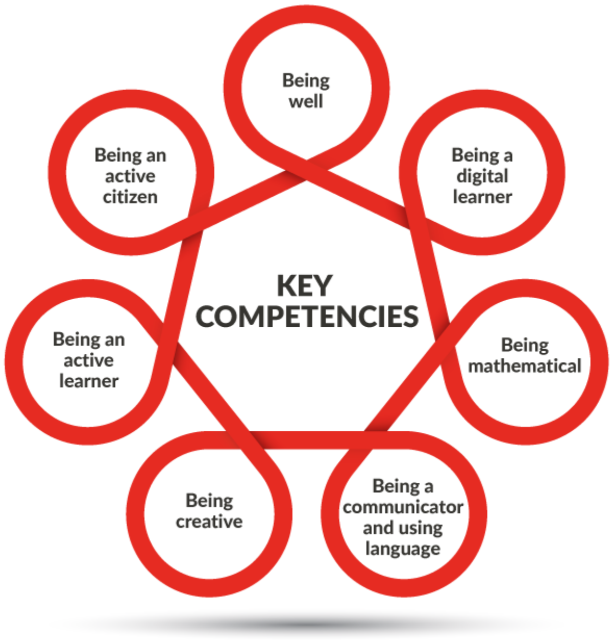

Figure 2: Key Competencies

Table 3: Examples of attributes of each key competency developed through learning in Science, Technology and Engineering Education

Key Competency	Examples of attributes developed through learning in Science, Technology and Engineering Education
Being an active citizen	• Searching for evidence and exploring solutions to problems in order to view different perspectives and to help others. • Applying skills acquired through scientific inquiry, design thinking and computational thinking to real-life contexts.
Being creative	• Exploring solution pathways that can creatively address a question or a challenge. • Using creativity to make choices, choose pathways and lead their own learning.
Being a digital learner	• Exploring and using a range of digital technologies to enhance how we learn about and work with science, technology and engineering. • Using digital technologies to design and create; fostering an awareness of the potential of the technological world.
Being mathematical	• Exploring the ways that Mathematics underpins and enhances learning in Science, Technology and Engineering Education. • Applying and consolidating mathematical ideas through a practical and playful approach.
Being an active learner	• Engaging in active, playful, hands-on and minds-on learning in collaborative contexts. • Participating in learning activities that involve/promote risk-taking and relationship building.
Being a communicator and using language	• Co-constructing and articulating ideas, discoveries, designs and solutions and how they contribute to our collective knowledge

	about the world. • Explaining and sharing the various ways that they have come to understand and apply ideas in science, technology and engineering.
Being well	• Developing a tolerance for risk-taking and mistake making; whilst collaborating with others and building perseverance. • Strengthening a sense of belonging, identity, motivation and confidence as learners and problem-solvers.

To assist teachers in identifying the Key Competencies that have been embedded within the Learning Outcomes you will see initials beside each Learning Outcome, as explained in Table 4.

In each instance, the three key competencies most relevant to the Learning Outcome are identified. It should be noted that in many instances other key competencies, outside of the three identified, are also embedded in the Learning Outcomes.

Table 4: Key competencies identified within Learning Outcomes

Key competency	Initials
Being well	W
Being a digital learner	DL
Being mathematical	M
Being a communicator and using language	CL
Being creative	C
Being an active learner	AL
Being an active citizen	AC

Table 5: Learning Outcomes across all strands of the Primary Science, Technology and Engineering Education specification

Strand	**Stage 1** Learning Outcome	**Stage 2** Learning Outcome	**Stage 3** Learning Outcome	**Stage 4** Learning Outcome
		Through appropriately playful and engaging learning experiences, children should be able to		
Nature of STEM	Explore and experience how people working in Science, Technology, Engineering and Mathematics (STEM) carry out investigations and help to solve problems, big and small, that impact our world. AL, DL, M	Develop their 'STEM eyes' by exploring their immediate environment (home, school, play areas) and everyday objects through a STEM lens. AL, DL, M	Explore, discuss and investigate the history of STEM, the evolving nature of STEM and how STEM is infused within our society. AL, DL, M	Build an understanding of key tenets of Nature of Science, Nature of Technology and Nature of Engineering; and discuss and research topical STEM issues in Ireland and in the wider world. AC, AL, DL
Living Things	Develop an awareness and understanding of the unique characteristics and functions of the external parts of the human body. Identify the basic needs for humans to grow and thrive. Explore and investigate the five human senses. AL, C, W Explore the natural world outdoors. Identify plants and animals in their local habitats and build an understanding of their physical characteristics and the basic conditions they	Understand the difference between living and non-living things. Develop an awareness of the main phases of the human life cycle and the importance of food for energy and growth. AL, W Observe and identify a range of plants (from both the local and wider environment); and design and conduct investigations into the conditions needed for plants to grow. Develop an awareness of how an animal grows and changes over its life cycle.	Identify and research the main organs of the human body and conduct a scientific inquiry into the function of at least one organ. Investigate how the organ works, how it keeps healthy and how it reacts to stimuli. AL, CL, W Classify groups of plants and animals in multiple ways with increasing detail. AL, C, M	Identify and discuss the main systems of the human body and how they work together. Research how at least one system of the human body operates. AL, CL, W Develop an understanding of the nutritional value of everyday foods and the importance of good nutrition on the human body. AL, W

	need to survive and flourish. AL, W	AL	Explore and investigate the interdependence of living things within ecosystems how they adapt so they can survive and thrive; and how basic food chains operate within them. AL, AC	Demonstrate awareness of how their learning about Living Things connects to the wider field of Biology and other 'Bio' fields. Explore how science can serve to better understand and solve biodiversity related problems locally and/or nationally. AL, AC, CL
Materials	Explore a range of common materials indoors and outdoors. Discuss what the materials are made of and the ways they can be used in different contexts. AL, CL Explore, observe and discuss the cause and effect of changes to everyday materials. AL, CL	Distinguish between natural and non-natural materials. Identify and classify the main properties of materials and investigate how the properties compare and contrast. Ask testable questions to determine what materials are most suitable for different circumstances AL, CL, M Plan, conduct and record inquiries on how materials are affected by changes in temperature, composition and the environment/weathering. AL, M	Classify materials according to their state (solids, liquids and gases), properties and how environmentally friendly they are. AC, AL, CL Plan, conduct, record and evaluate open-ended inquiries into the effect of heating and cooling on common materials, including foods; experiment how some changes to materials can be permanent or reversible; and determine which materials are better conductors or insulators of heat. AL, CL, M	Research how the composition of everything around us, even air, has mass and is made up of tiny particles. CL, M Identify the properties of materials that need to be considered when constructing structures, fashion and food. AL, CL, M Demonstrate awareness of how their learning about materials connects to the wider field of Chemistry. Explore and classify

				materials which are natural and manufactured and conduct open-ended, fair test investigations into the consequences of combining, separating and changing materials. AL, CL, M
Energy & Forces	Build on their awareness that energy is all around us. Explore and identify common sources and forms of energy and investigate how energy is used to make things work, including our bodies. AL, CL Explore and investigate different forces on objects including pushing, pulling, floating and sinking. Make predictions and investigate the effects magnets have on different materials. Discuss everyday uses of magnets. AL, CL	Explore the role that energy plays in everyday life and research how energy can be conserved for the good of the planet. AC, AL, CL Identify sources of sound in the environment. Investigate core ideas related to sound - vibrations, volume, sound waves, developing the skill of observation. AC, AL, C Conduct inquiries on how forces can affect the shape, movement and motion of objects. AL, C, M	Identify and distinguish between renewable and non-renewable sources of energy, and how sustainable these sources are. Explore how these energy sources can be stored, released and converted from one form to another. AC, AL, CL Identify natural and artificial sources of light. Investigate core ideas related to light including light as energy, the spectrum of colours, reflection, refraction and magnification. AL, CL, M Investigate and describe how forces can cause simple machines to operate. Deduce how forces can cause things to	Research and investigate environmental and social aspects of energy, including the role that society can play in reducing energy consumption and promoting clean energy. AC, AL, M Research how electricity works, conduct open-ended inquiries on electricity and electrical circuits. Identify and classify materials as electrical conductors or insulators. AC, AL Demonstrate awareness of how their learning about energy and forces connects to the wider field of Physics.

			start and stop moving; to change speed, direction or shape. AL, M	Conduct open-ended investigations on friction, gravity and the force of moving water. AL, C, M
Technology	Build on their awareness of a range of different types of technologies, including digital and non-digital, that they encounter in their everyday lives; explore and express how these technologies help us and those around us, to live and work in the world. AL, DL, W Explore how problems can be broken down (decomposed) into a sequence of steps (algorithm); apply their understanding of these ideas in unplugged and plugged contexts to solve problems. AL, DL, M	Explore how to use a range of common digital and non-digital technological tools to assist learning in their own lives; consider what purposes these tools serve and what makes them effective. AC, AL, DL Build on their understanding of digital tools to explore how they operate according to precise instructions; plan and create a program using a step-by-step process; adjust and modify steps when required. AL, DL, M	Understand and describe how a digital system operates, for example a computer or a tablet; build an awareness of how hardware and software enable a digital device to work effectively; explore and use a range of software and hardware to assist their own learning. AL, C, DL Create and test instructions (algorithms) or programs to achieve a desired outcome; identify when instructions have errors, suggest possible improvements and correct them (debugging). C, DL, M	Appreciate the role that data plays in the digital world; select and use a range of digital technologies to access, select and present information/data that is relevant to their learning. CL, DL, M Explore and use their understanding of algorithms or programs to create a representation (computer model) of something from the real-world; test and adjust (simulate) these representations to make them more effective. C, DL, M
Engineering	Explore real and imagined design problems that affect them and others; communicate and share ideas about solving these problems; plan, construct and reflect on a design.	Use empathy to identify and define design problems that they can solve with others; use a range of approaches to plan and create simple prototypes to represent the design solution; share	Identify and research design problems of interest; use empathy to consider user needs, risks and limitations when planning solutions; build, test and evaluate prototypes using	Collaborate with others to define and refine design problems and solutions; use sketching, traditional or digital tools to create plans and represent prototypes;

	AL, C, CL	reflections and feedback on the design process. AL, C, CL	everyday materials; make improvements and iterations based on reflection and feedback with others. AL, AC, CL	test and evaluate the impact of the design solution; draw conclusions and present an analysis of the design process. AL, C, DL

6. The Science, Technology and Engineering Education Curriculum in Practice

As outlined in chapters 2 and 3, the rationale and aims of the *Science, Technology and Engineering Education Curriculum* describe the vision held for children's learning in primary and special schools. This chapter describes the features of children's learning with the curriculum, the related pedagogical practices and an approach for supporting integrated STEM learning (section 6d) which outlines guidance on how to provide for integrated STEM learning experiences.

6a. Teaching in Primary Science, Technology and Engineering Education

A rich learning environment provides an important context for children's learning experiences in Science, Technology and Engineering Education. In providing for playful and engaging learning experiences, it is essential to offer opportunities for children to:

Table 6: Learning opportunities in Science, Technology and Engineering Education

Exploring and understanding	Creative and critical thinking
• Ask a range of questions, make observations and inferences • Conduct research and a range of investigations, both indoors and outdoors • Connect new and previous learning and ideas • Explore using a diverse range of materials, media, tools and approaches • Organise and make sense of information gathered from relevant sources • Analyse information, interpret results and make informed decisions • **Be active and curious**	• Take time to brainstorm ideas individually, in small groups and as a whole class • Consider diverse perspectives and different solution paths • Design and create open-ended investigations and plans • Make informed decisions and calculated risks • Investigate and critique ideas for relevance and clarity • Consider safety, limitations and possible ethical considerations • **Be open-minded and innovative**
Problem-solving and applying	**Evaluating and communicating**
• Work collaboratively with peers in pairs, small groups and as a whole class • Create, build and refine models and prototypes • Troubleshoot, debug and modify ideas and approaches, where appropriate • Select appropriate methods for collecting and recording relevant information • Develop and use hands-on, practical skills • **Be organised and persevere**	• Learn and use appropriate language and terminology • Present ideas, methods and results in meaningful ways • Listen to and reflect with others. • Offer, reflect on and respond to constructive feedback • Use evidence and logic to justify decisions and support arguments • Evaluate the strength and effectiveness of ideas, solution-paths and conclusions • **Be analytical and informed**

Supporting all children

Each child is an individual with a unique set of strengths that need to be nurtured. Learning Outcomes provide the opportunity for children to learn through multiple pathways supporting individualised and inclusive learning experiences, particularly for children with additional needs. Additional Support Pathways (ASP) help identify the most appropriate learning experiences for children as they engage with Learning Outcomes in the curriculum. Using the pathways teachers can consider the learning experience in greater detail and identify appropriate levels of challenge for children. In the course of their learning children can be experiencing, attending, responding, initiating, acquiring, becoming fluent and generalising. Table 7 describes these in more detail.

Table 7: Additional Support Pathways

Additional Support Pathways	The child…
Experiencing	is present during a learning activity. They are exposed to and/or aware of the learning environment. They are beginning to acclimatise to the learning environments such as objects, people, sounds and other sensory experiences.
Attending	becomes attentive to and/or engaged with the learning activities presented by changing gesture, posture, vocalisation, eye gaze, movement etc. They are acclimatised to the learning environment.
Responding	demonstrates capacity to actively or purposefully take an interest in the learning environment. They begin to indicate likes, dislikes or preferences. They actively respond to a learning activity with or without support.
Initiating	shows curiosity about the learning environment. They actively and independently seek opportunities to engage with and/or influence that environment.
Acquiring	demonstrates that knowledge, a concept or a skill is being learned. They explore and participates in the learning.
Becoming Fluent	moves towards fluency and accuracy in familiar learning contexts. They independently and consistently demonstrate recall mastery of the skill/concept/knowledge learned.
Generalising	transfers and applies learned skills, knowledge or concepts to familiar and unfamiliar contexts.

6b. Teaching in Primary Science, Technology and Engineering Education

'How' children learn is as important as 'what' children learn. The following pedagogies are considered essential to the provision of meaningful learning experiences in Science, Technology and Engineering Education. They foster an inclusive learning environment and culture where children engage in rich and meaningful learning processes, as described in section 6a. Moreover, these practices offer opportunities to connect with children's life experiences, strengths and interests and allow for children to develop at a pace and challenge that is individual to their needs and interests.

The practices highlighted here should not be considered exhaustive or hierarchical but as part of a repertoire of evidence-based pedagogical practices which can be used to support high-quality learning experiences in Science, Technology and Engineering Education.

Key Pedagogical Practices:

Table 8: Key Pedagogical Practices

1.	Scientific Inquiry
2.	Design Thinking
3.	Computational Thinking

Scientific Inquiry

Scientific inquiry is an approach which emphasises children's active participation in science. The inquiry process typically begins with a question or challenge for exploration, mirroring the way Scientists work in real contexts. Inquiries can initially be instigated and led by teachers to build on and develop children's prior science knowledge and scientific skills. The children can then advance from teacher-led, to guided and increasingly child-led inquiries which offer children more opportunities for decision-making throughout the inquiry process.

As children progress through each stage, inquiries can become more child-led, open-ended and challenging; with increased opportunities for children to pose their own scientific questions, design their own investigations and justify their own findings and conclusions. Children can build and strengthen scientific skills, scientific content knowledge and their understanding of the Nature of Science by engaging in a variety of types of scientific inquiries including; observation over time, pattern-seeking, identifying and classifying, fair testing and researching.

Inquiry-based science is not a prescribed, uniform or linear process. When children ask a testable question in science, they can use their agency and creativity to design investigations suitable for the inquiry they have chosen. For example, some inquiries may focus on making targeted observations, others may require a greater focus on data collection and some investigations may need to be carried out over weeks or months, all which can be addressed in bespoke planning. Inquiry design should allow for creativity, flexibility and adaptability.

Teachers can help promote the use of *scientific inquiry* by:

- Adopting an open-minded and curious disposition themselves
- Presenting children with opportunities and materials to actively engage in scientific inquiry
- Facilitating children to use their agency to choose questions/challenges that interest them
- Enabling children to discover knowledge that is new to them through their own investigations
- Drawing children's attention to the scientific skills they are using and how they are working 'like a scientist'
- Encouraging children to apply their mathematical skills when gathering evidence, interpreting, analysing and reporting on the inquiries they pursue
- Giving children opportunities to engage in different types of scientific inquiry
- Encouraging children to persevere with their inquiries when they encounter obstacles
- Emphasising the importance of evidence in making scientific arguments
- Fostering a culture of scientific collaboration in the classroom
- Engaging in reflection on skills used, content learned, and connections made to the scientific world
- Encouraging children to be aware of scientific inquiries in the news, online and in the world around them.

Design Thinking

Design Thinking (DT) is an action-based and practical process to support creative problem-solving and innovation in Science, Technology and Engineering Education. DT provides opportunities for children to collaboratively share knowledge, ideas and questions in authentic problem-solving contexts. Learning experiences in DT support the development of meaningful research and critical-thinking skills. By generating questions, planning for, and reflecting on the design process, children will learn how to explore the process of problem-solving.

DT emphasises the importance of different perspectives and approaches in viewing and solving problems. Opportunities afforded to children to reflect on and consider the needs of others support the development of empathy and understanding. DT encourages hands-on exploration of problem-solving through the processes of designing, creating, refining and evaluating. It encourages dispositions and a mind-set that is open to change and listening to the opinions of others. It fosters perseverance and creative risk-taking as children encounter challenges or setbacks in the design process.

Although a DT approach typically outlines several steps which can be followed sequentially, it is a flexible and iterative process, whereby children can move back and forth between the stages. The flexibility of using DT means that it can be adapted for a specific topic or integrated across several topics in order to simulate them together in a meaningful way.

Teachers can help nurture *Design Thinking* by:

- Modelling empathy, perseverance and a solution focused attitude to learning and working
- Assisting children in the selection of problems that are of interest to them and relevant to their own lives

- Modelling perspective-taking and encouraging children to explore problems from the perspectives of others
- Providing opportunities for children to brainstorm and generate ideas in pairs, groups and as a whole class
- Enabling children to research topics of interest collaboratively using a range of approaches
- Facilitating children to plan, build, test and apply prototype design
- Drawing children's attention to the engineering skills they are using and how they are working like an engineer
- Challenging children to test and refine their prototypes through collaboration and deliberation
- Encouraging children to be creative in their designs and to take risks as part of the process
- Providing opportunities for children to reflect on the process of design and evaluate their successes and setbacks.

Computational Thinking

Computational Thinking (CT) draws on the principles of computing to think about and solve problems. It involves the processes that we use when considering and solving problems in a way that computers can assist us. When children develop their CT, they can apply this learning across science, technology, engineering and beyond.

Learning experiences in CT encourage children to use logical thinking and reasoning to break down problems into manageable components, to apply prior knowledge to new contexts, and to focus on key information relevant to the process of problem-solving. These skills are supported and strengthened by a range of dispositions that can be fostered through CT approaches. When used effectively, children can develop confidence and persistence in working with challenging open-ended problems and can foster their ability to collaborate and communicate with others when problem-solving.

CT can be fostered through the experience of unplugged activities in the classroom setting which do not require the use of traditional or digital technology. However, as children progress through primary education, it is important that they have increased opportunities to apply and build on their CT through engagement with plugged activities which use digital technology. Beginning with basic programming languages and coding, these activities may involve the design and development of algorithms to create programs for a particular use and can be broadened to include many other aspects of digital technology.

Teachers can help foster *Computational Thinking* by:

- Broadening children's understanding of CT as a problem-solving approach across Science, Technology and Engineering Education and other curricular areas
- Assisting children in breaking down problems into a series of manageable steps (decomposition) and applying this skill in both digital and non-digital contexts
- Modelling the recognition of patterns and encouraging children to identify patterns that they have previously encountered (pattern recognition), when completing both unplugged and plugged activities
- Providing opportunities for children to investigate and engage as both a 'user' and 'creator' of digital and non-digital technology

- Facilitating children to plan, design, test and run algorithms (set of instructions) using both unplugged and plugged activities
- Challenging children to test and modify their creations in digital technology through collaboration (debugging and abstraction)
- Encouraging children to persevere in their explorations and designs and to take risks as part of the process
- Developing the children's awareness of the CT processes they are using and how they are working like a computer scientist
- Providing opportunities for children to reflect on the CT processes and to evaluate their successes and setbacks.

6c. Assessing Primary Science, Technology and Engineering

Assessment is an integral part of teaching and learning. It is a collaborative process which involves children and teachers working together to use information that can benefit and support children's learning. Classroom assessment is continually evolving, informed by the process of collecting, evaluating and using evidence. Teachers are committed, skilled and agentic professionals who make key decisions about teaching and learning in Science, Technology and Engineering Education every day.

These decisions are informed and shaped by:
knowledge of the child and their prior learning
knowledge of the curriculum
knowledge of pedagogy.

The child and their prior learning

Children's prior learning, interests and experiences will shape their engagement and understanding in Science, Technology and Engineering Education. Assessing children's prior knowledge can guide teachers on how to use a learning sequence or scaffolds which best support opportunities to build on and deepen children's knowledge, concepts and skills. Prior knowledge can be assessed though a wide range of activities which facilitate opportunities for children to express, communicate and share their meaningful experiences of Science, Technology and Engineering Education in their own lives. These include self and peer assessment, questioning and observation. These opportunities encourage children to connect their prior knowledge, skills and dispositions with new experiences, drawing together new learning in a relevant and purposeful way.

The curriculum

By engaging with the Science, Technology and Engineering Education curriculum, teachers can reflect on children's learning experiences. As children work towards Learning Outcomes and develop and deepen their learning in Science, Technology and Engineering Education, assessment provides valuable information about children's progress. Using knowledge of the curriculum and the child's prior learning, teachers exercise agency to inform decisions about future learning in their classroom contexts.

Pedagogy
By reflecting on the learning opportunities provided to children (as described in section 6a) and the pedagogical practices enacted in the classroom (as described in section 6b), teachers can refine and adjust both the learning experiences and the learning environment. This serves to ensure that teachers are responding appropriately to children's learning. Collaboration with colleagues, continual professional development and accessing Science, Technology and Engineering Education teaching resources and tools provide further supports for teachers.

Opportunities for assessing learning in Science, Technology and Engineering Education

The ability to recognise Science, Technology and Engineering Education in children's everyday activities and to extend the potential learning arising from these everyday activities is critical to planning for assessment in the classroom. Children's learning in Science, Technology and Engineering Education can be assessed along a continuum from 'intuitive' to 'planned interactions' to 'assessment events' as shown in Figure 3. The three types of assessment are complementary, and necessary, to gain a comprehensive picture of a child's progress and achievement.

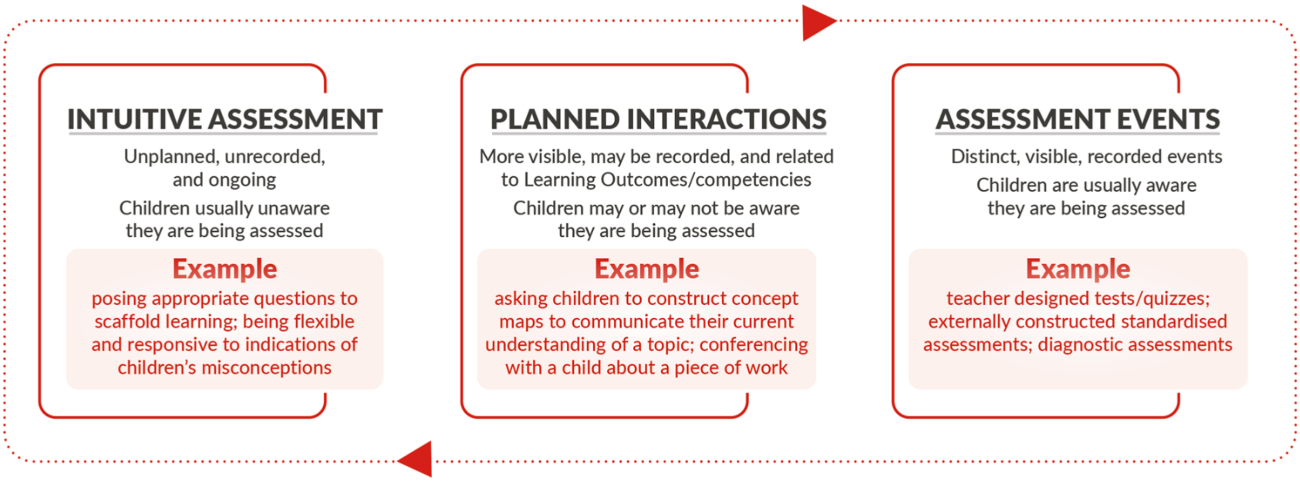

Figure 3: Types of assessment

During learning in Science, Technology and Engineering Education, assessment is likely to occur incidentally, intuitively and in response to contingency moments i.e., unplanned and unexpected responses from the child. Providing an openness for such contingency moments and capitalising where appropriate on insights gleaned from children's responses, questions, problems and tasks, can allow for very rich assessment data.

Methods for assessing learning in Science, Technology and Engineering Education

As teachers continually assess children's knowledge, skills and dispositions in Science, Technology and Engineering Education, they are likely to use a range of assessment methods, in inter-changeable ways, to build a rich picture of children's learning in Science, Technology and Engineering Education. Below are some of the methods likely to be used.

Observations: Observations support the use of intuitive as well as more structured and planned assessments. Teachers can actively listen, observe and respond to opportune learning situations when they arise organically as children explore, inquire and engage in Science, Technology and Engineering Education. Teachers can use structured observation of children's learning by focusing on certain skills, knowledge or dispositions in a range of different learning contexts.

Questioning: Effective questions in Science, Technology and Engineering Education consider the pacing and type of questions to be asked, the response method which will facilitate children's engagement and the information which can be used to inform future learning. As an assessment method, questioning encourages children to reflect, communicate and evaluate their own learning, encouraging agency and participation in the assessment process.

Feedback: The provision of feedback in Science, Technology and Engineering Education should centre around the process of learning, affording children the opportunity to communicate ideas and perspectives, identify and celebrate progress and achievements, reflect on challenges that they experience, and provide guidance for the direction of future learning.

Conferencing: Through teacher/child, peer/peer and group conferences, teachers can gain an insight into children's conceptual understanding in Science, Technology and Engineering Education and their progression in the use of relevant skills and dispositions, shaping the direction of future learning experiences.

Tasks/Digital Tasks: In Science, Technology and Engineering Education, tasks can provide opportunities for children to apply their understanding and skills in a range of different ways, including pair, group and individual contexts. Assessment tasks can be written, oral or practical and could incorporate the use of a digital tool or platform as a preferred method of engagement from children.

Rubrics/Shared Success Criteria: Rubrics involve the use of a coherent set of criteria for assessing children's learning which can be designed by teachers or created in collaboration with children. Rubrics can provide an insight into children's learning and assist the teacher in making judgements about children's progress and development. Rubrics are particularly helpful for teachers when assessing skills, dispositions or concepts that children use throughout the process of inquiry and problem-solving in Science, Technology and Engineering Education.

Peer and Self-Assessment: Peer and self-assessment involve learners thinking about their own and their peers learning. Through this reflection, children can make informed judgements and guide future learning. It encourages children to take responsibility for evaluating their own learning and to make connections across Science, Technology and Engineering Education. The teacher plays a significant role in fostering and scaffolding a learning environment which facilitates respectful and meaningful collaboration for peer and self-assessment.

Portfolios: Portfolios can be assembled, digitally or otherwise, to compile evidence of children's Science, Technology and Engineering learning and provide a source of self-reflection, feedback and assessment. Portfolios can be useful in Science, Technology and Engineering Education as a means of recording hands-on practical learning experiences. Artefacts could include pictures, recordings and work samples, among others.

Purposeful use of documentation supports good assessment practice. Documentation arises out of the process of gathering evidence, and includes the annotations and notes made by the teacher. Such documentation contributes to the rich, full picture that teachers need of each child as a learner in order to provide the support and experiences to support progression and development across the curriculum.

6d. Integrated STEM learning

Integrated STEM learning enables children to connect their learning across Science, Technology, Engineering and Mathematics and to apply this to real-world and imagined contexts. Dedicated time and space for children to engage in integrated STEM provides opportunities where they can apply, reinforce and consolidate the knowledge and skills they have acquired from their learning.

The following overarching statements set an important context for integrating learning experiences across the STEM subjects and the benefits this offers children in their learning and their lives, both in and outside of school.

Table 9: Overarching Statements on integrated STEM

Integrated STEM	Overarching Statements
Active Problem-Solving	Children become active problem solvers through opportunities to investigate and solve problems that require them to draw on and apply existing knowledge and skills associated with Science, Technology, Engineering and Mathematics.
STEM with a Conscience	Children develop ethical and responsible approaches to STEM by negotiating the impact of STEM endeavours for society, the environment and the planet; striving for improvement and sustainability.
STEM Mindset	Children develop a STEM mindset through learning experiences where they can look at the world with STEM eyes and consider alternative perspectives on how discoveries can be made, and problems can be solved; empowering them to think in new and beneficial ways.
STEM Literacy	Children enhance their STEM literacy through opportunities to connect and apply knowledge of STEM in practical and meaningful ways to inform decision-making and contribute to active citizenship.

An approach to integrated STEM learning

The following approach to integrated STEM learning outlines five phases that are useful to consider when guiding and supporting children's learning. It should be used flexibly and adapted to bespoke contexts. The five phases are as follows:

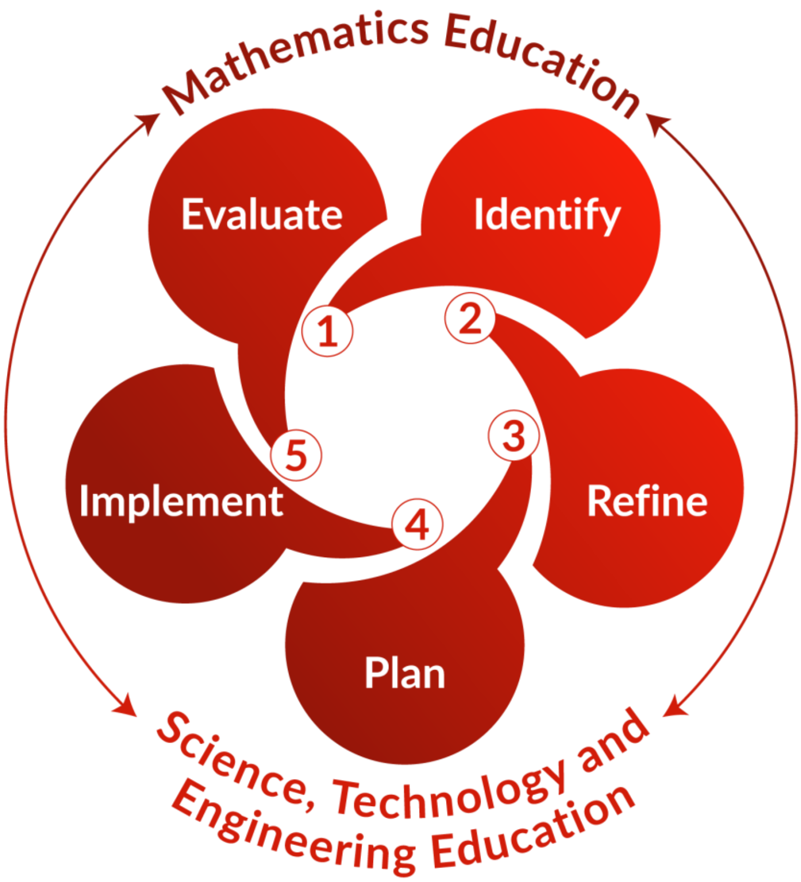

Figure 4: An approach to integrated STEM learning

1. IDENTIFY

- Children generate questions of interest on topics that have relevance to their lives or others. They can do so initially by exploring their wonderings on the topic e.g. "I wonder what ...."
- To identify the focus for an integrated STEM activity or task, the following questions can be considered by the teacher:
  - What problem or challenge is of most interest or relevance to the child?
  - What prior learning can be drawn on, consolidated and applied to help address a problem or challenge?
  - What new skill can be developed or strengthened during the process?

2. REFINE

- Using STEM eyes, children consider how a Scientist, Technologist, Engineer and/or Mathematician might 'look' at this question or challenge.

- To refine the focus for the integrated STEM activity or task the following questions can be considered by the teacher:
  - How might the detail of the question or challenge be adjusted so that it is more accessible, manageable or appropriately challenging?
  - What additional detail could be weaved into the task or activity to promote further integration? E.g. measuring or pattern identification
  - What equipment and resources will be necessary to address the question or challenge?
  - What safety issues, risks or environmental considerations may arise?

3. PLAN

- Drawing on previous learning experiences, children consider what processes a Scientist, Engineer, Technologist and Mathematician might adopt to tackle this problem or challenge (as described in Chapters 6a and 6b).
- Where helpful and relevant, children develop a plan, design or blueprint to tackle the problem or challenge. There are many different ways to plan, and plans can be modified and refined throughout the task or activity. To draft a useful plan, design or blueprint, the following questions can be considered:
  - What will the plan, design or blueprint look like? What format will it take and how will it be communicated to others?
  - What are the key steps necessary to take to tackle the problem or challenge?
  - What are potential obstacles that may be encountered? How can these be addressed?

4. IMPLEMENT

- Children implement their plans to tackle the question or challenge, with teachers promoting hands-on and minds-on learning (as described in Chapter 6a).
- Where gaps in existing knowledge and skills are identified that present an obstacle for learning progression, teachers can respond to these 'teachable moments'.
- As children implement their plans, designs or blueprints, the following questions can be considered by the teacher:
  - What opportunities are there to engage in essential learning as described in Chapters 6a?
  - What opportunities are there for children to lead and direct their own learning journey as they engage in the task or activity?
  - What skills, knowledge and perspectives are being used that are similar to those used by Scientist, Technologists, Engineers or Mathematicians?

5. EVALUATE

- Children present results, key learning and reflections from their engagement in the STEM task or activity, in ways that are meaningful to them and suitable for their audience.
- To support children's evaluation of their learning, the following questions can be considered:
  - What was the key learning from this task or activity?
  - What aspects of the task or activity worked well, not so well?
  - What knowledge and skills were critical to enable the problem or challenge to be tackled?
  - Reflecting on how you tackled the problem or challenge as a group, what would you do differently the next time?
  - What questions, problems or challenges remain that require further investigation?

Depending on the strengths, needs and interests of the children, the teacher's role in supporting children's learning will differ. While the aim is for children to lead and direct their own learning, children may require some scaffolds and supports to enable them to do this over time. The support and guidance offered by the teacher may also change depending on the phase of the activity or task. As children work on integrated STEM learning tasks and activities, the teacher plays an important role in spotlighting and naming the relevant knowledge and skills that the children are using; as well as how they are working like Scientists, Engineers, Technologists and Mathematicians.

Additional supports and exemplars for promoting and facilitating integrated STEM learning will be outlined in the Science, Technology and Engineering Education Online Toolkit.

7. Outline of the Primary Science, Technology and Engineering Online Toolkit

When developed, the Primary Science, Technology and Engineering Education Online Toolkit will provide practical support for teachers in building rich learning experiences for children. The components of the Online Toolkit will include support materials and examples of children's learning.

Contents of the Primary Science, Technology and Engineering Education Toolkit

Figure 5: Content of the Primary Science, Technology and Engineering Education Online Toolkit

8. Glossary

Table 10: Glossary

Term	Description
Abstraction	The process of filtering out and ignoring the characteristics of patterns that are not needed in order to concentrate on those that are.
Agency	The capacity to act independently and to make choices about teaching and learning.
Algorithm	A set of instructions and steps to create solutions to problems.
Biodiversity	Biodiversity refers to every living thing and the variety of life on Earth.
Biology	The study of the living world.
Chemistry	The study of matter/substances and the changes it can undergo.
Circuit	The complete path of an electric current around a series of wires and connections; if there is a break in the circuit the current will not flow.
Computational thinking	The processes that we use when considering and solving problems in such a way that computers can assist us.
Conductor	A material/substance that allows heat or electricity to flow through it.
Conservation	Prevention of wasteful use of a resource. The preservation and protection of the natural environment and of wildlife.
Data	A collection of information or facts, such as numbers, words, measurements, observations or other descriptions. Computer data is information in a form that can be processed by a computer.
Debugging	The process of checking and fixing errors in a program. A mistake or error in an algorithm or computer program is called a bug.
Decomposition	Breaking down a problem into several parts or components to make the problem-solving process more manageable and efficient.
Design problem	An open-ended problem that identifies a challenge, a question or a need.
Digital tool	Devices, web browsers, software and other digital technologies.
Digital system	Hardware and software components (internal and external) work together to make a digital device work efficiently.
Digital technologies	Electronic tools, systems, and devices that work by generating, storing or processing data.
Ecosystem	A community of organisms and their relationships with each other and with their environment.
Energy	Energy is the ability to move and do things.
Environment	The surroundings, natural and man-made, where plants, animals and

	humans live together.
Fair test	A test in which everything about the things being tested is equal, except the item being tested.
Food chain	The transfer of energy from one organism to another within a habitat or ecosystem; shows the feeding relationships between organisms.
Force	Anything that causes a change in the velocity of an object; force is loosely understood as being a push or a pull; it can make an object speed up, slow down, stop, change shape or change direction or can hold an object in place.
Friction	A force that opposes movement.
Gravity	A force of attraction between all bodies in the universe; the force of attraction between objects depends on their mass; the greater the mass of an object the greater the force of attraction.
Habitat	The place where an organism lives; it provides a particular set of conditions for life; it may be large (a field) or small (a leaf).
Hands-on/minds-on learning	Engaging in higher-level thinking **and** active learning.
Hardware	Hardware is the physical parts of a digital tool e.g., keyboard, mouse.
Heat transfer	The way in which heat is moved: in solids by conduction, in liquids and gases by convection, and from a hot object like the sun or a stove by radiation.
Hydraulics	The pressure/force of liquids that can make something work.
Inference	A conclusion reached on the basis of evidence and reasoning.
Innovation	The creating and use of new ideas and/or methods.
Insulate	Means to use a material to keep heat/electricity in or out of something.
Insulator	A material/substance that does not allow heat/electricity to flow through it.
Iterations	Changes that are made to a design or a prototype to improve its use and effectiveness.
Key Competencies	The essential knowledge, skills, concepts, dispositions, attitudes, and values which enable children to adapt to and deal with a range of situations and challenges.
Magnification	The apparent enlargement of an object by an optical instrument.
Mass	The measurement of how much matter is in an object.
Matter	Anything that takes up space.
Computer model	A representation of a real-world issue/event/challenge.
Nature of STEM	What STEM is, how it works and how it relates to the world around us.
Observation	Using the senses to obtain information about objects and events.
Physics	The study of how matter interacts with energy and forces.

Plugged activity	Activities which engage children in the process of computational thinking and computing with the use of digital technologies.
Programming	The process of writing instructions (algorithms) in a language that a program on a digital tool can understand.
Properties of materials	The features of a material that can be sensed, measured and tested.
Prototype	An early sample or a first draft of a design or a creation which can be adapted.
Reflection	A ray of light that hits off something and bounces back; all objects reflect light to some extent, some better than others; a mirror reflects light very well; sound can also be reflected.
Refraction	The change of direction of light when it passes from one transparent medium to another, for example from air to glass, water or plastic.
Renewable energy	Energy that is made from something that doesn't get used up, for example energy from wind, sun and water.
Resilience	The ability to recover quickly from difficulties or problems.
Scientific inquiry	The range of ways in which scientists investigate and study the world and propose explanations based on evidence.
Simulation	Computer programs that model a real-life scenario/task/challenge and test many possible outcomes against it.
Software	The programs which tell a digital tool what to do.
Spectrum (visible)	The range of colours produced when light is passed through a prism; colours can be seen when white light is split by droplets of water and forms only a small part of the whole electromagnetic spectrum. This spectrum includes radio waves, microwaves, X- rays and gamma rays, among others.
STEM Eyes	Looking at the world through the perspective of Science, Technology, Engineering and Mathematics (STEM)
Sustainability	Responsible use and preservation of resources to meet the needs of the present without compromising the ability of future generations to meet their own needs.
Teachable moments	Teachable moments occur where a teacher identifies that children would benefit from a short pause during a lesson to focus on the acquisition of specific and/or targeted disciplinary knowledge, skills or perspectives that can deepen and enhance their overall learning experience.
Testable question	A question that can be investigated by experimental inquiry.
Unplugged activity	Activities which engage children in the process of computational thinking and computing without the use of digital technologies.

Appendix 1: Technology Concepts within Science, Technology and Engineering Education

Concepts in Science, Technology and Engineering Education are considered key ideas that underpin each Learning Outcome. These key ideas may provide useful entry and reference points in relation to planning, teaching and assessment and may serve to remind teachers of key knowledge at each stage. They are presented according to stages 1 to 4 and link with the corresponding Learning Outcomes.

Table 11 outlines concepts for the Technology strand of Science, Technology and Engineering Education.

Table 11: Concepts underpinning the Technology strand across stages 1-4

	Stage 1	Stage 2	Stage 3	Stage 4
Learning Outcomes	Build on their awareness of a range of different types of technologies (digital and non-digital) that they encounter in their everyday lives; explore and express how these technologies help us and those around us, to live and work in the world. Explore how problems can be broken down (decomposed) into a sequence of steps (algorithm); apply their understanding of these ideas in unplugged and plugged contexts to solve problems.	Explore how to use a range of common digital and non-digital technological tools to assist learning in their own lives; consider what purposes these tools serve and what makes them effective. Build on their understanding of digital tools to explore how they operate according to precise instructions; plan and create a program using a step-by-step process (algorithm); adjust and modify steps when required.	Understand and describe how a digital system operates, for example a computer or a tablet; build an awareness of how hardware and software enable a digital device to work effectively; explore and use a range of software and hardware to assist their own learning. Create and test instructions (algorithms) or programs to achieve a desired outcome; identify when instructions have errors, suggest possible improvements and correct them (debugging).	Appreciate the role that data plays in the digital world; select and use a range of digital technologies to access, select and present information/data that is relevant to their learning. Investigate and use their understanding of algorithms or programs to represent a computer model of something from the real-world; test and adjust (simulate) these representations to make them more effective.
Key Concepts	Technology is designed and created by people to help make our lives better and easier.	Digital and non-digital technologies help us to learn, communicate and play in a variety of ways.	Hardware is the physical parts of a digital device e.g., keyboard, mouse. Software contains a collection of instructions which tells a digital device what to do. Software can be big like an operating system that runs the computer, or small like an app that runs on your phone.	Data is information. Digital technologies operate by storing and processing data. Data can be stored in different ways e.g., in the digital device itself, using external devices e.g. a hard drive or online e.g., through a virtual cloud.

	Technology can be digital and non-digital. Examples of non-digital technologies include pens, paperclips and hammers. Examples of digital technologies include computers, smart phones and televisions.	Digital tools can help us to: • Communicate with one another e.g., voice messages, video calls • Search for information quickly e.g., looking on the Internet for information, a video or a photograph • Present information in a variety of ways e.g., written, video, animation, infographics	Digital systems are different parts of software and hardware working together that enable a system to function for a purpose e.g., traffic lights, smartphone. Digital systems store information in digital form.	Input refers to the data that is entered into a computer or digital device. There are many ways that data can be inputted e.g. a touchscreen, microphone and keyboard. When a computer has finished processing input, it is sent back out of the computer ready to be used.
	Technology is all around us in many different forms and many people use it in their jobs. It helps us to learn, play and communicate.	Both digital and non-digital technologies are designed to perform a particular job or function. A difference is that digital technologies have been programmed.	Computers and digital systems can be connected in a network. This allows information to be shared and can help with tasks such as emailing and printing. The Internet is the biggest network of computers working together world-wide.	Output is the result produced by the digital device based on the input. Outputs can be sent to lots of different types of devices, including screens, printers, speakers and headphones.
	To solve problems, computers must follow a series of steps to break the problem down (decomposition) so that they can manage it more easily. When people work in this way, it is called computational thinking.	Digital tools are designed and programmed with specific instructions or commands (input). These tell the tool about what job or function they need to perform (process). In performing this job or function (output), they help us in different ways (output).	When creating an algorithm there are several considerations that we can think about.	Computer programs can help to create a representation or a model (e.g., number, graph, figure) of real-world or mathematical objects, properties, actions, or relationships. The model can be tested (simulated) to create different responses.

	An algorithm is what we call the series of steps or instructions that we create to solve problems. Algorithms can be used in both plugged and unplugged contexts.	Some digital tools perform a single job/function e.g., a remote control; while others perform many different jobs e.g. a computer.	The order or the sequence of instructions is important in an algorithm (sequencing). If the instructions are not in the correct order, the algorithm will not work effectively.	Abstraction is the process of filtering out and ignoring information that is not needed. It helps to concentrate on the important information needed.
	When we use digital devices to solve problems, this is called a 'plugged' activity. Activities that do not use digital devices are considered unplugged.	To be able to understand and process the instructions that a digital tool receives, the instructions must be written in a language or code that make sense. There are lots of different types of coding languages.	To make a program more efficient, sets of instructions can be repeated. This is called a loop.	The process of selection allows several paths to be included in an algorithm. When a question is asked, the program decides what to do based upon the answer. It is sometimes referred to as an if-then-else statement.
		Coding refers to the process of writing instructions (Algorithms) in a language that a program on a digital tool can understand.	A mistake or an error in an algorithm or computer program is called a bug. Debugging is the process of checking and fixing errors in a program. Coding in small chunks and testing frequently helps to reduce the task of debugging.	Programs hold information in different ways. A variable is a way of storing information in a computer program. The variable is like a container and remains constant. However, what is in the container may change.
		We often use the term coding and programming together. However, programming is broader than coding in that it involves designing and testing,	It can be useful to look for patterns in previously used algorithms and to consider how they can be applied in other ways.	Some variables are used to store numbers while others are used to store text. Variables can help make the programming more efficient.

		as well as writing instructions (coding).		

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