Science and Technology
K–6

Science
7–10

Draft syllabus

Consultation period
14 June – 22 August 2011

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Contents

Background information

The *Science K–10 Syllabus* is being developed to deliver the Australian Curriculum to NSW schools. The syllabus is being developed within the context of the NSW Board of Studies *K–10 Curriculum Framework*, using the Board's syllabus development process.

On 8 December 2010 Australian education ministers endorsed the Australian Curriculum content descriptions for Foundation to Year 10 Science. The endorsed content descriptions form the basis for the Board's development of the *Science K–10 Draft Syllabus* for implementation in NSW schools.

The K–10 syllabus will challenge students to meet high, but realistic, expectations as they progress through the years of schooling. It clearly articulates standards that show what students are expected to know and be able to do at each stage from Kindergarten to Year 10. This provides the context for assessment for learning and meaningful reporting of student achievement.

The draft syllabus

The draft syllabus has been guided by the *Science K–10 Directions for Syllabus Development* available on the NSW Board of Studies website. The *Directions for Syllabus Development* reflects the Australian Curriculum, Assessment and Reporting Authority (ACARA) developed curriculum, the feedback received from NSW stakeholders and the advice of the K–10 Board Curriculum Committee for Science.

The Board's syllabus development process

This project commenced at the draft syllabus development phase of the Board's syllabus development process, recognising the substantial work that ACARA has undertaken. Broad consultation with teachers and other interest groups will precede the finalisation of the syllabus.

The process and timeline for the development of the syllabus follows.

Timeline for the development of the Science K–10 syllabus

Steps in the syllabus development process	Date
Directions for syllabus development	
K–10 Board Curriculum Committee established to provide advice to the Board of Studies during the syllabus development process, including actions for the development of a quality syllabus	Established May 2010
Endorsement of the Australian Curriculum content descriptions as the basis for development of the NSW syllabus	8 December 2010
Directions for Syllabus Development prepared	February to March 2011
Syllabus development	
Draft syllabus and survey prepared	March to May 2011
Consultation	14 June to 22 August 2011
Consultation report and final syllabus to K–10 Board Curriculum Committee	September 2011
Consultation report and final syllabus to Board of Studies for endorsement	October 2011
Publication of the syllabus	Term 4, 2011

Assisting respondents

The following icons are used to assist respondents:

ⓘ for your information	This icon indicates general information that assists in reading or understanding the information contained in the document. Text introduced by this icon will not appear in the final syllabus.
✍ consult	This icon indicates material on which responses and views are sought through consultation.

Note: Australian curriculum content has a grey screen to differentiate it from NSW content. It looks like this:

Science as a Human Endeavour
- Science involves exploring and observing the world using the senses

Consultation

The *Science K–10 Draft Syllabus* is accompanied by an online consultation survey on the Board of Studies website. The purpose of the survey is to obtain detailed comments from individuals and systems/organisations on the syllabus. Please comment on both the strengths and the weaknesses of the draft syllabus. Feedback will be considered when the draft syllabus is modified.

The consultation period is from 14 June to 22 August 2011.

Written responses may be forwarded to:

Curriculum Support Officer, Science
GPO Box 5300
Sydney NSW 2001

Or emailed to: anthony.giusti@bos.nsw.edu.au

Or faxed to: (02) 9367 8476

Structure of the draft syllabus

The draft syllabus has the following sections:

- The K–10 curriculum
- Rationale
- The Place of *Science K–10 Syllabus* in the K–12 curriculum
- Aim
- Objectives
- Outcomes
- Content
- Years 7–10 Life Skills outcomes and content
- Continuum of learning in Science K–10
- Assessment.

Each section of the draft syllabus includes:

- an explanation of the section's purpose
- the material on which responses and views are sought through the consultation.

The draft syllabus

1 Introduction

1.1 The K–10 curriculum

This syllabus has been developed within the parameters set by the Board of Studies NSW in its *K–10 Curriculum Framework*. This framework ensures that K–10 syllabuses and curriculum requirements are designed to provide educational opportunities that:

- engage and challenge all students to maximise their individual talents and capabilities for lifelong learning
- enable all students to develop positive self-concepts and their capacity to establish and maintain safe, healthy and rewarding lives
- prepare all students for effective and responsible participation in their society, taking account of moral, ethical and spiritual considerations
- encourage and enable all students to enjoy learning and to be self-motivated, reflective, competent learners who will be able to take part in further study, work or training
- promote a fair and just society that values diversity
- promote continuity and coherence of learning and facilitate the transition between primary and secondary schooling.

The framework also provides a set of broad learning outcomes that summarise the knowledge, understanding, skills, values and attitudes essential for all students to succeed in and beyond their schooling. These broad learning outcomes indicate that students will:

- understand, develop and communicate ideas and information
- access, analyse, evaluate and use information from a variety of sources
- work collaboratively with others to achieve individual and collective goals
- possess the knowledge and skills necessary to maintain a safe and healthy lifestyle
- understand and appreciate the physical, biological and technological world and make responsible and informed decisions in relation to their world
- understand and appreciate social, cultural, geographical and historical contexts and participate as active and informed citizens
- express themselves through creative activity and engage with the artistic, cultural and intellectual work of others
- understand and apply a variety of analytical and creative techniques to solve problems
- understand, interpret and apply concepts related to numerical and spatial patterns, structures and relationships
- be productive, creative and confident in the use of technology and understand the impact of technology on society
- understand the work environment and be equipped with the knowledge, understanding and skills to evaluate potential career options and pathways
- develop a system of personal values based on their understanding of moral, ethical and spiritual matters.

The broad learning outcomes of the *K–10 Curriculum Framework* are consistent with the *Melbourne Declaration on Educational Goals for Young Australians (December 2008).* These goals are:

> Goal 1: Australian schooling promotes equity and excellence
> Goal 2: All young Australians become successful learners, confident and creative individuals and active and informed citizens.

The way in which learning in the *Science K–10 Syllabus* will contribute to the curriculum and to the student's achievement of the broad learning outcomes is outlined in the draft syllabus rationale.

In accordance with *the K–10 Curriculum Framework* and the Board's *Statement of Equity Principles*, the *Science K–10 Syllabus* takes into account the diverse needs of all students. It identifies essential knowledge, understanding, skills, values and attitudes. It enunciates clear standards of what students are expected to know and be able to do in K–10. It provides structures and processes by which teachers can provide continuity of study for all students. It contains advice to assist teachers to program learning for those students who have gone beyond achieving the outcomes through their study of the essential content.

1.2 Students with special education needs

The rationale, aim, objectives, outcomes and content of the *Science K–10 Syllabus* have been designed to accommodate teaching approaches that support the learning needs of all students. The stage statements and the continuum of learning can help teachers identify the starting point for instruction for every student, including those with special education needs.

Most students with special education needs will participate fully in learning experiences based on the regular syllabus outcomes and content. Students may require additional support, including adjustments to teaching, learning and assessment activities.

Collaborative curriculum planning will determine the most appropriate curriculum options for students with special education needs in keeping with their interests, strengths, goals and learning needs.

Students with special education needs can access the syllabus outcomes and content in a range of ways including:

- under regular course arrangements
- through content from a different stage
- with curriculum adjustments
- through Years 7–10 Life Skills outcomes and content.

Curriculum adjustments are measures or actions taken in relation to teaching, learning and assessment that enable a student to access syllabus outcomes and content. These adjustments may involve:

- classroom organisation
- appropriate materials and resources to support teaching and learning activities
- the amount of content to be covered in a particular lesson or unit of work or the time allocated to complete work
- additional demonstration of key concepts and skills by the teacher, teacher's aide or a peer
- a range of appropriate learning activities with structured opportunities for guided and independent practice and effective feedback
- additional support through group work, peer or volunteer tutoring, and other individual assistance.

For some students with special education needs, particularly those students with an intellectual disability, it may be determined that the Stage 4 and Stage 5 outcomes are not appropriate, even with adjustments to teaching, learning and assessment. For these students, the Years 7–10 Life Skills outcomes and content can provide the basis for developing a

relevant and meaningful age-appropriate program. A range of curriculum adjustments should be explored before a decision is made to access Years 7–10 Life Skills outcomes and content.

Kindergarten–Year 6

In Kindergarten to Year 6, it is important for all students to have the opportunity to participate fully in and progress through the curriculum. As they move through the developmental stages of learning, students demonstrate individual strengths and establish preferred ways of learning.

There are several curriculum options for students with special education needs in K–6. Students may engage with syllabus outcomes and content with adjustments, and/or may engage with outcomes and content from an earlier stage. All decisions regarding curriculum options for students with special education needs should be made through the collaborative curriculum planning process, to ensure that syllabus outcomes and content reflect the learning needs and priorities of individual students.

In addition, the NSW K–6 curriculum provides for students with special education needs through:

- inclusive syllabus outcomes and content accessible by the full range of students
- additional advice and programming support for teachers on how to assist students to access the outcomes of the syllabus
- specific support documents for students with special education needs as part of the overall syllabus package.

Years 7–10

Students build on their achievement from Kindergarten to Year 6 as they undertake courses to meet the requirements for the School Certificate. For a small percentage of these students the provision of curriculum adjustments may be insufficient to enable access to the regular syllabus outcomes and content. In this case the Years 7–10 Life Skills outcomes and content may be appropriate.

The Years 7–10 Life Skills outcomes and content are developed from the objectives of the *Science 7–10 Syllabus*. Further information relating to accessing and implementing Science Years 7–10 Life Skills outcomes and content can be found in the Science support document and *Life Skills Years 7–10: Advice on Planning, Programming and Assessment*.

The Years 7–10 Life Skills outcomes and content are in Section 8 of the syllabus. Assessment and reporting information for students with special education needs is contained in Section 10.

School principals have the authority to approve student access to courses based on Years 7–10 Life Skills outcomes and content, and to determine the appropriateness of making adjustments to curriculum and assessment for individual students.

Science and Technology
K–6

2 Rationale

ⓘ for your information

The rationale describes the distinctive nature of the subject and outlines its relationship to the contemporary world and current practice. It explains the place and purpose of the subject in the curriculum.

✍ Consult

Scientific and technological advances are integral to and are of increasing importance in the contribution they make in our rapidly changing world. A student's sense of wonder and curiosity about the natural and made world is fostered through actively engaging in the processes of working scientifically and technologically. Students develop understanding of the significance, uses and influences of science and technology in relation to questions and problems of relevance to them, locally, nationally and globally.

Scientific inquiry is a distinct way of finding answers to interesting and important questions about the natural world. Science knowledge provides explanations for a variety of phenomena and enables sense to be made of the Natural Environment and the Made Environment**.** Through posing questions, testing ideas, developing and evaluating arguments based on evidence, students develop their scientific inquiry skills and understanding of important science concepts. As students actively engage in scientific inquiry through working scientifically, they develop an understanding of the contribution of science to society and its applications in their lives.

Technology and an understanding of design processes enable people to manage, interpret, shape and alter their environment to improve their quality of life at home, school, in work places and in the broader community. Students learn about technologies and safely, creatively and competently use a range of materials, tools, equipment and techniques relevant to their world. The study of technology provides opportunities to solve real problems and create ideas and solutions in response to needs and opportunities.

The study of science and technology provides opportunities to think and act critically and creatively and be innovative in developing working solutions and ideas in response to opportunities and questions. Through engaging in science and technology learning, students develop informed attitudes based on evidence and reason, to participate responsibly in personal, social and environmental issues relevant to their lives and to shape sustainable futures. They develop understanding of the relationships between science, technology and society.

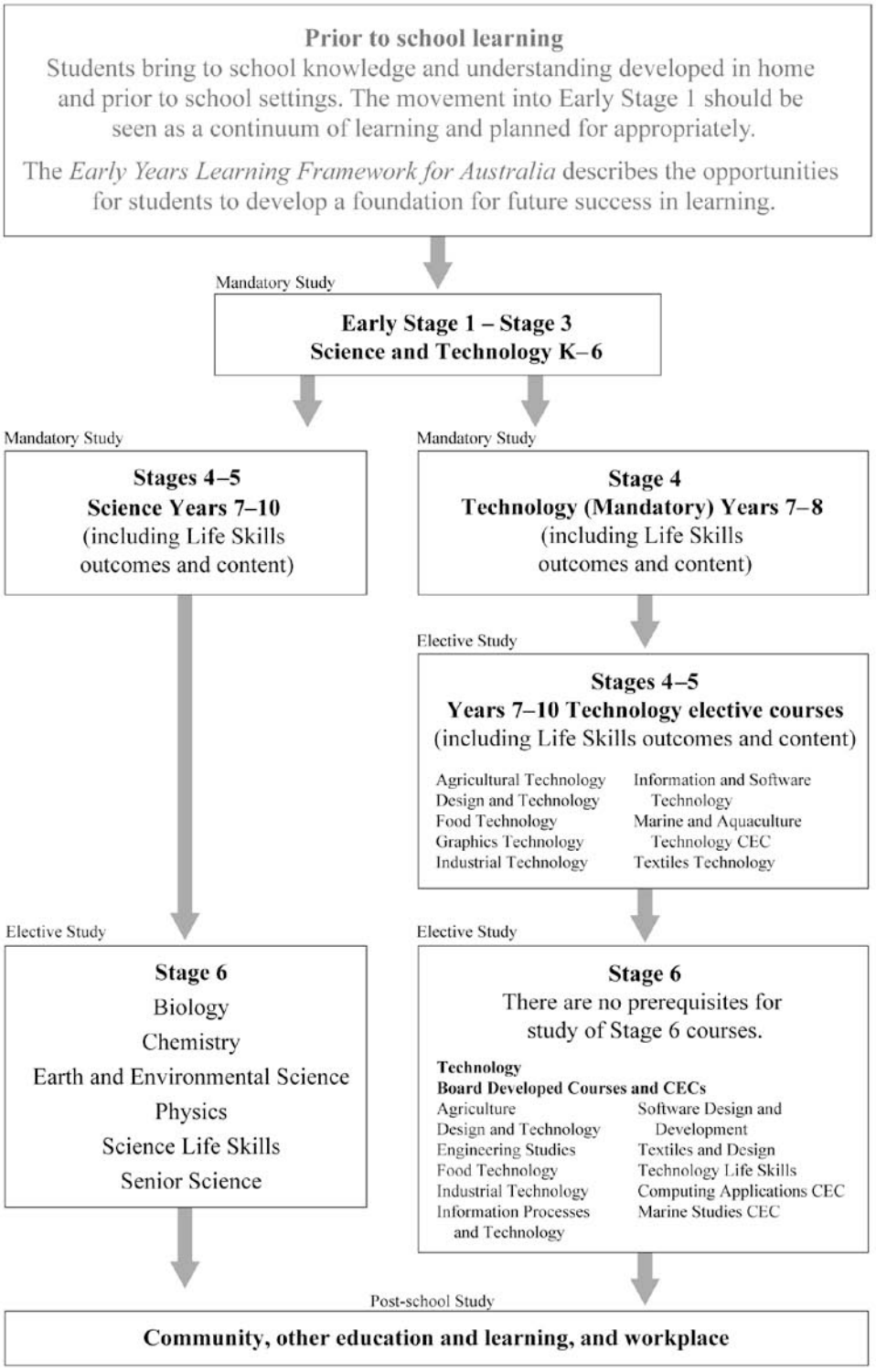
The study of science and technology enables students to develop a positive self-concept as learners, develop confidence in and gain enjoyment from their learning. They become self-motivated learners through inquiry and active participation in challenging and engaging experiences to develop innovative solutions.

3 The place of the Science K–10 syllabus in the K–12 curriculum

ⓘ for your information

This section of the syllabus demonstrates the relationship between the K–10 syllabus and other associated courses. It shows the possible pathways of learning in the learning area.

✍ Consult



4 Aim

ⓘ for your information

The aim provides a succinct statement of the overall purpose of the syllabus. It indicates the general educational benefits for students from programs based on the syllabus.

✍ Consult

The aim of the *Science and Technology K–6 Syllabus* is to:

- foster students' sense of wonder and expand their natural curiosity about the world around them in order to develop their understanding of, interest in, and enthusiasm for science and technology
- develop students' competence and creativity in applying processes of working scientifically and working technologically to appreciate and understand the natural and made environment
- enhance students' confidence in making evidence-based decisions about the influences of science and technology in their lives
- enable students to confidently respond to needs and opportunities when designing solutions relevant to science and technology in their lives.

5 Objectives

ⓘ for your information

Objectives provide specific statements of the intention of a syllabus. They amplify the aim and provide direction to teachers on the teaching and learning process emerging from the syllabus. They define, in broad terms, the knowledge, understanding, skills and values and attitudes to be developed through study in the subject. They act as organisers for the intended outcomes.

Objectives will be organised under the areas of:

- knowledge, understanding and skills
- values and attitudes.

✍ consult

Knowledge, understanding and skills

Students:

- Develop knowledge, understanding and skills in working scientifically through the processes of investigating
- Develop knowledge, understanding and skills in working technologically through processes of designing and producing, including the purposeful selection and use of tools, materials, equipment and techniques
- Develop knowledge and understanding about the Natural Environment including Living World, Earth and Space, Physical World
- Develop knowledge and understanding about the Natural Environment and Made Environment through the Material World
- Develop knowledge and understanding about the Made Environment including Built Environments, Information, Products

Values and attitudes

Students:

- Develop interest and positive, informed values and attitudes towards science and technology and its importance in their every day lives

6 Outcomes

ⓘ for your information

Syllabus outcomes express the specific intended results from teaching the syllabus. They provide clear statements of the knowledge, understanding, skills, values and attitudes expected to be gained by most students as a result of effective teaching and learning. They are derived from the objectives of the syllabus.

✍ consult

Table of objectives and outcomes

Objective: Students: • Develop knowledge, understanding and skills in working scientifically through processes of investigating			
Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:
WS ES1.1 explores their immediate surroundings and what they already know by questioning, observing and communicating	WS 1.1 investigates by comparing what they and others already know, predicting, collecting and recording data, considering evidence and reflecting on their experiences	WS 2.1 investigates their questions and predictions by considering scientific information, collecting and analysing data, communicating and reflecting on their evidence and the process undertaken	WS 3.1 poses questions, including testable questions, that they investigate scientifically to draw evidence-based conclusions and develop explanations

Objective: Students: • Develop knowledge, understanding and skills in working technologically through processes of designing and producing, including the purposeful selection and use of tools, materials, equipment and techniques			
Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:
WT ES1.2 uses a simple design process to produce solutions with identified purposes	WT 1.2 uses a structured design process, everyday tools, materials, equipment and techniques to produce solutions that respond to identified needs and wants of users/audiences	WT 2.2 applies a design process and uses some specialised tools, equipment, materials and techniques to produce solutions that address specific design criteria	WT 3.2 plans and implements a design process selecting specialised tools, equipment, materials and techniques to produce solutions that consider constraints

Objective: Students: • Develop knowledge and understanding about the Natural Environment including the Living World, Earth and Space and the Physical World			
Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:
NE ES1.3 observes how their immediate environment provides for the needs of living things and how this affects everyday life	LW S1.3.1 identifies that living things have observable physical features and grow and change	LW S2.3.1 describes how living things can be grouped, have life cycles and are dependent on each other and the environment to survive	LW S3.3.1 describes how structural adaptations of living things enable them to survive in their environment
	ES S1.3.2 identifies some physical features of and useful resources in the environment	ES S2.3.2 describes some simple relationships and patterns of change that are observed on the Earth's surface and in space	ES S3.3.2 describes changes at the Earth's surface and Earth's movements in space
	PW S1.3.3 identifies some different sources of light and sound and the effects of pushes and pulls on objects	PW S2.3.3 describes how objects are affected by heat and forces	PW S3.3.3 describes the transfer and transformation of electricity and the properties of light

Objective: Students: • Develop knowledge and understanding about the Natural Environment and Made Environment through the Material World			
Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:
	MW S1.4.1 identifies ways everyday materials can be physically changed and combined for a particular purpose	MW S2.4.1 identifies that heat can cause changes in the physical properties of substances	MW S3.4.1 describes the changes made to everyday materials as reversible or irreversible
	MW S1.4.2 identifies properties of materials they encounter in everyday life and how materials are suitable for their use	MW S2.4.2 identifies that the physical properties of natural and processed materials influence their use	MW S3.4.2 describes how the properties of materials determine their use for specific purposes

<table>
<tr><td colspan="4">Objective: Students:
• Develop knowledge and understanding about the Made Environment including Built Environments, Information and Products</td></tr>
<tr><td>Early Stage 1 outcomes
A student:</td><td>Stage 1 outcomes
A student:</td><td>Stage 2 outcomes
A student:</td><td>Stage 3 outcomes
A student:</td></tr>
<tr><td rowspan="3">ME ES1.5
recognises how familiar objects, products, places and spaces in their immediate environment suit their purpose and are made using some common materials</td><td>BE S1.5.1
describes the range of places and spaces in their local environment and how they are designed for different purposes</td><td>BE S2.5.1
describes ways different built environments are designed and constructed and how people interact within them</td><td>BE S3.5.1
describes systems and how social and environmental factors influence the design of built environments</td></tr>
<tr><td>I S1.5.2
describes the range of familiar information products and how their different purposes influence their design</td><td>I S2.5.2
describes ways different information products are designed and produced and the factors to consider when people use and interact with them</td><td>I S3.5.2
describes information and communication systems and how social influences impact on their design and use</td></tr>
<tr><td>P S1.5.3
describes the range of manufactured products in their local environment and how their different purposes influence their design</td><td>P S2.5.3
describes ways different products are designed and produced and the ways people interact with them</td><td>P S3.5.3
describes systems used to produce or manufacture products and social and environmental influences on product design</td></tr>
</table>

<table>
<tr><td>Objective: Students:
• Develop interest and positive, informed values and attitudes towards science and technology and its importance in their everyday lives</td></tr>
<tr><td>Early Stage 1 to Stage 3 outcomes
A student:</td></tr>
<tr><td>VA ES1-3.6
shows interest and enthusiasm for science and technology in responding to their curiosity, questions and perceived needs, wants and opportunities

VA ES1-3.7
develops informed attitudes, based on evidence and reason about current and future applications of science and technology

VA ES1-3.8
demonstrates willingness to engage responsibly with local, national and global issues relevant to their lives and to shaping sustainable futures</td></tr>
</table>

7 Content

7.1 Organisation of content

ⓘ for your information

Content includes knowledge, understanding, skills, values and attitudes and describes the substance of the subject matter that is to be studied. Syllabus content reflects a balance between the acquisition of knowledge and the processes of learning so that students are encouraged to engage in, take responsibility for and continue their own learning.

✍ consult

In Kindergarten to Year 6, the Key Learning Area of Science and Technology leads to the study of the Science Key Learning Area and the Technology Key Learning Area in the Years 7 to 10 curriculum.

In the *Science and Technology K–6 Syllabus*, the knowledge, understanding and skills content is organised into the four strands of:

- Working Scientifically
- Working Technologically
- Natural Environment
- Made Environment.

In each year students develop their science and technology knowledge, understanding and skills by learning about the Natural Environment and Made Environment strands through actively engaging in Working Scientifically and Working Technologically.

The content of the Working Scientifically and Working Technologically strands describes the knowledge, understanding and skills students should develop by the end of the stage. The content in these strands is organised under subheadings that identify what students learn about and should learn to do to demonstrate understanding when Working Scientifically and Working Technologically. In each year students are to participate in hands-on scientific investigations and design projects that require them to demonstrate their knowledge, understanding and skills in undertaking the processes of Working Scientifically and Working Technologically.

The Natural Environment and the Made Environment strands encompass the key ideas and concepts fundamental to scientific and technological understanding. In each year content is to be selected from both the Natural Environment and Made Environment strands. By the end of the stage all content from these strands is to have been addressed.

Within the Natural Environment and the Made Environment strands the content is grouped into sections. Each section includes an overarching statement identifying what students will learn about and should be able to do as a result of addressing all of the content described below. The content in each section is to be maintained in its entirety with the overarching statement when developing a unit of work. However there is flexibility for teachers to select sections of content from within each strand and integrate these as appropriate into different units of work.

The knowledge, understanding and skills content is to be developed in contexts relevant to the needs, interests and experiences of students. Contexts are devised by teachers to assist their students make meaning of the syllabus outcomes and content. The *Science and Technology K–6 Syllabus* does not specify contexts as the choice of these in each unit of work will be selected by the teacher considering factors such as local resources and students' interests, learning history and cultural backgrounds.

Content Strands

Working Scientifically and Working Technologically

In Working Scientifically, students identify and ask questions about their world. They plan, conduct and reflect on their first-hand investigations, process data and information to draw evidence-based conclusions. Scientific investigations are activities in which ideas and predictions are tested. Students collect, analyse and represent data and information in meaningful and useful ways and use this evidence to develop explanations to justify conclusions.

In Working Technologically, students recognise problems and respond to opportunities, needs and wants in their world for which possible solutions can be designed and produced. They explore and define design tasks, generate and develop ideas, produce solutions and evaluate their design processes and solutions.

The Natural Environment and the Made Environment

Students learn about key concepts fundamental to scientific and technological understanding about the natural and the made environments. The Natural Environment and Made Environment highlight the importance of the contribution of science and technology to contemporary decision-making and problem-solving.

The Natural Environment highlights science as a unique way of answering questions and finding out about the world. Students recognise that many different people from different cultures make contributions to developments in scientific knowledge. They consider how advances in scientific and technological understanding are influenced by the needs and priorities of society.

The Made Environment provides the contexts for students to learn about technologies and their uses relevant to the personal, commercial and global areas of human activity. Students recognise that technology and understanding of design processes enables people to manage, interpret, shape and alter their environment to improve their quality of life.

In Early Stage 1, through Working Scientifically and Working Technologically, students explore and observe the Natural Environment and the Made Environment in a holistic way. In the Natural Environment students recognise the needs of living things and how daily and seasonal changes in the environment affect everyday life. In the Made Environment students recognise that familiar objects, products, places and spaces in their immediate environment suit their purposes and are made using common materials.

In Stages 1 to 3, by Working Scientifically and Working Technologically, students develop their understanding of the key ideas and concepts of the Natural Environment and Made Environment through the following strands:

Living World – students develop their understanding of living things. They investigate the diversity of living things, including plants, animals and microorganisms, their interdependence and interactions with each other and their environment. They explore their life cycles and structural features and how these aid survival.

Earth and Space – students develop their understanding of Earth's dynamic structure and its place in space. The key concepts developed are that Earth is part of the solar system and is subject to change as a result of natural processes and human activity. In attempting to shape sustainable futures on Earth, there is a growing need to develop understanding of the Earth's characteristics and how people interact with their environment.

Physical World – students develop their understanding of heat energy, electricity, light, forces and motion. The key concepts developed are that forces affect the movement of objects and that heat energy and electricity can be transferred and transformed.

Material World – students develop their understanding of the properties of materials, the way they behave and the changes they undergo. Material World includes content related to the properties of materials and how these properties influence the way materials are used by people in objects, products, places and spaces.

Built Environments – students develop their understanding about space, places and their use. People create, construct and modify their surroundings for a wide range of purposes. The environments people build are an important part of our communities and culture.

Information – students develop their understanding about the design and use of information for the purpose of conveying messages. Information and communication systems are fundamental to human activity. People create, communicate and access information using highly developed media and information technologies.

Products – students develop their understanding of products that include objects, systems and artefacts and the nature of materials and resources used to produce them. Products range from those that are individually crafted through to those that are produced commercially or in large quantities.

Note

In developing and delivering teaching programs teachers should be aware of and adopt, relevant guidelines and directives of their education authorities and/or schools. Teaching programs should recognise and reflect relevant State and Commonwealth legislation, regulations and standards including **Occupational Health and Safety Standards, Chemical Safety in Schools and Animal Welfare guidelines**. Teachers need to be aware of activities that may require notification, certification, permission, permits and licences.

Cross-curriculum areas

ⓘ for your information

The Board of Studies has described cross-curriculum areas that are to be included in syllabuses. In K–10 syllabuses, the identified areas will be embedded in the descriptions of content. The cross-curriculum areas address issues, perspectives and policies that will assist students to achieve the broad learning outcomes defined in the Board of Studies *K–10 Curriculum Framework*. The cross-curriculum areas take account of the general capabilities and cross-curriculum priorities in the Australian Curriculum.

Knowledge, understanding, skills, values and attitudes derived from the cross-curriculum areas will be included in Board syllabuses, while ensuring that subject integrity is maintained.

✍ Consult

Aboriginal and Torres Strait Islander Histories and Cultures [ATSI]

The syllabus provides opportunities in teaching and learning programs for the inclusion of Aboriginal and Torres Strait Islander contexts and perspectives relevant to Science and Technology such as products, ecology, the environment and astronomy.

Students may develop an understanding of aspects of Aboriginal and Torres Strait Islander Histories and Cultures by:

- identifying traditional items made from natural materials
- researching traditional ways of interpreting the world around us, such as seasonal calendars and the night sky.

Asia and Australia's relationship with Asia [A]

The syllabus provides opportunities for students to understand the importance of Australia's relationship with Asia and the significance of Asia's role in the development of scientific ideas and technological advances. Students are also provided with opportunities to engage with contemporary events which have resulted in shared experiences and regional collaboration in response to earthquakes, volcanic eruptions, tsunamis and floods.

Students may develop an understanding of Asia and Australia's relationship with Asia by:

- describing the use of technology in improving our understanding of the solar system
- describing the impact of geological activity in the Asia-Pacific region and Australia as part of the Pacific Rim
- describing how developments in science and technology have assisted in the management of natural disasters.

Civics and Citizenship [CC]

The syllabus provides opportunities for students to broaden their understanding of aspects of civics and citizenship in relation to the application and development of scientific ideas and technological advances. The syllabus also allows students to engage with the commitment to ecological sustainability and the relevance of intergenerational justice to environmental and sustainable practices.

Students may develop an understanding of civics and citizenship by:

- observing some common materials and identifying the properties of the materials that make them suitable for their uses such as plastics and glass
- combining a variety of media such as visual images, sound and text in digital presentations to address the particular needs of a specific audience
- identifying elements that work together as a system to serve and support built environments and how they are designed to meet the needs of people, such as transport systems that provide access for people to get to work.

Critical and Creative Thinking [CCT]

The syllabus provides opportunities for students to develop skills in critical and creative thinking through problem-solving, conducting appropriate and innovative investigations to test questions and predictions, developing appropriate work plans and design criteria, mind mapping, brainstorming, sketching and modelling. Students also are provided with the opportunity to apply logic and reasoning to evaluate possibilities and reflect on procedures and products.

Students may develop critical and creative thinking skills by:

- comparing and discussing whether observations were expected and related to questions and predictions in working scientifically
- exploring different materials by observing and manipulating them and using trial-and-error when working technologically
- considering different approaches to developing evidence-based conclusions and explanations about the natural and made environments.

Difference and Diversity [DD]

The syllabus provides opportunities for students to understand and appreciate individual rights, challenge stereotypes and engage with opinions different to their own. Students explore products and places that represent or express personal and cultural identities, allowing them to reflect upon their own identities, understand those of others and develop inclusive attitudes through an understanding of diversity.

Students may develop an understanding of difference and diversity by:

- discussing their personal responses to some familiar changes that are experienced in natural conditions such as hot and cold, rainy and dry weather, night and day
- developing design criteria that consider function, aesthetics, social and environmental considerations when working technologically
- using creative thinking methods to explore different ways products are used to express personal or cultural identity and ownership such as the use of uniforms to indicate group membership.

Ethical Understanding [EU]

The syllabus provides opportunities for students to engage with situations or circumstances which involve an ethical or moral decision-making process. Students discuss ethical considerations in relation to the use of technology when conducting investigations and in acting fairly and honestly.

Students may develop an understanding of ethical understanding by:

- sharing ideas about ethical considerations in observation, representation and interpretation of data and information
- demonstrating an understanding of computer etiquette and appropriate behaviours to ensure personal security and confidentiality
- demonstrating the importance of maintaining the safety and privacy of personal information.

Information and Communication Technologies [ICT]

The syllabus provides opportunities for students to enhance and develop ICT skills and work effectively with ICT to aid in representation of data, information and observations. Students also engage with the complexity of rapid change and development in technology, which can concurrently enhance and inform scientific knowledge and understanding. ICT use in science and technology facilitates learning through the appropriate application of digital technologies, research on the internet and engaging with emerging technologies.

Students develop ICT skills to facilitate learning by:

- conducting first-hand investigations, gathering data, conducting research and collecting information from secondary sources
- representing data, information and observations in databases, spreadsheets, graphs, diagrams, flowcharts, tables and multimedia presentations
- considering ethical practices in their ICT use.

Intercultural Understanding [IU]

The syllabus provides opportunities for students to enhance their intercultural understanding through consideration of other cultures in relation to the development of scientific knowledge. Our knowledge of the solar system has been significantly enhanced by the contributions of scientist from various cultures and histories.

Students may develop intercultural understanding by:

- developing a timeline to describe how people from a range of cultures and organisations such as Aryabhata, Copernicus, Galileo, CSIRO and NASA, used the technologies of the time to improve our understanding of the solar system and contribute to the advancement of science
- surveying a range of places and spaces in built environments and identifying how they express personal or cultural identity, such as a local place of worship, museum or community hall.

Literacy [L]

The syllabus provides opportunities for students to develop broad literacy skills as well as more science specific literacy. Language and literacy knowledge specific to the study of science enables students to comprehend increasingly complex theories, make judgements based on scientific knowledge and accurately report upon findings.

Students may develop literacy skills by:

- communicating their observations
- understanding the importance of the audience when producing texts and selecting appropriate genres and formats

- conducting research from a range of sources to extract, summarise, analyse and present qualitative data and information
- present information in multimodal formats, using ICT and digital technologies where appropriate.

Numeracy [N]

The syllabus provides opportunities for students to develop numeracy skills in order to comprehend and interpret data, units of measurement and accurately record observations and findings. Numeracy skills are required to represent data in various formats, identify trends and patterns in findings and consider reliability and integrity of numerical data.

Students may develop numeracy skills by:

- gathering data by estimating, using tally marks and informal units
- using tables, column and bar graphs, databases and spreadsheets to interpret and represent data
- using numerical techniques including calculations and percentages of data
- using formal units of measurement to construct or make a product.

Personal and Social Competence [PSC]

The syllabus provides opportunities for students to develop an awareness of their individual personal and social competence through comparing their own understandings and conclusions respectably with peers, working cooperatively with others, recognising the strengths of team members and conducting self assessment of their produced work.

Students may develop an understanding of personal and social competence by:

- working individually and cooperatively when participating in different types of guided investigations to explore and answer questions when working scientifically
- identifying the needs and wants of users/audiences by using methods such as interviews, observations and surveys when investigating technologically
- examining some local environments and identifying some factors that have been considered in their design such as the design of a local playground, considering the purpose, access, movement within the space and layout.

Sustainability and Environment [SE]

The syllabus provides opportunities for students to engage with scientific, technological or societal impacts on the natural and made environment. Students develop understanding of the importance of resource conservation, recycling and the development of sustainable practices and technologies.

Students may develop an understanding of sustainability and environment by:

- considering use and conservation of natural resources
- understanding the impact of products and technological advances on the environment
- discussing the impact of human activities on the environment
- exploring advances in science and developments in technology that increase our understanding of sustainable practices and products.

Work and Enterprise [WE]

The syllabus provides opportunities for students to develop work related skills and an appreciation of the value of collaborative team work and working individually. Students learn

to prioritise safe practices and understand the potential risks and hazards present when conducting investigations, using electrical devices and when using classroom equipment and specialised tools.

Students may develop an understanding of work and enterprise by:

- interviewing the users of information products to find out how the design of the products can influence people's decisions and opinions such as the design of advertisements and web pages
- developing design criteria that consider, where relevant, function, aesthetics, social and environmental considerations
- demonstrating appropriate ethics when using information products considering, where relevant, different points of view and/or stereotyping.

7.2 Content for Early Stage 1

✍ Consult

Science and Technology • Early Stage 1

Working Scientifically

Outcome:
A student:
- explores their immediate surroundings and what they already know by questioning, observing and communicating

Science as a Human Endeavour
- Science involves exploring and observing the world using the senses

Science Inquiry Skills
- Respond to questions about familiar objects and events
- Explore and make observations by using the senses
- Engage in discussions about observations and use methods such as drawing to represent ideas
- Share observations and ideas

Students question and predict by:
- posing and responding to questions about familiar objects and things they are curious about in the natural and made environments
- making predictions resulting from their questions

Students plan investigations by:
- sharing what they already know and how they could find out more about their questions relating to the natural and made environment

Students conduct investigations by:
- exploring and making careful observations by using the senses to gather information about their immediate surroundings
- manipulating objects and materials through purposeful play

Students process and analyse data and information by:
- organising objects or images of objects to display data and/or information
- engaging in informal and guided discussions about their observations, what was or was not expected or interesting

Students communicate by:
- referring to a range of representations for sharing and making sense of their observations and ideas by talking, role-play, drawing, contributing to joint construction of short texts and/or using digital technologies [ICT]
- working in groups to reflect on what they liked or disliked about what they did and what they would do differently [CCT]; [PSC]

Background information
Progression:
The emphasis in Early Stage 1 is on fostering curiosity and wonder while developing skills in questioning, exploring and observing. In activities set by the teacher, students explore through purposeful play, manipulating, observing and describing what is accessible to their direct experience. They are encouraged to value and share their own questions and ideas about what happens, suggest reasons and name some cause and effect associations.

Science and Technology • Early Stage 1

Working Technologically

Outcome:
A student:
- uses a simple design process to produce solutions with identified purposes

Students explore and define the task by:
- identifying the purpose and use of existing products, places and spaces
- describing their likes and dislikes of existing products, places and spaces
- discussing the purpose and main features of what they need to produce and the materials they will use

Students develop ideas and produce solutions by:
- using play and imagination to explore possibilities of products, places and spaces
- following a series of steps to draw or model ideas or construct solutions
- safely using common classroom equipment, resources and techniques to shape and join familiar materials

Students evaluate by:
- recounting the steps taken to reach a final solution
- discussing their likes and dislikes in relation to what they have produced [PSC]
- reflecting on what they did and the usefulness of the final solution

Background information:
Progression:
In Early Stage 1 students use and learn about designing and producing as a structured series of activities. They observe the use of existing products, places and spaces. Students explore tasks set by the teacher with a particular emphasis on the purpose of their designs and how their designs relate to similar products and places in their immediate environment. In this Stage modelling is a common technique for developing design ideas. While drawing may be used to stimulate their own imagination and ideas, it is not used to communicate design ideas to others. In Early Stage 1, little distinction need be made between developing ideas and producing solutions and modelled ideas may often be regarded as a solution. Students reflect on their solutions in relation to perceived ‘usefulness’ in the wider world.

Science and Technology • Early Stage 1

Natural Environment

Outcome:
A student:
- observes how their immediate environment provides for the needs of living things and how this affects everyday life

Science as Human Endeavour
- Science involves exploring and observing the world using the senses

Science Understanding
- Living things have basic needs, including food and water
- Daily and seasonal changes in our environment, including the weather, affect everyday life

- Living things have basic needs, including food and water

Students*:*
- discuss what plants and animals, including humans, need to stay alive and healthy such as food, water and air
- make observations at school, home and in the local environment to identify the needs of a variety of living things in a range of situations such as pets at home, plants in the garden or plants and animals in bushland

- Daily and seasonal changes in our environment, including the weather, affect everyday life

Students:
- discuss their personal responses to some familiar changes that are experienced in natural conditions such as hot and cold, rainy and dry weather, night and day
- communicate ideas to identify how we modify our behaviour and dress for different daily weather and seasonal changes using a variety of methods such as role play and drawing

Science and Technology • Early Stage 1

Made Environment

Outcome:
A student:
- recognises how familiar objects, products, places and spaces in their immediate environment suit their purpose and are made using some common materials

Science as a Human Endeavour
- Science involves exploring and observing the world using the senses

Science Understanding
- Objects are made of materials that have observable properties
- The way objects move depends on a variety of factors, including their size and shape

- Familiar objects, products, places and spaces in their immediate environment suit their purpose

Students:
  - explore a range of existing familiar products, places and spaces and discuss their likes and dislikes
  - examine some familiar products and discuss the features that help the product to work and be useful such as the shoulder straps, zipper and different compartments of a school bag
  - sketch or model ideas for a product or a place and space and recount how their ideas suit its purpose

- Objects, products, places and spaces are made of materials that have observable properties

Students:
  - use their senses to observe a range of materials and group them on the basis of observable properties such as flexibility, texture, strength
  - observe how different types of materials are used for specific purposes in their familiar environment such as carpets and timber are used for floor coverings, leather for shoes

- The way objects move depends on a variety of factors, including their size and shape

Students:
  - observe the different ways a variety of familiar objects move including rolling and sliding on the ground
  - suggest reasons why objects move the way they do, including their size and shape

7.3 Content for Stage 1

✍ consult

Science and Technology • Stage 1

Working Scientifically

Outcome:
A student:
- investigates by comparing what they and others already know, predicting, collecting and recording data, considering evidence and reflecting their experiences

Science as a Human Endeavour
- Science involves asking questions about, and describing changes in, objects and events

Science Inquiry Skills
- Respond to and pose questions and make predictions about familiar objects and events
- Participate in different types of guided investigations to explore and answer questions, such as manipulating materials, testing ideas and accessing information sources
- Use informal measurements in the collection and recording of observations, with the assistance of digital technologies as appropriate
- Use a range of methods to sort information, including drawings and provided tables
- Through discussion, compare observations with predictions
- Compare observations with those of others
- Represent and communicate observations and ideas in a variety of ways such as oral and written language, drawing and role play

Students question and predict by:
- responding to and pose interesting questions such as 'What will happen if—'
- with guidance making predictions using what they already know about familiar objects and events
- comparing their current understandings with peers to help them develop questions and predictions

Students plan investigations by:
- with guidance identifying the purpose when investigating scientifically
- suggesting some types of activities that need to be undertaken at different times during the process of working scientifically in order to test their ideas
- suggesting observations that could be made to collect data and/or information about their questions and predictions
- recognising that working scientifically is a sequence of activities for providing evidence in response to curiosity or a need to know and can inform the design and produce process

Students conduct investigations by:
- with guidance using a range of methods to gather data and/or information including manipulating materials, exploration, surveys, testing ideas and accessing information sources and field work
- making observations and informal measurements safely and carefully, using their senses and simple tools and equipment including digital technologies as appropriate [N]
- collecting and recording observations and measurements honestly, using tally marks and informal units [N]; [EU]
- working individually and cooperatively when participating in different types of guided

Science and Technology • Stage 1

Working Scientifically

investigations to explore and answer questions [PSC]

Students process and analyse data and information by:

- using a range of methods to sort information and match objects and events based on easily observable characteristics, including drawings and provided tables
- sharing their observations with other students to compare similarities and differences in results
- with guidance comparing and discussing whether observations were expected and related to their question and/or predictions [CCT]
- with guidance sharing their ideas about the need for safety, care and honesty in observing, recording, displaying and interpreting data and/or information

Students communicate by:

- with guidance displaying data and information using simple column graphs, provided tables, role-play, drawings and digital technologies as appropriate [ICT]
- representing shared observations and findings of their investigation in a variety of ways such as oral and written language, short texts, role-playing or drawing one aspect of what happened [L]
- with guidance sharing what they did and what they could do differently throughout the investigating process [CCT]

Background information:

Progression:

In Stage 1 students continue to use and learn about a process for working scientifically which has been structured by the teacher. They continue to observe and describe, as they did in Early Stage 1, but purposeful play becomes more focussed exploration.

They recognise sequences of activities that are common to scientific investigations and begin to understand that working scientifically includes planning, conducting, processing and reflecting on their findings or experiences. Students begin to understand that scientific investigations are more likely to produce useful results if they are planned and conducted in particular ways. They are introduced to specific types of investigation methods including exploration, surveys and field work. They employ strategies for recording, processing and communicating their findings, consistent with stage-appropriate understandings in literacy and numeracy. Students begin to recognise evidence from scientific investigations as the basis for accepting ideas.

In Stage 2 students begin to consider scientific information as well as their own prior knowledge in planning investigations. They offer reasons for selecting simple equipment to help make observations and measurements. They identify testable questions and use fair tests in gathering evidence. They begin to consider the relationship between the process undertaken and the evidence gathered in reflecting on their investigations.

Science and Technology • Stage 1

Working Technologically

Outcome:
A student:
- uses a structured design process, everyday tools, materials, equipment and techniques to produce solutions that respond to identified needs and wants of users/audiences

Students explore and define the task by:
- identifying needs and wants of users/audiences such as using interviews, observations and surveys [PSC]

Students generate and develop ideas by:
- researching and exploring different sources of information including searching the internet
- using techniques for documenting and communicating design ideas, including plans, drawings and making models using familiar materials
- exploring, where relevant, different materials by observing and manipulating them and using trial-and-error [CCT]
- explaining the features of design ideas and the materials to be used
- using feedback from others to refine design ideas

Students produce solutions by:
- suggesting simple steps for production
- using a range of everyday tools, equipment, materials and techniques to produce solutions
- working cooperatively and safely [PSC]

Students evaluate by:
- explaining the strengths and limitations of what they did and what could have been done differently to improve the solution [CCT]
- identifying how their solution meets the needs of users/audiences [PSC]

Background information:
Progression:
In Stage 1 students continue to use and learn about a process for designing and producing which has been structured by the teacher. They explore and define a teacher-determined task. In Early Stage 1 students explored the purpose of their designs where as in Stage 1 'purpose' is more directly related to the needs of users/audiences. Students are introduced to ways of evaluating how well existing solutions meet the needs of users/audiences. They begin to use methods such as drawing and modelling to assist design development and they obtain user feedback to refine their ideas. Whereas in Early Stage 1 students used a process that made little distinction between developing ideas and producing solutions, in Stage 1 students begin to treat production as a discrete phase of the process and suggest steps for producing their solution. They begin to use an expanded range of everyday tools, equipment, materials and techniques for production. They start to systematically reflect on what they have produced and how design and production could be improved.

Science and Technology • Stage 1

Living World

Outcome:
A student:
- identifies that living things have observable physical features and grow and change

Science as Human Endeavour
- Science involves asking questions about and describing changes in objects and events

Science Understanding
- Living things have a variety of external features
- Living things grow, change and have offspring similar to themselves
- Living things live in different places where their needs are met

- Living things have a variety of external features

Students:
  - use a range of methods, including field work, to identify plants and animals in their local area
  - devise simple classification systems based on the features of plants and animals identified in the local area

- Living things grow, change and have offspring similar to themselves

Students*:*
  - observe and record growth and change in the life of a common animal or a plant, using informal units and/or digital technologies or provided tables as appropriate [N]; [ICT]
  - compare the appearance of living things with their offspring such as dogs, cats, humans, fish, frogs, trees and insects

- Living things live in different places where their needs are met

Students:
  - explore with guidance the needs of a plant in its environment
  - participate in fieldwork to observe the physical features of a local land or aquatic environment and identify how that environment meets the needs of the animals and plants that live there such as a pond, beach, bush or backyard [SE]

Science and Technology • Stage 1

Earth and Space

Outcome:
A student:
- identifies some physical features of and useful resources in the environment

Science as Human Endeavour
- People use science in their daily lives, including when caring for their environment and living things
- Science involves asking questions about and describing changes in objects and events

Science Understanding
- Observable changes occur in the sky and landscape
- Earth's resources, including water, are used in a variety of ways

- Observable changes occur in the sky and landscape

Students:
- use a range of methods to record observable, short term changes in:
  - the day and night sky, such as clouds, appearance of the moon and stars at night and the position of the sun during the day
  - the landscape, such as those caused by weathering, erosion, floods or earthquakes
- observe and record changes over a longer time to identify patterns of events such as seasonal changes in temperature and the effect of these changes on the environment [SE]; [N]

- Earth's resources, including water are used in a variety of ways

Students:
- identify the sources of some common materials and describe how these are used for a range of products at home and at school such as soil from the earth, wood from trees, water from clouds
- survey water use within the school or at home, identifying actions that they could take to conserve water such as turning off dripping taps or fixing broken bubblers [SE]
- discuss ways in which they and others in the community can use scientific knowledge to care for their local environment both now and in the future [SE]; [CCT]

Science and Technology • Stage 1

Physical World

Outcome:
A student:
- identifies some different sources of light and sound and the effects of pushes and pulls on objects

Science as Human Endeavour
- Science involves asking questions about and describing changes in objects and events

Science Understanding
- Light and sound are produced by a range of sources and can be sensed
- A push or a pull affects how an object moves or changes shape

- Light and sound are produced by a range of sources and can be sensed

Students:
  - explore using their senses and share their observations about different sources of light including the sun
  - use their sense of touch to feel vibrations from familiar objects and infer that sound is made when an object vibrates such as vocal chords, a stringed instrument, rubber bands
  - produce different sounds from familiar objects using actions such as striking, blowing, scraping and shaking
  - compare the loudness and pitch of sounds made by musical instruments and the actions used to make the sound

- A push or a pull affects how an object moves or changes shape

Students:
  - explore the effects of pushes and pulls on familiar objects, such as moving, stopping, changing direction, changing shape or breaking
  - explore ways that familiar objects and products move on land, through water and in the air

Science and Technology • Stage 1

Material World

Outcomes:
A student:
- identifies ways everyday materials can be physically changed and combined for a particular purpose
- identifies properties of materials they encounter in everyday life and how materials are suitable for their use

Science as Human Endeavour
- Science involves asking questions about and describing changes in objects and events

Science Understanding
- Everyday materials can be physically changed in a variety of ways
- Different materials can be combined, including by mixing, for a particular purpose

- Everyday materials can be physically changed in a variety of ways

Students:
  - use actions to explore how some everyday materials can be physically changed such as bending, twisting, stretching and squashing

- Different materials can be combined, including by mixing, for a particular purpose

Students:
  - mix materials together and compare their observations with their predictions about the changes materials undergo when they are mixed together such as sugar in water, sand in water, mixing ingredients to make a cake and mixing different colours of paints
  - different parts of everyday objects and products are made from different materials

- The different properties of materials enable them to be used for a variety of purposes

Students:
  - use their senses to identify the similarities and differences in the properties of materials such as the textures of different fabrics, the hardness of different solids, the runniness of different liquids
  - observe some common materials and identify the properties of the materials that make them suitable for their uses such as plastic used in rainwear as it is waterproof, glass used in windows as it is transparent [CCT]
  - identify a range of materials used by Aboriginal and Torres Strait Islanders and share ideas about the ways they are used to suit a purpose such as the use of grasses for a woven dilly bag [ATSI]

Science and Technology • Stage 1

Built Environments

Outcome:
A student:
- describes the range of places and spaces in their local environment and how they are designed for different purposes

- There is a range of places and spaces in the local environment

Students:
  - observe ways people use and interact within a range of places and spaces in the local environment

- The different purposes of places and spaces influence their design

Students:
  - explore a range of places and spaces in their local environment and discuss their different purposes such as a hospital or playground
  - describe how the different purposes of places and spaces in their local environment influence their design, such as a supermarket has storage shelves and refrigeration areas that are needed to display and store goods [CCT]

Science and Technology • Stage 1

Information

Outcome:
A student:
- describes the range of familiar information products and how their different purposes influence their design

- There is a range of information products

Students:
  - use information products to communicate with others such as letters, phone and digital technologies [L]; [ICT]
  - explore how different symbols can be used to communicate information such as logos, road signs and flags
  - interact with an information product to explore the ways different forms of information are combined including text, image and sound such as a website or digital game [ICT]; [PSC]

- The different purposes of information products influence their design

Students:
  - interact with a range of familiar information products and identify their different purposes such as television programs, websites, digital games [ICT]
  - describe how the purpose of a specific information product influences its design such as a website [L]; [PSC]

Science and Technology • Stage 1

Products

Outcome:
A student:
- describes the range of manufactured products in their local environment and how their different purposes influence their design

- There is a range of manufactured products in the local environment

Students:
  - explore a variety of products in their local environment such as food products and industrial products
  - identify the purpose of some familiar products and explore the features of their design that make the product work such as the broad brim on a sun hat
  - construct a timeline using pictures to show how the design of a specific product has changed over time such as the telephone, television or cars
  - discuss the strengths and limitations of a specific product with respect to materials from which it is made [CCT]

- The different purposes of products influence their design

Students:
  - examine some familiar products and describe how they are designed for particular purposes
  - explore ways in which products may be designed to conserve resources such as using recyclable materials and refillable containers including lunch boxes and drink bottles [SE]

7.4 Content for Stage 2

✍ consult

Science and Technology • Stage 2

Working Scientifically

Outcome:
A student:
- investigates their questions and predictions by taking into account scientific information, collecting and analysing data, communicating and reflecting on their evidence and the process undertaken

Science as a Human Endeavour
- Science involves making predictions and describing patterns and relationships

Science Inquiry Skills
- With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge
- Suggest ways to plan and conduct investigations to find answers to questions
- Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate
- Use a range of methods including tables and simple column graphs to represent data and identify patterns and trends
- Compare results with predictions, suggesting possible reasons for findings
- Reflect on the investigation, including whether a test was fair or not
- Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports

Students question and predict by:
- using curiosity, prior knowledge, experiences and scientific information to identify interesting questions in familiar contexts
- with guidance making predictions about what might happen in an investigation
- with guidance identifying questions that can be investigated scientifically

Students plan investigations by:
- with guidance suggesting ways to plan investigations to find answers to their questions
- with guidance working individually and in teams to outline how to record aspects of their plan
- suggesting simple equipment and materials they could use and safety rules for their use
- identifying where working scientifically might inform or test elements of design and production in relation to established criteria [CCT]

Students conduct investigations by:
- using the planned method and adjust procedures as necessary
- using a range of methods to gather data and information first-hand, including exploration, field work, surveys and researching secondary sources
- safely and accurately using appropriate materials, tools or equipment, to make and record observations [ICT]; [PSC]
- recording observations and measurements in tables using formal units including abbreviations such as formal units for length, time and mass [N]

Science and Technology • Stage 2

Working Scientifically

Students process and analyse data and information by:

- using a range of methods to organise and represent data and information to identify trends and patterns, including tables, column graphs and labelled diagrams using digital technologies as appropriate [ICT]
- sharing their findings with others to compare how well the results of the investigation match their predictions [PSC]
- suggesting possible reasons for their findings
- reflecting on their investigation, including whether the test was fair or not
- with guidance proposing explanations and relationships that are supported by their gathered data and information [CCT]
- using their ideas and findings to identify what they could find out next through the processes of working scientifically or designing and producing

Students communicate by:

- using a range of ways to present what they did and found out to their peers for review
- using labelled diagrams, physical representations, tables and simple column graphs, written and oral factual texts, simple reports, explanations and arguments to communicate ideas and findings
- with guidance, discussing some strengths and limitations of the method they used and what could be done differently to improve their investigation

Background information:

Progression:

In Stage 2 the emphasis of scientific investigation is producing evidence that can be shared with peers, requiring honesty and accuracy in recording and communicating, as well as evaluation of the process undertaken. Students begin to reflect on the relationship between the process undertaken and their evidence, reflecting on such questions as "how sure am I?" Students continue to use the range of investigation methods encountered in Stage 1 (exploration, surveys and field work). They are introduced to the notion that only certain types of questions are testable using fair tests. They use data and/or information from secondary sources where necessary to extend the scope of their investigations. Students make suggestions about the selection of simple equipment to help make observations and measurements. Students employ additional strategies for recording, processing and communicating their findings, consistent with stage-appropriate understandings in literacy and numeracy. They draw on appropriate digital technologies where relevant to locate and access data and/or information, to record and process data and to share and communicate their ideas and understandings.

In Stage 3 students take greater responsibility for planning, including posing testable questions and designing fair tests. They refine their use of exploration, field work and data from secondary sources. Students reflect on their evidence in relation to the process used.

Science and Technology • Stage 2

Working Technologically

Outcome:
A student:
- applies a design process and uses some specialised tools, equipment, materials and techniques to produce solutions that address specific design criteria

Students explore and define the task by:
  - exploring design situations and/or existing solutions relevant to the needs and wants of themselves and others
  - developing a design brief that identifies simple design criteria relating to requirements that make it useful, attractive and cause minimal impact on the environment [CC]; [SE]
  - working individually and within teams

- Students generate and develop ideas by:
  - using creative thinking techniques including brainstorming, sketching and modelling [CCT]
  - using a range of research techniques to access information relevant to the task
  - using techniques for documenting and communicating design ideas, including labelled drawings, modelling, storyboarding and using digital technologies and multimedia presentations [ICT]
  - investigating the suitability of materials, where relevant, for example using guided fair tests
  - refining ideas in responding to feedback from others [PSC]

- Students produce solutions by:
  - developing and applying a plan and sequence for production that considers, where relevant, time and resources
  - safely and correctly using some specialised tools, equipment, materials and techniques, such as cutting, combining, joining, shaping, assembling and finishing materials

- Students evaluate by:
  - reflecting on the process followed and what could be done differently to ensure that the solution meets the needs of themselves and others [PSC]
  - using established design criteria to evaluate the process and suggesting how their design solution could be adjusted

Background information:
Progression:
In Stage 2 students begin to develop and use a design process that identifies simple design criteria. They continue to generate design ideas using creative thinking methods and begin to refine their ideas using established design criteria and feedback provided by others. Students begin to develop and apply a sequence of production steps and identify, select and correctly use some specialised tools, equipment, materials and methods to produce their designed solution. They begin to use methods including investigating scientifically to evaluate their ideas and solutions in relation to the specific design criteria and suggest how their design could be adjusted.

Science and Technology • Stage 2

Living World

Outcome:
A student:
- describes how living things can be grouped, have life cycles and are dependent on each other and the environment to survive

Science as Human Endeavour
- Science involves making predictions and describing patterns and relationships

Science Understanding
- Living things can be grouped on the basis of observable features and can be distinguished from non-living things
- Living things have life cycles
- Living things, including plants and animals, depend on each other and the environment to survive

- Living things can be grouped on the basis of observable features and can be distinguished from non-living things

Students:
  - group things according to whether they are living or not living
  - identify some features of living things that distinguish them from non-living things
  - identify patterns in the features of living things and use these to group them
  - use tables, flowcharts or diagrams to show the relationships between groups of living things

- Living things have life cycles

Students:
  - observe first-hand and use diagrams to record the stages in the life cycle of at least one animal or plant as they grow and develop [L]
  - use evidence to argue that a plant or animal is living at every stage of its lifecycle

- Living things, including plants and animals, depend on each other and the environment to survive

Students*:*
  - identify the variety of roles of the living things within a local habitat
  - describe the relationship between plants and animals noting that plants are able to use sunlight to make food, while to obtain food animals must eat plants or other animals [L]
  - use secondary sources to gather information about ways that living things depend on each other and the environment to survive [SE]; [L]

Science and Technology • Stage 2

Earth and Space

Outcome:
A student:
- describes some simple relationships and patterns of change that are observed on the Earth's surface and in space

Science as Human Endeavour
- Science involves making predictions and describing patterns and relationships

Science Understanding
- Earth's surface changes over time as a result of natural processes and human activity
- Earth's rotation on its axis causes regular changes, including night and day

- Earth's surface changes over time as a result of natural processes and human activity

Students:
  - observe and use appropriate tools and equipment to collect data on changes in natural conditions such as sunrise and sunset, daily temperature, rainfall and wind and record the data in tables [N]; [L]; [ICT]
  - explore local areas that have changed as a result of natural processes and human activities
  - research and compare seasonal calendars such as the D'harawal seasonal calendar with the traditional three-monthly seasonal calendar [ATSI]; [IU]; [DD]; [CCT]

- Earth's rotation on its axis causes regular changes, including night and day

Students:
  - observe and record changes in the length and direction of a shadow during the day and use simple graphs or diagrams to identify patterns of change [N]
  - use models of the Earth and sun to show that the rotation of the Earth on its axis is the cause of day and night
  - explore the position of a person's shadow when the person or a light source moves
  - make a simple shadow clock or sundial to show how predictions about the movement of the sun can be used to tell time

Science and Technology • Stage 2

Physical World

Outcome:
A student:
- describes how objects are affected by heat and forces

Science as Human Endeavour
- Science knowledge helps people to understand the effect of their actions

Science Understanding
- Heat can be produced in many ways and can move from one object to another
- Forces can be exerted by one object on another through direct contact or from a distance

- Heat can be produced in many ways and can move from one object to another

Students:
  - observe some different ways in which heat is produced in the environment such as by friction (motion), electricity and burning (chemical)
  - identify situations in which the senses can be used to observe the effects of heat moving from one object to another, such as hands placed into warm or cold water
  - measure the temperature of some substances using a thermometer [N]
  - describe how the transfer of heat to and from the surroundings affects the environment and people's lives [SE]; [PSC]
  - describe how we use scientific knowledge in everyday life to control the movement of heat from one object to another, such as a pot holder, insulated bags or thermos

- Forces can be exerted by one object on another through direct contact or from a distance

Students:
  - conduct tests to investigate the effect of forces on the behaviour of an object by dropping, bouncing or rolling [CCT]
  - investigate the way gravity pulls objects, such as dropping objects from different heights
  - observe everyday situations where the direct contact force (friction) affects the movement of objects
  - carry out tests to investigate the forces of attraction and repulsion between magnets

Science and Technology • Stage 2

Material World

Outcomes:
A student:
- identifies that heat can cause changes in the physical properties of substances
- identifies that the physical properties of natural and processed materials influence their use

Science as Human Endeavour
- Science knowledge helps people to understand the effect of their actions

Science Understanding
- A change of state between solid and liquid can be caused by adding or removing heat
- Natural and processed materials have a range of physical properties which influence their use

- A change of state between solid and liquid can be caused by adding or removing heat

Students:
  - describe some everyday situations where solids and liquids change state by adding heat (heating) or removing heat (cooling)
  - make predictions and conduct tests to observe the effects of adding or removing heat (cooling) on a variety of everyday solids and/or liquids such as butter, chocolate and water
  - identify how heating and cooling affects the actions of people in everyday life such as the types of clothes that we wear

- Natural and processed materials have a range of physical properties which influence their use

Students:
  - observe and compare the parts of materials and describe the structure they can see with the naked eye and with a magnifying glass such as grains in bread, particles in chip board or cork, threads within a fabric or fibres in paper
  - conduct tests using some natural and processed materials and suggest suitable uses based on the properties of the material [CCT]
  - observe the changes that occur in everyday materials when they are heated, cooled, bent and twisted

Science and Technology • Stage 2

Built Environments

Outcome:
A student:
- describes ways different built environments are designed and constructed and how people interact within them

- Factors considered in the design and construction of built environments

Students:
  - examine some local built environments and identify some factors that have been considered in their design such as the design of a local playground and consideration of purpose, access and movement within the space and layout [PSC]; [CCT]

- How people interact within built environments

Students:
  - observe how people interact within a place or space and discuss how its design meets the needs of the users such as the ways people use and interact within a local playground
  - survey a range of places and spaces in the local built environments and identify how they express personal or cultural identity such as a local place of worship, community hall, museum [DD]; [IU]

Science and Technology • Stage 2

Information

Outcome:
A student:
- describes ways information products are designed and produced and the factors to consider when people use and interact with them

- Designing and producing information products

Students:
  - use common digital technologies and applications to organise and communicate information for a specific task using word processing and digital presentation software [ICT]
  - investigate the effectiveness of an information product for its intended use such as a digital game
  - experiment and combine a variety of media, such as combining of visual images, sound and text in visual presentations [ICT]; [L]; [WE]

- People interact with information products in a variety of ways

Students:
  - interview the users of an information product and find out how the design of the product has influenced their decisions and opinions such as the design of advertisements and web pages [CCT]; [PSC]
  - explore how people use new and emerging technologies to communicate, access and record information, such as email, mobile phones, blogs and wikis [ICT]

- Factors to consider when using information products

Students:
  - demonstrate appropriate etiquette in relation to computer usage such as general computer care, file security and maintaining confidentiality of passwords, printing and sharing resources [PSC]; [ICT]; [EU]
  - acknowledge ownership of information when selecting and using information such as citing sources of information

Science and Technology • Stage 2

Products

Outcome:
A student:
- describes ways different products are designed and produced and the ways people interact with them

- The ways in which people design and produce different products

Students:
  - in teams, identify the component parts of a product and explain how the parts are designed to work together such as pedals, cogs and chains work to make bicycle wheels move
  - explore the ways existing products have been designed and produced to incorporate environmental considerations such as products designed from recycled materials [SE]
  - create a flowchart showing the process used to produce an existing product such as a food product

- People interact with products in different ways

Students:
  - explore ways products are used to express personal or cultural identity and ownership such as the use of a uniform to indicate group membership [CCT]; [DD]; [CC]

7.5 Content for Stage 3

✍ consult

Science and Technology • Stage 3

Working Scientifically

Outcome:
A student:
- poses questions, including testable questions, that they investigate scientifically to draw evidence-based conclusions and develop explanations

Science as a Human Endeavour
- Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena

Science Inquiry Skills
- With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be
- With guidance, select appropriate investigation methods to answer questions or solve problems
- Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data, using digital technologies as appropriate
- Use equipment and materials safely, identifying potential risks
- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate
- Compare data with predictions and use as evidence in developing explanations
- Suggest improvements to methods used to investigate a question or solve a problem
- Communicate ideas, explanations and process in a variety of ways, including multi-modal texts

Students question and predict by:
- with guidance, posing questions to clarify practical problems or inform scientific investigations and predicting the findings of the investigation
- applying experience to similar situations in the past to predict what may happen in a new situation
- using systematic exploration to help develop ideas and questions for an investigation or for designing and producing [CCT]

Students plan investigations by:
- with guidance, working individually and collaboratively to select appropriate methods to answer questions or solve problems
- selecting suitable methods for gathering data and information first-hand and from reliable secondary sources, including exploration, surveys, field work, research and fair tests
- designing fair tests identifying which variable should be changed and measured while keeping everything else the same
- suggesting investigation methods appropriate to specific design criteria to inform or evaluate their design and production such as using surveys and fair tests [L]
- considering different approaches to developing evidence-based conclusions and explanations about the natural and made environment [CCT]

Science and Technology • Stage 3

Working Scientifically

Students conduct investigations by:

- using a range of methods, including exploration, surveys, field work, research and fair tests, to gather data and information first-hand and from reliable secondary sources
- working individually and collaboratively in conducting a range of types of investigations
- using suitable equipment, tools and methods to accurately observe, measure and record data, including using digital technologies as appropriate [ICT]
- checking observations and measurements by repeating them where appropriate
- safely using suitable equipment, materials and tools, identifying potential risks
- using formal units and abbreviations for measuring and recording data [N]
- identifying that in a fair test something is being investigated by changing it and measuring the effect of this change (the term independent variable should not be used at Stage 3)
- suggesting improvements that could be made to methods used to investigate a question or solve a problem

Students process and analyse data and information by:

- using numerical techniques (including calculating the means and percentages of small sets of data) to analyse data and information [N]
- drawing conclusions and explanations based on data and information gathered first-hand or from secondary sources
- comparing data with predictions and using evidence in developing explanations
- reflecting on their evidence in relation to:
  - the process used
  - their own prior knowledge as well as accepted scientific explanations
  - their own and others' conclusions
  - stimulating their ideas for designing and producing [CCT]

Students communicate by:

- constructing and using a range of representations including tables, graphs, (column, picture graphs, line graphs, divided bar graphs) and labelled diagrams to represent and describe observations, patterns and relationships including using digital technologies as appropriate [N]; [ICT]; [L]
- using a variety of ways to communicate ideas, explanations and processes including multimodal texts and labelled diagrams, written and oral factual texts as appropriate [L]; [N]

Background information:

Progression:

In Stage 3 students understand the importance of undertaking scientific investigations honestly and accurately to develop shared evidence-based understandings. They further develop their understanding of the relationship between evidence and the process undertaken, reflecting on their evidence in relation to the process used. Students are more self-reliant in asking questions and in planning and conducting their investigations with guidance. They pose testable questions relating to simple cause-and-effect relationships and consider fairness and ways to check observations and measurements. They bring a greater understanding of scientific explanations to their work. Students select and refine their application of the investigation methods encountered in previous Stages (exploration, surveys, field work, research and fair tests) by considering data and information from secondary sources, comparing field observations made at different sites or times and using systematic approaches to exploration. Students employ additional methods for recording, processing and communicating their findings, consistent with their stage-appropriate progression in literacy and numeracy including using introductory scientific language and graphical representations. They select and use digital technologies where relevant to gather, organise, process and communicate information and/or data from a variety of sources for

Science and Technology • Stage 3

Working Scientifically

identified purposes and audiences.

In Stage 4 there is an emphasis on planning and conducting investigations in which variables are controlled. The terms independent and dependent variables are introduced. Students move into specialised school laboratory environments and the use of laboratory equipment which they learn to use safely and effectively. They refine their skills in planning and conducting investigations, processing data and/or information and communicating findings. They further develop skills in critical thinking, problem-solving and the use of creativity and imagination in investigating scientifically.

Science and Technology • Stage 3

Working Technologically

Outcome:
A student:
- plans and implements a design process selecting specialised tools, equipment, materials and techniques to produce solutions that consider constraints

Students explore and define the task by:
- exploring needs or opportunities for the task
- identifying the needs and wants of users/audiences using techniques such as observations, surveys, interviews and market research
- developing a design brief in collaboration with others
- developing design criteria that considers, where relevant, function, aesthetics, social and environmental considerations [CCT]; [SE]
- planning the process considering constraints where relevant, such as time, finance, resources and expertise

Students generate and develop ideas by:
- selecting and using creative thinking techniques including mind-mapping, brainstorming, sketching and modelling [CCT]
- selecting and using research techniques appropriate to the task
- selecting and using techniques for documenting and communicating design ideas to others such as drawings, plans, storyboarding, modelling and presentations using digital technologies [ICT]; [L]
- selecting and using techniques, where relevant, to investigate the suitability of materials
- applying established criteria to evaluate and modify ideas

Students produce solutions by:
- developing a plan and specifications to guide production
- using their plans and production sequence to produce solutions
- for a design project, selecting and safely using specialised tools, equipment and related techniques**,** to cut, edit, join, manipulate and shape materials and/or information

Students evaluate by:
- identifying the strengths and limitations of the process used
- self or peer assessing the final product by using the established design criteria

Background information:
Progression:
In Stage 3 students continue to implement a process of design and begin to plan this process considering constraints of time, finance, resources and expertise. They select appropriate methods to generate ideas and apply established criteria to evaluate and modify their ideas. Students continue to use communication techniques to present ideas to others and begin to prepare documentation using plans and specifications. They produce their solutions following their own plans and select and use specialised tools, equipment, materials and techniques appropriate for the task. Students continue to evaluate throughout the process of designing and producing using their established criteria and constraints.

Science and Technology • Stage 3

Living World

Outcome:
A student:
- describes how structural adaptations of living things enable them to survive in their environment

Science as Human Endeavour
- Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena

Science Understanding
- The growth and survival of living things are affected by the physical conditions of their environment
- Living things have structural features and adaptations that help them to survive in their environment

- The growth and survival of living things are affected by the physical conditions of their environment

Students:
  - pose questions and make predictions about how changing the physical conditions, such as temperature or amount of water, impacts on the growth and survival of a plant
  - collaboratively design a fair test by identifying an environmental variable to be changed and measuring the effects of changing this variable on the growth of living things such as a plant, yeast or bread mould [CCT]; [PSC]
  - use gathered data to develop explanations about how changing this variable affects the growth of living things [L]; [N]
  - research why particular plants are grown in a certain area [L]

- Living things have structural features and adaptations that help them to survive in their environment

Students:
  - observe and describe structural features of some native Australian animals and plants and describe how these enable them to survive in their environment [SE]
  - present ideas and explanations of how the features, including behaviour, of some living things suit them to surviving in their environment [L]; [CCT]

Science and Technology • Stage 3

Earth and Space

Outcome:
A student:
- describes changes at the Earth's surface and Earth's movements in space

Science as Human Endeavour
- Important contributions to the advancement of science have been made by people from a range of cultures
- Scientific understandings, discoveries and inventions are used to solve problems that directly affect peoples' lives

Science Understanding
- The Earth is part of a system of planets orbiting around a star (the sun)
- Sudden geological changes or extreme weather conditions can affect Earth's surface

- The Earth is part of a system of planets orbiting around a star (the sun)

Students:
- use models to demonstrate how the Earth revolves around the sun and the moon revolves around the Earth
- develop a timeline to describe how people from a range of cultures and organisations such as Aryabhata, Copernicus, Galileo, CSIRO and NASA, used the technologies of the time to improve our understanding of the solar system and contribute to the advancement of science [CCT]; [IU]
- identify how Aboriginal and Torres Strait Islander people have used observations of the night sky to assist in everyday activities such as food gathering and ceremonies [ATSI]

- Sudden geological changes or extreme weather conditions can affect Earth's surface

Students:
- describe by focusing on events in Australia and Asia, either:
  - sudden geological changes such as earthquakes, volcanic eruptions and tsunamis or
  - extreme weather conditions such as cyclones, droughts and floods [A]
- describe how some discoveries and inventions in science and technology have assisted people to solve problems and manage natural disasters such as early warning systems for tsunamis, floods and bush fires [SE]

Science and Technology • Stage 3

Physical World

Outcome:
A student:
- describes the transfer and transformation of electricity and the properties of light

Science as Human Endeavour
- Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena
- Scientific knowledge is used to inform personal and community decisions

Science Understanding
- Electrical circuits provide a means of transferring and transforming electricity
- Energy from a variety of sources can be used to generate electricity
- Light from a source forms shadows and can be absorbed, reflected and refracted

- Electrical circuits provide a means of transferring and transforming electricity

Students:
- demonstrate the need for a circuit to be complete to allow the transfer or flow of electricity
- construct simple circuits incorporating devices such as switches and light globes
- use electrical devices safely, identifying potential risks
- describe how devices such as light bulbs and motors transform electricity for specific purposes [L]

- Energy from a variety of sources can be used to generate electricity

Students:
- research and present ideas about the different ways electricity can be generated [L]
- discuss how scientific knowledge can be used to inform personal and community decisions about our use and conservation of sustainable sources of energy [SE]; [PSC]

- Light from a source forms shadows and can be absorbed, reflected and refracted

Students:
- classify materials as transparent, opaque or translucent, based on whether light passes through them, is absorbed, is scattered or is reflected
- use simple equipment, such as a torch and a mirror, to predict the path of light and use evidence to explain that light travels in straight lines and that mirrors reflect light
- devise a way to observe and describe how the absorption of light forms shadows such as a puppet show
- use secondary sources to investigate inventions that depend on the refraction of light, such as magnifiers and spectacles

Science and Technology • Stage 3

The Material World

Outcomes:
A student:
- describes the changes made to everyday materials as reversible or irreversible
- describe how the properties of materials determine their use for specific purposes

Science as Human Endeavour
- Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena

Science Understanding
- Solids, liquids and gases have different observable properties and behave in different ways
- Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting

- Solids, liquids and gases have different observable properties and behave in different ways

Students:
  - observe and compare the differences in the properties and behaviour of solids and liquids, such as the ability to flow or maintain shape and volume
  - perform an investigation to show that air has mass and takes up space in an inflated basketball

- Changes to materials can be reversible, such as melting, freezing and evaporating or irreversible, such as burning and rusting

Students:
  - observe and describe some readily reversible changes that materials can undergo such as melting and then solidifying chocolate in moulds
  - make and test predictions about the effect of temperature on the state of some substances such as melting ice and boiling water
  - observe some irreversible changes that common everyday materials undergo and identify that the changes may result in new materials or products such as rusting iron, burning paper, cooking a cake, making toffee

- The properties of materials determine their use for specific purposes

Students:
  - describe how the properties of materials used in a familiar product make it suitable for its use
  - explore how materials are used in innovative ways for specific purposes such as the use of geo-textiles to retain water in landscaping, the use of soft fall materials in playgrounds [CCT]
  - test a range of materials to identify and compare the way they behave when used for a specific purpose

Science and Technology • Stage 3

Built Environments

Outcome:
A student:
- describes systems and how social and environmental factors influence the design of built environments

- Systems in built environments are designed to meet the needs of people

Students:
- identify elements that work together as a system to serve and support built environments and how they are designed to meet the needs of people such as transport systems that provide access for people to get to work
- draw a plan or model of a built environment that includes a range of systems to meet the needs and wants of a specific group of users

- Social and environmental factors influence the design of built environments

Students:
- consider changes in design or use of places and spaces over time and the factors that have influenced these changes such as changes in the design of and arrangement of a library and the factors that have influenced the changes such as developments in technology [CCT]; [EU]; [CC]
- brainstorm ideas about how built environments might be designed and constructed in the future to incorporate sustainable environmental practices such as the use of recycled materials and/or the use of natural lighting [CCT]; [EU]; [PSC]

Science and Technology • Stage 3

Information

Outcome:
A student:
- describes information and communication systems and how social influences impact on their design and use

- Systems can be used to transfer information and support communication

Students:
- explore how information and communication systems can be used to exchange ideas, collaborate with others, organise and present data such as a database, spreadsheet, communication systems, multimedia designs [ICT]
- communicate with others in different social and/or cultural contexts such as communicating for the purpose of collecting information about the needs of the audience when designing an information product [L]

- Social influences can impact on the design of information

Students:
- demonstrate appropriate ethics when using information products considering where relevant, different points of view and/or stereotyping [WE]; [EU]
- explore a range of emerging information products and the ways communicating with others have changed such as the use of video conferencing
- discuss issues of safety and privacy of personal information when communicating, selecting and using information products [L]

Science and Technology • Stage 3

Products

Outcome:
A student:
- describes systems used to produce or manufacture products and the social and environmental influences on product design

- Systems are used to produce or manufacture products

Students*:*

- use a system to produce or manufacture a product such as using an assembly line to produce a food product for sale in the school canteen, or the use of robotics in manufacturing a product
- compare the production process in a domestic setting to mass production such as baking bread in the home to making it in a bakery

- Social and environmental factors can influence the design of products

Students:

- research using a variety of sources, the environmental impact of an everyday product such as a sport shoe, torch, a car or newspaper from its production, through its use and disposal [L]; [EU]; [ES]
- record the changes that have occurred in the design of a familiar product over time, due to availability of resources and innovation in technology such as the changes in the design of sport shoes [ICT]
- redesign a product to respond to a specific social or environmental consequence such as redesign the packaging of a food product to reduce garbage [CCT]; [ES]

Science
7–10

2 Rationale

ⓘ for your information

The rationale describes the distinctive nature of the subject and outlines its relationship to the contemporary world and current practice. It explains the place and purpose of the subject in the curriculum.

✍ consult

Science provides an empirical way of answering interesting and important questions about the biological, physical and technological world. Scientific knowledge is contestable and is revised, refined and extended as new evidence arises. The study of science is a collaborative, creative endeavour and has led to a dynamic body of knowledge organised as an interrelated set of models, theories, laws, systems, structures and interactions. It is through this body of knowledge that science provides explanations for a variety of phenomena and enables sense to be made of the natural world. An understanding of science and its social and cultural contexts provides a basis for informed future choices and ethical decisions about local, national and global issues and the current and future practice of science.

Through the study of science, students investigate phenomena that occur over a range of scales, from the subatomic to the cosmological, from events that take place almost instantaneously to processes occurring over billions of years, from the origins of the universe to contemporary phenomena. As an important part of their science education, students examine the historical and ongoing contributions of scientists, including Australian scientists, to international scientific research. They consider the influence of society on advances in technology and science understanding. The study of science provides students with the opportunity to examine the applications and influence of scientific knowledge on their lives, communities and globally. Students are provided with opportunities to become independent learners, willing to engage with the scientific approach to understanding the world. They develop informed attitudes towards science, the environment and in shaping sustainable futures.

The study of science provides opportunities for students to develop the skills of working scientifically. They use scientific knowledge to identify questions for investigations. Students work individually and in teams in planning and conducting investigations to acquire new knowledge and explain scientific phenomena. They are encouraged to think critically in analysing data and information, drawing evidence-based conclusions about science-related issues. Students are called upon to communicate their findings, to evaluate issues and be creative in applying problem-solving processes and their scientific understanding in new situations and events.

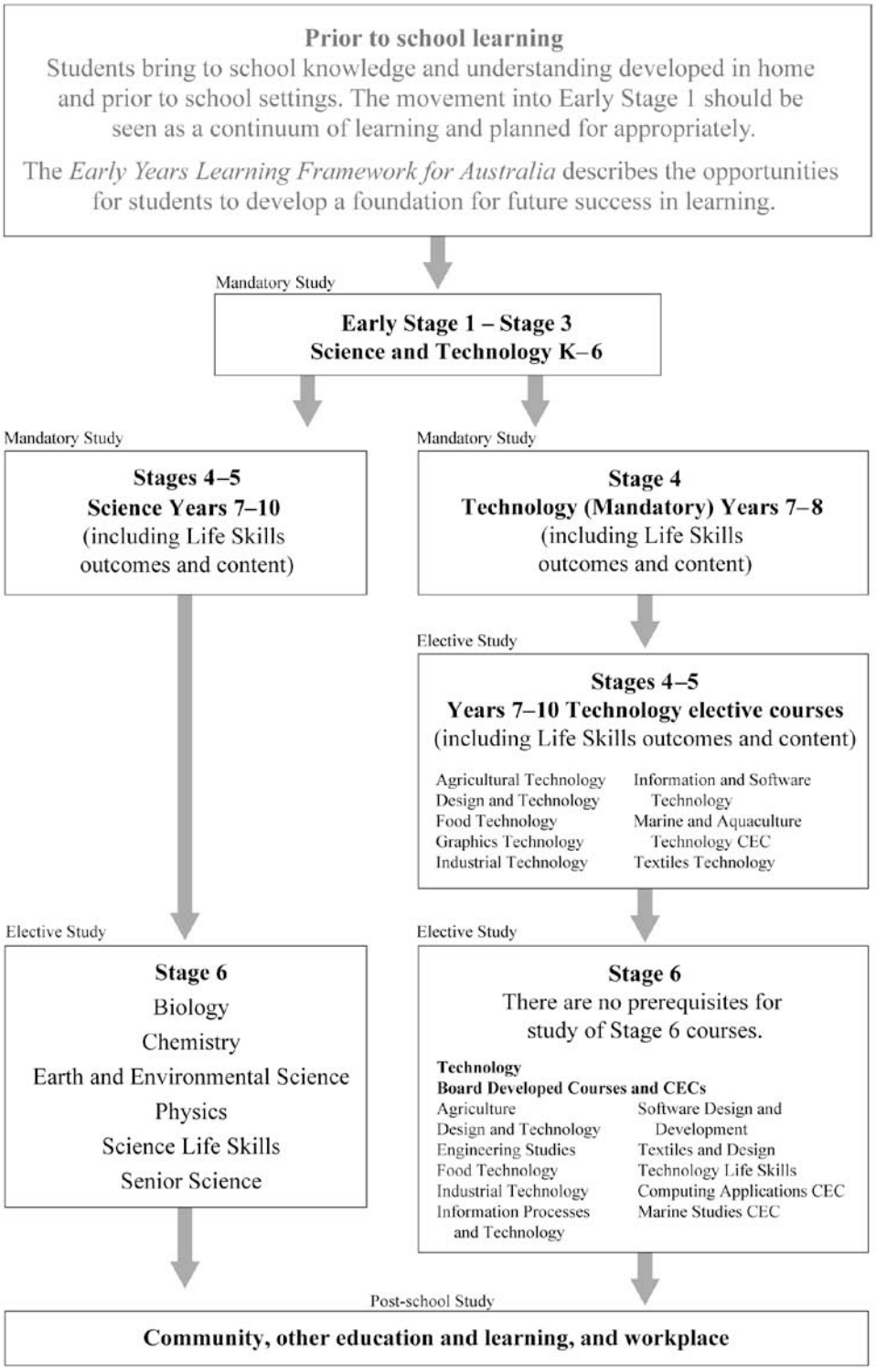
Students develop an understanding of important scientific and technological concepts and processes by engaging in a range of learning experiences that build on prior learning and are set in meaningful and relevant contexts. It is through the scientific inquiry processes students develop a deeper appreciation of the nature of science as an evolving body of knowledge, of the provisional nature of scientific explanations and of the complex relationship between evidence and ideas.

3 The place of the Science K–10 syllabus in the K–12 curriculum

ⓘ for your information

This section of the syllabus demonstrates the relationship between the K–10 syllabus and other associated courses. It shows the possible pathways of learning in the learning area.

✍ consult



4 Aim

ⓘ for your information

The aim provides a succinct statement of the overall purpose of the syllabus. It indicates the general educational benefits for students from programs based on the syllabus.

✍ Consult

The aim of the *Science Years 7–10 Syllabus* is to develop students':

- scientific knowledge about phenomena within the natural world and the application of their understanding to new situations and events
- knowledge and understanding of the nature and practice of scientific inquiry and skills in applying the processes of working scientifically
- appreciation of the dynamic nature of scientific knowledge, its development and influence in improving understanding of the natural world and contribution to finding solutions to problems and how this relates to their lives
- interest in and enthusiasm for science and willingness to engage with science-related problems and issues relevant to their lives.

5 Objectives

ⓘ for your information

Objectives provide specific statements of the intention of a syllabus. They amplify the aim and provide direction to teachers on the teaching and learning process emerging from the syllabus. They define, in broad terms, the knowledge, understanding, skills and values and attitudes to be developed through study in the subject. They act as organisers for the intended outcomes.

Objectives will be organised under the areas of:

- knowledge, understanding and skills
- values and attitudes.

✍ consult

Knowledge, understanding and skills

Students:

- Develop knowledge, understanding and skills in working scientifically through:
  - Questioning and predicting
  - Planning investigations
  - Conducting investigations
  - Processing and analysing data and information
  - Problem-solving
  - Communicating
- Develop knowledge and understanding of the Biological sciences
- Develop knowledge and understanding of the Chemical sciences
- Develop knowledge and understanding of the Earth and space sciences
- Develop knowledge and understanding of the Physical sciences.

Values and attitudes

Students:

- Develop informed attitudes and understanding, based on evidence and reason, towards science related personal, social and global issues relevant to their lives
- Develop a willingness to engage with and respond to science-related ideas and issues as informed, reflective citizens.

6 Outcomes

Syllabus outcomes express the specific intended results from teaching the syllabus. They provide clear statements of the knowledge, understanding, skills, values and attitudes expected to be gained by most students as a result of effective teaching and learning. They are derived from the objectives of the syllabus.

✍ consult

Table of objectives and outcomes

Objective: Students: • Develop knowledge, understanding and skills in working scientifically through: – Questioning and predicting – Planning investigations – Conducting investigations – Processing and analysing data and information – Problem-solving – Communicating	
Stage 4 outcomes A student:	**Stage 5 outcomes** A student:
4.1 identifies questions and problems that can be tested or researched and makes predictions	5.1 formulates questions or hypotheses in order to investigate a problem
4.2 describes the purpose of an investigation and produces a plan to investigate questions and problems	5.2 explains the purpose of an investigation and produces a plan to investigate a question, hypothesis or problem
4.3 follows a sequence of instructions and uses given criteria to undertake a first-hand investigation, individually and in a team	5.3 undertakes a first-hand investigation with safety and competence, individually or in a team
4.4 processes and analyses data from a first-hand investigation or secondary sources	5.4 processes, analyses and evaluates data from a first-hand investigation or secondary sources
4.5 applies understanding to suggest possible solutions to an identified problem	5.5 applies understanding to suggest possible solutions to an identified problem
4.6 presents appropriate information to a given audience	5.6 presents and explains appropriate information to a given audience

Objectives: Students: • Develop knowledge and understanding of the Biological sciences • Develop knowledge and understanding of the Chemical sciences • Develop knowledge and understanding of the Earth and space sciences • Develop knowledge and understanding of the Physical sciences	
Stage 4 outcomes A student:	**Stage 5 outcomes** A student:
4.7 relates the structure and function of living things to their survival and reproduction 4.8 explains the contribution of biological understanding and technological advances to finding solutions to contemporary issues that impact on people's lives	5.7 relates explanations of biological concepts to interactions between and within structures and systems 5.8 explains how refinements in scientific knowledge and technological developments have increased understanding and influenced research in the biological sciences
4.9 describes the observed properties and behaviour of matter using the motion and arrangement of particles 4.10 explains how scientific understanding of the properties of elements, compounds and mixtures relates to their uses in everyday life	5.9 explains how models, theories and laws about matter have been refined as new scientific evidence becomes available 5.10 discusses the importance of chemical reactions in the production of a range of substances and how society influences the development of new materials
4.11 describes the dynamic nature of models, theories and laws in developing scientific understanding of the solar system 4.12 explains how advances in scientific understanding of processes that occur within and on the Earth influence resource management practices	5.11 describes changing ideas about the structure of the universe to illustrate how models, theories and laws are refined by the scientific community 5.12 explains how scientific knowledge about global patterns of geological activity and interactions in the biosphere can be used to inform decisions related to contemporary issues
4.13 describes the action of forces in everyday situations 4.14 discusses how scientific understanding of energy transfer and transformations has been applied in the development of technologies used in everyday life	5.13 applies models, theories and laws to situations involving energy, force and motion 5.14 explains how scientific understanding is applied in systems involving energy transfer, transformations and conservation

<table>
<tr><td colspan="2">Objectives:
Students:
• Develop informed attitudes and understanding, based on evidence and reason, towards science-related personal, social and global issues relevant to their lives
• Develop a willingness to engage with and respond to science-related ideas and issues as informed, reflective citizens</td></tr>
<tr><td>Stage 4 outcomes
A student:</td><td>Stage 5 outcomes
A student:</td></tr>
<tr><td colspan="2">4/5.15
acknowledges responsibility for and willingness to engage with science related issues relevant to their lives

4/5.16
recognises the role of science in contributing to finding solutions to personal, social and global issues, including considering sustainable futures</td></tr>
</table>

Years 7–10 Life Skills outcomes

For students with special education needs, particularly those students with an intellectual disability, it may be determined that these outcomes and content are not appropriate. For these students, Life Skills outcomes and content can provide a relevant and meaningful program – see section 8.

7 Content

7.1 Organisation of content

ⓘ for your information

Content includes knowledge, understanding, skills, values and attitudes and describes the substance of the subject matter that is to be studied. Syllabus content reflects a balance between the acquisition of knowledge and the processes of learning so that students are encouraged to engage in, take responsibility for and continue their own learning.

✍ consult

In the *Science Years 7–10 Syllabus* knowledge, understanding and skills content is organised by the following five strands:

- Working Scientifically
- Biological sciences
- Chemical sciences
- Earth and space sciences
- Physical sciences.

The content described in each strand reflects the knowledge, understanding and skills students should be able to demonstrate by the end of the stage.

The strand Working Scientifically includes the following six processes that are addressed each year as an integrated aspect of each unit of work:

- Questioning and predicting
- Planning investigations
- Conducting investigations
- Processing and analysing data and information
- Problem-solving
- Communicating.

In the *Science Years 7–10 Syllabus* reflection and evaluation are ongoing throughout the processes of Working Scientifically.

Scientific knowledge and understanding is organised into four strands. The content described in each strand is addressed once only in each stage. The knowledge and understanding strands are:

- Biological sciences
- Chemical sciences
- Earth and space sciences
- Physical sciences.

Each of the four strands integrates content relating to scientific knowledge to explain phenomena or predict events with content designed to increase students' understanding of the nature, development, use and influence of science. In these strands the sections are presented with an overarching statement and underpinning content. The content in each section is to be maintained in its entirety with the overarching statement.

In order to enhance the relevance of each unit of work, teachers should select a suitable context. Contexts are the framework that teachers devise to assist students to make meaning of the knowledge, understanding and skills content. The *Science Years 7–10 Syllabus* does not specify the contexts because the choice of these will depend on the societal context of the students, as well as factors such as local resources and students' interests, learning history and cultural backgrounds.

Content strands

The content of the five strands of the *Science Years 7–10 Syllabus* develops students' understanding of the nature and development of science as a unique way of knowing and doing. The essential content provides opportunities for students to gain knowledge and understanding of the role of science in contemporary decision-making and problem-solving in relation to issues relevant to their lives.

Working Scientifically

In each unit of work in each year of the Science Year 7–10 learning program the Working Scientifically processes should be at the centre of teaching and learning. By actively engaging in the processes of Working Scientifically students build on their prior learning to further develop their scientific understanding and skills. By applying the processes of Working Scientifically when undertaking a range of practical experiences, including their own research projects, students gain an understanding of the unique nature of science as a discipline in contexts relevant to their lives.

The Working Scientifically strand involves students in the processes of:

Questioning and predicting

This involves increasing students' skills in:

- identifying and constructing questions
- proposing hypotheses
- making predictions about possible outcomes.

Planning investigations

This involves increasing students' skills in:

- working individually and in teams to plan and organise activities
- using time and resources effectively
- establishing priorities between tasks
- selecting appropriate methods, materials, specimens and equipment to complete activities
- identifying ways of reducing risks and addressing ethical issues in the laboratory and in the field.

Conducting investigations

This involves increasing students' skills in:

- working individually and in teams to locate and gather information from a variety of sources for a planned investigation
- increasing students' skills in performing first-hand investigations
- gathering first-hand data and information
- assessing risks in using science equipment and chemicals safely

- accessing and collecting information from secondary sources using a variety of digital technologies.

Processing and analysing data and information

This involves increasing students' skills in:

- organising data and information to explain trends, patterns and relationships
- representing data and information in meaningful ways
- evaluating the quality of data, information, processes and evidence
- using evidence to draw and justify conclusions.

Problem-solving

This involves increasing students' skills in:

- identifying issues and problems
- framing possible problem-solving processes
- using critical thinking skills to pose questions, make predictions and evaluate evidence
- using creative thinking to develop ideas and possibilities that are new and applying them in different and new situations
- anticipating issues that may arise
- devising appropriate strategies to deal with issues and working through them in a logical and coherent way.

Communicating

This involves increasing students' understanding and skills in:

- conveying information, ideas and findings of investigations to others through appropriate representations
- listening, speaking, reading, writing and visual literacy.

Practical experiences

These must occupy **a minimum of 50% of allocated course time** for students to demonstrate achievement in relation to the outcomes of the syllabus.

Practical experiences should emphasise hands-on activities and include:

- undertaking laboratory investigations including fair tests and controlled experiments
- undertaking fieldwork and surveys
- researching by using a variety of print and audiovisual media, internet and electronic sources of data and information
- using a range of strategies and technologies, including data loggers to collect and record data
- using and constructing models
- using or reorganising second-hand data including those in spreadsheets and databases
- extracting information and reorganising information in the form of flow charts, tables, graphs, diagrams, prose, keys, spreadsheets and databases
- using digital technologies such as computer animations and simulations to capture and analyse data and information
- representing data and information in multimodal text.

As well as undertaking practical experiences conducted in class time, students are to undertake a variety of research projects which provide opportunity for further development and application of the skills of working scientifically.

Student research project

The work of scientists involves planning and carrying out investigations, communicating ideas and findings and seeking constructive evaluation by peers. The student research project provides opportunities for students to engage in similar processes during the course of their learning.

All students are required to undertake **at least one** substantial research project during each of Stage 4 and Stage 5.

- At least one project will involve hands-on practical investigation.
- At least one Stage 5 project will be an individual task.

Students should choose investigations related to one of the topics they have studied or to an area of interest. They should be encouraged to address problems relevant to their immediate environment and use readily available materials to undertake their investigation. Apart from the mandatory Stage 5 individual project, projects may involve collaboration with peers.

Class time should be allocated to assist students in planning their investigations, carrying out research, clarifying their questions, developing hypotheses, identifying the dependent and independent variables and reporting results.

Student research projects may be used to assess the achievement of course outcomes as part of the school-based assessment program. Research projects can also be used as a diagnostic assessment tool to assist with learning and inform future teaching. They contribute to the development of the skills of working scientifically as identified in the syllabus outcomes and related content.

Note

In developing and delivering teaching programs teachers should be aware of and adopt, relevant guidelines and directives of their education authorities and/or schools. Teaching programs should recognise and reflect relevant State and Commonwealth legislation, regulations and standards including **Occupational Health and Safety Standards, Chemical Safety in Schools and Animal Welfare guidelines**. Teachers need to be aware of activities that may require notification, certification, permission, permits and licences.

Knowledge and understanding

In each of the four knowledge and understanding strands, content about scientific concepts, principles, models, theories and laws relevant to each discipline is integrated with content related to the nature, development, use and influence of science.

Biological sciences

The Biological sciences strand is concerned with understanding living things. The key concepts developed within this strand are that:

- the cell is the basic unit of life and the processes central to this function
- a diverse range of living things have evolved on Earth
- living things are interdependent and interact with each other and their environment

- the structure of living things relates to the functions that their body systems perform and how these features aid their survival.

Chemical sciences

The Chemical sciences strand is concerned with understanding the composition and behaviour of matter. The key concepts developed within this strand are that the chemical and physical properties of substances are determined by their structure on an atomic scale and that substances change and new substances are produced in chemical reactions by rearranging atoms through atomic interactions and energy transfer.

Earth and space sciences

The Earth and space sciences strand is concerned with Earth's dynamic structure and its place in the cosmos. The key concepts developed within this strand are that Earth is part of a solar system that is part of a larger universe and Earth is subject to change within and on its surface, over a range of timescales as a result of natural processes. Students explore the ways in which humans use resources from the Earth and appreciate the influence of human activity on the surface of the Earth and the atmosphere.

Physical sciences

The Physical sciences strand is concerned with understanding the nature of forces and motion and matter and energy. The two key concepts developed within this strand are that forces affect the motion and behaviour of objects and that energy can be transferred and transformed from one form to another. Through this strand students gain an understanding of how the concepts of force, motion, matter and energy apply to systems ranging in scale from atoms to the universe itself.

Through the essential content of these four strands of the *Science Years 7–10 Syllabus* students should develop an understanding of how science constructs explanations based on evidence. Science attempts to explain phenomena or predict events by identifying consistent trends and patterns from which models, theories and laws can be generated and to provide explanations for phenomena in terms of interactions within and between systems and structures.

The syllabus essential content provides opportunities for students to consider the nature and development of science. An appreciation of the historical development of current science knowledge is important to student's understanding of science as an ever-developing body of knowledge, the provisional nature of scientific explanations and the complex relationship between evidence and ideas.

Students explore how the uses and applications of science knowledge affect everyday life. They consider the influences of society on science including scientific research and careers. They develop their understanding of the role and contribution of science understanding and technological advances in making informed decisions in relation to contemporary issues with a major scientific component.

Essential and additional content

The essential content has been designed to be addressed by typical students in an indicative time of 400 hours. While some students may undertake this content and demonstrate syllabus standards of achievement in fewer hours, others may require additional time. Indicative hours may also provide a basis for programming and timetabling decisions by teachers and schools.

The distinction between essential and additional content recognises that some students will need all of the available time to focus on the essential content, while others will extend their learning by engaging with content beyond the syllabus. The additional content cannot be selected from either the Preliminary or HSC courses in Science.

The additional knowledge and understanding content presented in the syllabus provides suggestions only and should not be considered an exhaustive list. Additional content selected for the school learning program must be based on scientific understanding that is evidence-based and has been refined over time through review processes by the scientific community. All scientific ideas are theories and must be testable and measurable using the procedures of scientific inquiry.

Teachers are required to develop units of study to address all of the essential content of the syllabus. Teachers may use any remaining allocated time in each stage to:

- incorporate additional content into units of study throughout their teaching program or develop extension units in their teaching program. In this way, students' learning can be extended into areas of specific interest
- choose other contexts to reinforce the essential content of the syllabus. In this way, students can be given more time to acquire the essential knowledge, understanding and skills
- undertake remediation of knowledge, understanding and/or skills in addressing the outcomes and essential content of the syllabus.

Life Skills

Life Skills outcomes and content are in section 8 of the syllabus.

Cross-curriculum areas

ⓘ for your information

The Board of Studies has described cross-curriculum areas that are to be included in syllabuses. In K–10 syllabuses, the identified areas will be embedded in the descriptions of content. The cross-curriculum areas address issues, perspectives and policies that will assist students to achieve the broad learning outcomes defined in the Board of Studies *K–10 Curriculum Framework*. The cross-curriculum areas take account of the general capabilities and cross-curriculum priorities in the Australian Curriculum.

Knowledge, understanding, skills, values and attitudes derived from the cross-curriculum areas will be included in Board syllabuses, while ensuring that subject integrity is maintained.

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Aboriginal and Torres Strait Islander Histories and Cultures [ATSI]

The syllabus provides opportunities in teaching and learning programs for the inclusion of Aboriginal and Torres Strait Islander contexts and perspectives relevant to science such as ecology, the environment, sustainability and astronomy.

Students may develop an understanding of aspects of Aboriginal and Torres Strait Islander Histories and Cultures by engaging in the following activities:

- analysing traditional knowledge systems that inform our scientific understanding and decision-making processes for Country and Place, such as care of waterways or sustainable management of the environment
- researching how traditional knowledge of physical properties has influenced production of materials.

Asia and Australia's relationship with Asia [A]

The syllabus provides opportunities for students to understand the importance of Australia's relationship with Asia and the significance of Asia's role in the development of scientific ideas and technological advances.

Students may develop an understanding of the importance of Australia's relationship with Asia by engaging in the following activities:

- considering how some technological developments have increased scientific understanding of global patterns in continental movement and geological activity
- describing how some impacts of natural events including cyclones, volcanic eruptions and earthquakes have influenced the focus of scientific research.

Civics and Citizenship [CC]

The syllabus provides opportunities for students to broaden their understanding of aspects of civics and citizenship in relation to the application and development of scientific ideas and technological advances. The syllabus also allows students to engage with the commitment to ecological sustainability and the relevance of intergenerational justice to environmental and sustainable practices.

Students may develop an understanding of civics and citizenship by engaging in the following activities:

- investigating the application of physical separation techniques used in everyday situations and industrial processes
- describing examples to show how understanding and skills from across the disciplines of science are used in occupations related to the mining industry and processing of minerals in Australia
- describing how collaboration and connecting ideas across the disciplines of science has increased knowledge about obtaining new materials from living things, the air, Earth or water
- outlining recent examples where scientific or technological developments in areas such as low-emissions electricity generation, reduction in atmospheric pollution, the role of deep ocean currents in regulating global climate and marine life have involved teams of specialists from different branches of science, engineering and technology.

Critical and Creative Thinking [CCT]

The syllabus provides opportunities for students to develop skills in critical and creative thinking through problem-solving, conducting appropriate and innovative investigations to question and predict, develop appropriate work plans and design criteria, mind mapping, brainstorming and sketching and modelling. Students also are provided with the opportunity to apply logic and reasoning to evaluate possibilities and reflect on procedures and processes.

Students may develop an understanding of critical and creative thinking by engaging in the following activities:

- investigating the type of information and/or data that needs to be collected in a range of investigation types
- reflecting on the effectiveness of the method employed in an investigation and making suggestions for improvement
- evaluating on the quality of the information and/or data collected
- discussing strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality and sustainability of the environment
- discussing benefits and problems associated with medical and industrial uses of nuclear energy.

Difference and Diversity [DD]

The syllabus provides opportunities for students to understand and appreciate individual rights, challenge stereotypes and engage with opinions different to their own. Students explore ideas and concepts that represent or express personal and cultural identities, allowing them to reflect upon their own identities, understand those of others and develop inclusive attitudes through an understanding of diversity.

Students may develop an understanding of difference and diversity by engaging in the following activities:

- comparing the current model to explain the relationship between the movement of the sun and Earth with some historical models and theories that have been modified or rejected as a result of new evidence
- demonstrating how collaboration and connecting ideas across the disciplines of science has increased knowledge about obtaining new materials from living things, the air, Earth or water.

Ethical Understanding [EU]

The syllabus provides opportunities for students to engage with situations or circumstances which involve an ethical or moral decision-making process. Students discuss ethical considerations in relation to the uses and advances of scientific knowledge and technology when conducting investigations and in acting fairly and honestly.

Students may develop ethical understanding by:

- investigating contemporary societal issues such as stem cell research and organ transplantation
- discussing the benefits and problems associated with biotechnology
- discussing ethical considerations of emerging scientific knowledge and technology and the impact that this may have on the environment, with reference to sustainable practices and intergenerational justice
- discussing how scientific knowledge can be used to inform personal and community issues.

Information and Communication Technologies [ICT]

The syllabus provides opportunities for students to enhance and develop ICT skills and work effectively with ICT to aid in representation of data, information and observations. Students also engage with the complexity of rapid change and development in technology, which can concurrently enhance and inform scientific knowledge and understanding. ICT use in science and technology facilitates learning through the appropriate application of digital technologies, research on the internet and engaging with emerging technologies.

Students may develop ICT skills to facilitate learning by:

- conducting first-hand investigations, gathering data, conducting research and collecting information from secondary sources
- representing data, information and observations in databases, spreadsheets, graphs, diagrams, flowcharts, tables and multimedia presentations
- considering ethical practices in their ICT use
- selecting appropriate digital technologies to aid scientific processes and representation of information such as using probes and data loggers to gather data and using the internet to conduct collaborative research.

Intercultural Understanding [IU]

The syllabus provides opportunities for students to enhance their intercultural understanding through consideration of other cultures in relation to the development of scientific knowledge. Students are able to engage with and discuss global issues such as sustainability and international responses to climate change through exploration of international conventions and protocols. Intercultural understanding is also developed through consideration of global warming issues and the impact of shared experiences of climatic phenomena such as El Niño and La Niña.

Students may develop intercultural understanding by engaging in the following activities:

- describing how some technological developments have increased scientific understanding of global patterns in continental movement and geological activity
- discussing how different groups in contemporary society may use or weight criteria differently to make decisions about issues involving a major scientific component such as climate change, long-term effects of loss of biodiversity and waste management.

Literacy [L]

The syllabus provides opportunities for students to develop broad literacy skills as well as more science-specific literacy. Language and literacy knowledge specific to the study of science enables students to comprehend increasingly complex theories, make judgements based on scientific knowledge and accurately report upon findings.

Students may develop literacy skills by:

- communicating their observations
- understanding the importance of the audience when producing texts and selecting appropriate genres and formats
- conducting research from a range of sources to extract, summarise, analyse and present qualitative data and information
- present information in multimodal formats, using ICT and digital technologies where appropriate.

Numeracy [N]

The syllabus provides opportunities for students to develop numeracy skills in order to comprehend and interpret data, units of measurement and accurately record observations and findings. Numeracy skills are required to represent data in various formats, identify trends and patterns in findings and consider reliability and integrity of numerical data.

Students may develop numeracy skills by:

- gathering data by estimating, using tally marks and informal units
- using tables, column and bar graphs, databases and spreadsheets to interpret and represent data
- using numerical techniques including calculations and percentages of data
- using formal units of measurement to construct or make a product.

Personal and Social Competence [PSC]

The syllabus provides opportunities for students to develop an awareness of their individual personal and social competence through comparing their own understandings and conclusions respectably with peers, working cooperatively with others, recognising the strengths of team members and conducting self assessment of their produced work.

Students may develop an understanding of personal and social competence by:

- identifying safety and ethical guidelines to be addressed when working scientifically
- addressing risk factors when working scientifically
- investigating a contemporary issue in which science and/or technology have contributed to finding solutions, including identifying ethical considerations that may have been involved in the choices made to use the scientific advances, such as immunisation, pasteurisation, stem cell research or organ transplantation.

Sustainability and Environment [SE]

The syllabus provides opportunities for students to engage with scientific, technological or societal impacts on the environment. Students develop understanding of the importance of resource conservation, recycling and the development of sustainable practices and technologies. Students also develop an appreciation of the impact that human activity has upon the environment and the positive and negative effects of technological advances.

Students may develop an understanding of sustainability and environment by:

- analysing the impacts of human activity on ecosystems, such as industrial processes, mining, use of renewable and non-renewable resources and agricultural water management
- debating the impacts that scientific and technological advances have upon the environment, such as the usage of fossil fuels and the impact that pollution and by-products have upon air, Earth and water
- describing how technological advances have concurrently improved energy efficiency and increased our understanding and application of more sustainable products and technology
- discussing sustainable strategies to balance human activities and the needs of ecosystems by conserving, protecting and maintaining quality of environments, with reference to ethical considerations and intergenerational justice
- discussing the role of international conventions and protocols that influence government and commercial organisations' decisions.

Work and Enterprise [WE]

The syllabus provides opportunities for students to develop work-related skills and an appreciation of the value of collaborative team work and working individually. Through scientific experimentation, students learn to prioritise safe practices and understand the potential risks and hazards present when conducting investigations with scientific equipment such as chemicals, heating devices, cooling devices and biological matter.

Students may develop an understanding of work and enterprise by:

- reflecting on the effectiveness of the method used in working scientifically
- demonstrating, using examples, how collaboration and connecting ideas across the disciplines of science have increased knowledge and understanding about obtaining new materials from living things, the air, Earth or water
- selecting and effectively assembling, manipulating and safely using identified equipment, either individually or as a member of a team.

7.6 Content for Stage 4

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Science • Stage 4

Working Scientifically

Science Inquiry Skills

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed
- In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task
- Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate
- Summarise data, from students' own investigations and secondary sources and use scientific understanding to identify relationships and draw conclusions
- Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method
- Use scientific knowledge and findings from investigations to evaluate claims
- Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

Questioning and predicting

Outcome:
A student:
- identifies questions and problems that can be tested or researched and makes predictions

Students:
- identify questions and problems that can be tested or researched
- make predictions based on their own observations and using their scientific knowledge

Planning investigations

Outcome:
A student:
- describes the purpose of an investigation and produces a plan to investigate questions and problems

Students:
- individually or as a member of a team plan a range of investigation types including fieldwork, surveys, research and experiments [PSC]
- identify the type of information and/or data that needs to be collected in a range of investigation types [N]; [CCT]
- identify variables that need to be kept constant in fair tests if reliable first-hand data is to be collected
- identify with guidance the dependent and independent variables when planning controlled experiments
- outline a logical procedure for undertaking a fair test to collect valid first-hand data
- identify suitable equipment and/or resources to perform the task including safety

Science • Stage 4

Working Scientifically

equipment and appropriate digital technologies [ICT]
- propose possible sources of data and/or information, including secondary sources, relevant to the investigation [CCT]; [L]
- identify safety and ethical guidelines to be addressed [EU]; [PSC]
- describe ways to reduce the risk to themselves and others when working in a laboratory or in the field [PSC]; [WE]

Conducting investigations

Outcome:
A student:
- follows a sequence of instructions and uses given criteria to undertake a first-hand investigation, individually and in a team

Students:
- select, assemble and use appropriate equipment and/or resources to perform the task, including safety equipment
- select and use equipment, including data loggers and digital technologies as appropriate, to collect and record data with accuracy appropriate to the task [ICT]; [N]
- follow the planned procedure when performing an investigation, including controlling variables in fair tests and ensuring safety and ethical guidelines are used [EU]; [PSC]
- record observations and measurements accurately using appropriate units for physical quantities
- accept specific allocated roles when working in a team [PSC]
- show personal responsibility for maintaining a safe working environment for themselves and others [PSC]
- reflect on the effectiveness of the method, either individually or in a team and make suggestions for improvement [CCT]; [WE]

Processing and analysing data and information

Outcome:
A student:
- processes and analyses data from a first-hand investigation or secondary sources

Students:
Processing information
- summarise and collate data, from students' own investigations and secondary sources [N]
- use a range of representations, including diagrams, tables, models, spreadsheets and databases to organise data and represent patterns or relationships [CCT]; [N]
- access information from a range of sources including digital technologies [ICT]
- extract information from flow diagrams, tables and graphs including column graphs, histograms, sector graphs, line graphs, other texts and audio visual resources [N]; [L]
- evaluate the quality of the information and/or data collected [CCT]

Science • Stage 4

Working Scientifically

Analysing information

- describe patterns or relationships within data, using a range of representations, including graphs, keys, models and digital technologies as appropriate [ICT]; [N]; [L]
- identify trends, patterns, relationships and contradictions in data and information [CCT]
- use scientific understanding to identify relationships and draw conclusions
- check the reliability of gathered data and information by comparing them with observations or information from other sources
- produce inferences based on presented information and observations [CCT]
- identify data which supports or discounts a question being investigated or a proposed solution to a problem
- use models, including mathematical ones, to explain phenomena and make predictions [N]; [CCT]
- identify data which supports or discounts a question being investigated or a proposed solution to a problem [CCT]; [N]

Problem-solving

Outcome:
A student:
- applies understanding to suggest possible solutions to an identified problem

Students:

- identify a range of types of problems with a scientific component
- describe different strategies that could be employed to solve an identified problem
- use identified strategies to suggest possible solutions to a particular problem [CCT]
- use cause and effect relationships to explain ideas [CCT]
- evaluate the appropriateness of different strategies for solving an identified problem [CCT]

Communicating

Outcome:
A student:
- presents appropriate information to a given audience

Students:

- use drawings, images, databases, spreadsheets and flowcharts to show relationships and present information clearly and/or succinctly, using digital technologies as appropriate [L]; [ICT]
- select the appropriate type of graph (from column graph, histogram, sector or line graph) or diagram to present information and relationships clearly and succinctly, using, as appropriate, digital technologies [N]; [ICT]
- use an appropriate method to acknowledge sources of data
- select and use appropriate text types for different purposes and contexts including a discussion, explanation, procedure or recount, for oral and written presentation [L]
- assess the reliability of scientific information presented in a range of sources including the media [CCT]

Science • Stage 4

Biological Sciences

Outcomes:
A student:
- relates the structure and function of living things to their survival and reproduction
- explains the contribution of biological understanding and technological advances to finding solutions to contemporary issues that impact on people's lives

Science as a Human Endeavour
- Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations
- Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management

Science Understanding
Year 7 Biological Sciences
- There are differences within and between groups of organisms; classification helps organise this diversity
- Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions

Year 8 Biological Sciences
- Cells are the basic units of living things and have specialised structures and functions
- Multi-cellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce

- Cells are the basic units of structure and function in living things and only come from other living cells

Students:
  - identify that living things are made of cells
  - identify structures within cells and describe their functions including the nucleus, cytoplasm, cell membrane, cell wall, chloroplast
  - identify that substances move into and out of cells
  - outline the role of respiration in providing energy for the activities of cells
  - describe how reproduction in unicellular organisms takes place by cell division
  - describe some beneficial and harmful effects that microorganisms can have on living things and the environment

- Classification helps organise the study of the differences within and between groups of living things

Students:
  - identify reasons for classifying living things
  - classify a variety of living things on the basis of similarities and differences in structural features
  - use simple keys to identify a range of plants and animals
  - distinguish between unicellular and multi-cellular organisms
  - outline the structural features used to group living things including plants, animals, fungi and bacteria
  - describe, using an example of an organism or group of organisms, where the classification has changed as a result of technological developments or advances in scientific understanding

Science • Stage 4

Biological Sciences

- Advances in scientific understanding about the specialised functions carried out by organs in a multi-cellular organism may involve ethical considerations

Students:

- identify that tissues, organs and organ systems in multi-cellular organisms consist of different types of cells
- explain why multi-cellular organisms require systems of organs that carry out specialised functions to enable them to survive and reproduce
- describe the role of the root, stem and leaf in maintaining flowering plants as functioning organisms
- relate the structure and function of the digestive, circulatory, excretory, skeletal and respiratory systems to their role in maintaining humans as a functioning multi-cellular organism
- relate the organs involved in human reproductive systems to their function
- identify the role of cell division in growth, repair and reproduction in multi-cellular organisms
- investigate a contemporary issue in which science and/or technology have contributed to finding solutions, including identifying ethical considerations that may have been involved in the choices made to use scientific advances such as immunisation, pasteurisation, stem cell research or organ transplantation [EU]; [CCT]; [PSC]

- Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems

Students:

- describe some adaptations of living organisms that enable them to survive and reproduce in their environment
- construct and interpret food chains and food webs from Australian ecosystems to show interactions between producers, consumers and decomposers [SE]
- describe the roles of photosynthesis and respiration in ecosystems
- explain using examples how science and technology contribute to finding solutions to the effects of bushfires, drought, cyclones or floods on Australian ecosystems
- investigate how Aboriginal and Torres Strait Islander knowledge such as care of waterways or sustainable management of the environment is used to inform scientific decisions to care for Country and Place [ATSI]; [SE]; [IU]
- discuss how scientific understanding has influenced the development of management practices in agriculture such as animal husbandry or crop cultivation [SE]; [PSC]

Additional content:

Students:

- design simple keys to identify a range of living things
- discuss the concept of a species
- describe the gaseous exchange systems of species of animals other than humans
- relate the location of chloroplasts to their role in the process of photosynthesis
- describe the nutritional requirements for maintaining humans as functioning organisms

Science • Stage 4

Chemical Sciences

Outcomes:
A student:
- describes the observed properties and behaviour of matter using the motion and arrangement of particles
- explains how scientific understanding of the properties of elements, compounds and mixtures relates to their uses in everyday life

Science as a Human Endeavour:
- Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world.

Science Understanding:
Year 7 Chemical Sciences
- Mixtures, including solutions, contain a combination of pure substances and can be separated using a range of techniques

Year 8 Chemical Sciences
- The properties of the different states of matter can be explained in terms of the motion and arrangement of particles
- Differences between elements, compounds and mixtures can be described at a particle level
- Chemical change involves substances reacting to form new substances

- Scientific knowledge has changed people's understanding of the motion and arrangement of particles in matter

Students:
  - describe how the motion and arrangement of particles in solids, liquids and gases is related to their different physical properties
  - describe expansion and contraction of materials in terms of a simple particle model
  - relate an increase or decrease in the amount of energy possessed by particles to changes in particle movement [CCT]
  - demonstrate that heat energy can bring about changes in the physical properties of matter that occur during observations of evaporation, condensation, boiling, melting and freezing
  - outline how some historical developments have contributed to evidence which has advanced our understanding of the particle model of matter
  - identify the benefits and limitations of using models to explain the properties of solids, liquids and gases

- Mixtures including solutions can be separated using a range of techniques

Students:
  - describe aqueous mixtures in terms of solute, solvent and solution
  - relate a range of physical separation techniques, including filtration, decantation, evaporation, crystallisation, chromatography and distillation, used to separate the components of some common mixtures, to the scientific principles involved in each process [CCT]
  - investigate the application of a physical separation technique used in everyday situations or industrial processes, such as water filtering, sorting waste materials, extracting pigments or oils from plants, separating blood products or cleaning up oil spills

Science • Stage 4

Chemical Sciences

- Improvements in technologies have changed scientific knowledge about the nature and properties of elements

Students:

- distinguish between elements, compounds and mixtures in terms of the type and arrangement of particles
- identify reasons for the use of internationally recognised symbols for common elements
- describe the properties and uses of some common elements, including metals and non-metals
- investigate how improvements in technologies have changed our understanding about the nature and properties of elements [CCT]

- In a chemical change, new substances are formed, which may have uses in everyday life

Students:

- compare physical and chemical changes in terms of the arrangement of particles and reversibility of the process
- identify that a chemical change involves substances reacting to form new substances
- identify when a chemical change is taking place by observing a change in temperature, the appearance of new substances, or disappearance of an original substance
- investigate the properties and uses of common acids and bases and how they are identified

Additional content:

Students:

- research how a knowledge of physical properties of natural materials, including ochres and dyes, has been used by Aboriginal and Torres Strait Islanders in the production of artefacts and weapons, shelter and housing and cloth and string production [ATSI]
- explain why crystallisation can be used as a method of purification or separation of substances
- identify some common colloids
- investigate the nature of mineral crystals

Science • Stage 4

Earth and space sciences

Outcomes:
A student:
- describes the dynamic nature of models, theories and laws in developing scientific understanding of the solar system
- explains how advances in scientific understanding of processes that occur within and on the Earth influence resource management practices

Science as a Human Endeavour
- Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world
- Science understandings influence the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management
- People use understanding and skills from across the disciplines of science in their occupations
- Science knowledge can develop through collaboration and connecting ideas across the disciplines of science

Science Understanding
Year 7 Earth and space sciences
- Predictable phenomena on Earth, including seasons and eclipses, are caused by the relative positions of the sun, Earth and the moon
- Some of Earth's resources are renewable, but others are non-renewable
- Water is an important resource that cycles through the environment

Year 8 Earth and space sciences
- Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales

- As new evidence becomes available scientific knowledge increases and people's understanding of the solar system changes

Students:
  - describe qualitatively the relative sizes, distances between, features and movements of the main components of the solar system [L]
  - explain how the relationships between the relative positions of the sun, Earth and moon cause predictable phenomena including seasons, phases of the moon, solar and lunar eclipses
  - compare the current model to explain the relationship between the movement of the sun and Earth with some historical scientific models and theories that have been modified or rejected as a result of new evidence [CCT]
  - describe some examples of how technological advances have lead to discoveries and increased scientific understanding of the solar system
  - use examples to show how ideas from different cultures have contributed to current understanding of the solar system [IU]

- Scientific understanding and skills from across the disciplines of science contribute to knowledge about sedimentary, igneous and metamorphic rocks, the minerals they contain and the processes by which they are formed over a variety of timescales

Students:
  - describe the inner structure of the Earth in terms of core, mantle, crust and lithosphere
  - relate the formation of a range of common landforms to weathering, erosion and deposition

Science • Stage 4

Earth and space sciences

- outline the origins of and relationships between sedimentary, igneous and metamorphic rocks
- describe conditions under which fossils form
- outline how geological history can be interpreted in a sequence of horizontal sedimentary layers, in which the oldest are at the base and the youngest at the top
- identify that sedimentary, igneous and metamorphic rocks contain minerals
- classify a variety of common rocks and minerals into groups according to their observable properties [L]
- explain the breaking down of rocks in terms of chemical and physical changes
- describe examples to show how understanding and skills from across the disciplines of science are used in occupations related to the mining and processing of minerals in Australia [WE]

• Scientific understanding influences the choices people make in regard to the use and management of Earth's resources

Students:

- examine the importance of a variety of natural and made resources obtained from living things, the air, Earth and water
- classify a range of resources, including fossil fuels obtained from living things and those extracted from the air, Earth and water as renewable and non-renewable resources
- discuss issues related to the current level of use of a major non-renewable resource found in Australia [SE]
- outline the choices that need to be made when considering whether to use scientific and technological advances to obtain a resource from living things, the air, Earth or water [EU]; [SE]; [PSC]
- propose reasons why society should support scientific research into the development of new materials obtained from living things and the air or Earth or oceans [EU]; [CCT]; [PSC]
- describe the water cycle in terms of the physical processes involved
- explain how scientific understanding of the water cycle has influenced the development of household, industry and agricultural water management practices [SE]; [CCT]
- demonstrate using examples, how collaboration and connecting ideas across the disciplines of science has increased knowledge about obtaining new materials from living things, the air, Earth or water

Additional content:

Students:

• describe the effect of the forces of the sun and moon on the hydrosphere
• discuss economic and environmental impacts of mining and resource exploration
• evaluate costs and benefits of various sources of energy, including those available to remote communities
• describe some methods used by scientists to determine the relative age of rock layers
• describe ways in which technology has increased the variety of made resources

Science • Stage 4

Physical sciences

Outcomes:
A student:
- describes the action of forces in everyday situations
- discusses how scientific understanding of energy transfer and transformations has been applied in the development of technologies used in everyday life

Science as a Human Endeavour
- People use understanding and skills from across the disciplines of science in their occupations
- Science understandings influence the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management

Science Understanding
Year 7 Physical Sciences
- Change to an object's motion is caused by unbalanced forces acting on the object
- Earth's gravity pulls objects towards the centre of the Earth

Year 8 Physical Sciences
- Energy appears in different forms including movement (kinetic energy), heat and potential energy and causes change within systems

- An understanding of forces and how they affect the motion of objects can be used in technological developments

Students:
Forces
  - identify changes that take place when particular forces are acting
  - identify that a change to an object's motion is caused by unbalanced forces acting on the object
  - investigate and describe common situations where forces are unbalanced
  - describe some examples of technological developments to show how the impact of forces can be reduced by modern safety devices such as safety helmets, seat belts and air bags

Frictional force
  - describe friction as a contact force which opposes motion
  - identify and investigate factors which influence the size and effect of frictional forces

Gravitational force
  - use the term 'field' in describing forces acting at a distance [L]
  - describe how gravity affects objects at the surface of the Earth
  - distinguish between the terms 'mass' and 'weight'

- The actions of electrostatic and magnetic forces may be observed and used in everyday life

Students:
Electrostatic forces
  - describe ways in which objects acquire electrostatic charge
  - describe the behaviour of charges when they are brought close to each other
  - investigate and describe everyday situations where effects of electrostatic forces can be observed such as lightning strikes during severe weather, volcanic eruptions and dust storms [CCT]

Magnetic force
  - describe the behaviour of magnetic poles when they are brought close together
  - describe how magnets and electromagnets are used in some everyday devices or technologies used in everyday life

Science • Stage 4

Physical sciences

- Scientific understanding about energy transfer and transformation is applied in a range of technologies used in everyday life

Students:

Law of conservation of energy

- identify situations or phenomena in which energy appears in different forms and causes changes within systems
- identify that objects possess energy because of heat, their motion (kinetic energy) and position (potential energy)
- investigate and describe energy transformations in a variety of everyday devices involving heat energy electricity, sound and light
- qualitatively account for the total energy involved in energy transfers and transformations

Electricity

- associate electricity with energy transfer in a simple circuit
- construct and draw circuits containing a number of components to show a transfer of electricity

- Science understanding of heat energy and energy conversions are important considerations in finding solutions to current energy usage issues impacting on our society

Students:

- describe heat transfer by conduction, convection and radiation including situations in which each occurs
- explain how heat energy contributes to the inefficiency of most energy conversions [CCT]
- describe examples of ways in which scientists and engineers use scientific principles to improve the energy efficiency of processes and technologies to reduce energy consumption [CCT]

Additional content:

Students:

- describe characteristics of specific forces in terms of size and direction
- identify some advantages of levers, pulleys, gears and inclined planes
- analyse various simple machines in terms of energy input and output and work done
- distinguish between everyday and scientific meanings of work
- trace the history of the development of particular devices or technologies such as circuitry through to microcircuitry
- describe the scientific principles used in some traditional technologies used and developed by Indigenous peoples [ATSI]
- trace the history of pendulum motion studies and its connection with timekeeping and setting standards of length

7.7 Content for Stage 5

✍ consult

Science • Stage 5

Working Scientifically

Science Inquiry Skills

- Formulate questions or hypotheses that can be investigated scientifically
- Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods
- Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data.
- Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies
- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
- Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data
- Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems
- Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Questioning and predicting

Outcome:
A student:
- formulates questions or hypotheses in order to investigate a problem

Students:
- describe a problem and develop a question or hypothesis that can be tested or researched
- predict outcomes based on observations and scientific knowledge

Planning investigations

Outcome:
A student:
- explains the purpose of an investigation and produces a plan to investigate a question, hypothesis or problem

Students:
- select an appropriate investigation method and produce a plan to investigate an identified problem [CCT]; [PSC]; [WE]
- describe a logical procedure for undertaking controlled experiments to collect valid and reliable first-hand data
- assess risk factors and consider ethical issues associated with the method selected [PSC]; [EU]
- explain why certain types of information or data needs to be collected in a range of investigation types conducted individually and in a team [WE]
- justify variables that need to be kept constant if reliable first-hand data is to be collected

Science • Stage 5

Working Scientifically

- specify the dependent and independent variables when planning a controlled experiment
- design an appropriate means of recording data or information to be gathered, using digital technologies as appropriate [ICT]; [N]
- identify the appropriate units to be used in collecting data [N]

Conducting investigations

Outcome:
A student:
- undertakes a first-hand investigation with safety and competence, individually and in a team

Students:

- select, effectively assemble, manipulate and safely use identified equipment, either individually or as a member of a team [WE]
- follow the planned method for the investigation and modify the procedure as appropriate [PSC]
- make and record observations and measurements accurately, using data loggers and digital technologies as appropriate [N]
- record observations and information from a range of sources [N]; [L]
- negotiate and allocate specific roles when working in a team, according to the requirements of the task [PSC]
- evaluate the effectiveness of the planned procedure and suggest improvements as appropriate [CCT]

Processing and analysing data and information

Outcome:
A student:
- processes, analyses and evaluates data from a first-hand investigation or secondary sources

Students:

Processing information

- organise data using a variety of methods including diagrams, tables, spreadsheets and databases, distinguishing between relevant and irrelevant information [N]; [ICT]; [L]
- select and use a variety of methods to organise data including diagrams, tables, models, spreadsheets and data bases [L]
- use a range of appropriate digital technologies to access information [ICT]
- extract information from tables, flow diagrams, graphs including column graphs, histograms, sector graphs, line graphs, other texts and audiovisual resources [N]
- suggest ways to improve the quality of the data collected [CCT]

Analysing information

- analyse trends, patterns, relationships and identify inconsistencies in data and information [N]; [CCT]
- critically analyse the validity and reliability of first-hand data and information [CCT]
- apply mathematical concepts and digital technologies to assist analysis of data and information [N]; [CCT]; [ICT]
- develop simple models to explain observed phenomena or make predictions [CCT]; [L]
- use scientific concepts to draw evidence-based conclusions
- assess the validity of data from secondary sources

Science • Stage 5

Working Scientifically

Problem-solving

Outcome:
A student:
- applies understanding to suggest possible solutions to an identified problem

Students:
- identify data which supports or discounts an hypothesis, a question being investigated or a proposed solution to a problem [CCT]; [N]
- describe strategies to develop a range of possible solutions to a particular problem
- apply critical thinking in considering proposals, solutions and conclusions including a consideration of risk [CCT]
- formulate cause-and-effect relationships
- describe how scientific understanding can influence decisions about personal and community issues [SE]; [EU]; [PSC]
- assess strategies that have been identified as possible solutions to a particular problem

Communicating

Outcome:
A student:
- presents and explains appropriate information to a given audience

Students:
- construct evidence-based arguments using appropriate scientific ideas and information [CCT]
- construct the appropriate type of diagram, table or graph (from column graph, histogram, sector or line graph) to present information and relationships clearly and succinctly [N]; [L]
- use appropriate scientific language, conventions and text types for different purposes and contexts, including a discussion, explanation, procedure or recount, for oral and written presentation [L]
- use appropriate units for physical quantities and symbols to express relationships, including mathematical ones [N]
- propose ideas that demonstrate coherence and logical progression [CCT]
- use as appropriate digital technologies to present findings and ideas [ICT]

Science • Stage 5

Biological sciences

Outcomes:
A student:
- relates explanations of biological concepts to interactions between and within structures and systems
- explains how refinements in scientific knowledge and technological developments have increased understanding and influenced research in the biological sciences

Science as a Human Endeavour
- Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community
- Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries
- Advances in science and emerging sciences and technologies can significantly affect people's lives including generating new career opportunities
- The values and needs of contemporary society can influence the focus of scientific research

Science Understanding
Year 9 Biological Sciences
- Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment
- Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems

Year 10 Biological Sciences
- The transmission of heritable characteristics from one generation to the next involves DNA and genes
- The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence

- Advances in science and technology have improved understanding of how multicellular organisms' internal systems respond to changes to their environment

Students:
  - explain that body systems of multicellular organisms work together to serve the needs of cells
  - describe the role of and interaction between, the coordination systems in maintaining humans as functioning organisms
  - describe some responses of body systems to infectious and non-infectious diseases
  - explain using examples how advances in technology have improved scientific understanding of the functioning and interactions of body structures and systems
  - identify examples from the biological sciences where emerging science and technologies have generated new career opportunities, such as biomedical engineering, immunology, pharmacology, nuclear medicine or nanotechnology [WE]

- Conserving and maintaining the quality and sustainability of the environment requires scientific understanding of matter and energy flow through ecosystems

Students:
  - distinguish between biotic and abiotic features of a local ecosystem
  - identify an ecosystem as consisting of communities of interdependent organisms and abiotic components of the environment
  - outline how matter cycles in ecosystems

Science • Stage 5

Biological sciences

- explain how energy flows into and out of an ecosystem through a food web and must be replaced to maintain the sustainability of the system [SE]
- predict how changes in the biotic and abiotic features of an ecosystem affect populations of organisms [SE]
- discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality and sustainability of the environment [SE]; [EU]; [CCT]; [CC]

• Advances in scientific understanding and discoveries in biotechnology can be linked to developments in technology

Students:

- outline how the Watson-Crick model of DNA explains:
  - the exact replication of DNA
  - changes in genes (mutation)
- identify that genes are part of DNA and that information is transferred as DNA on chromosomes when cells reproduce themselves
- describe some examples demonstrating how developments in technology have advanced understanding of biotechnology
- describe some benefits and problems of using biotechnology including gene technology [EU]
- outline using examples how the needs of contemporary society have influenced the focus of scientific research in biotechnology [EU]

• Scientific knowledge and evidence supporting the theory of evolution by natural selection can be used to explain the diversity of living things and has been refined through a process of review by the scientific community

Students:

- describe scientific evidence that present-day organisms have evolved from organisms in the past
- relate the fossil record to the age of the Earth and the time over which life has been evolving
- demonstrate, using examples such as resistance to antibiotics and pesticides, how natural selection relates to the theory of evolution
- outline the roles of genes and environmental factors in determining the features and survival of organisms in a population

Additional content:

Students:

- identify the role of mitosis and cell differentiation during the production of new cells for growth and replacement of damaged cells
- identify the role of meiosis in producing specialised cells for reproduction
- explain why the same genetic information is not equally expressed in all cells
- explain the role of DNA in controlling cellular activity and producing proteins
- describe the range of functions carried out by various endocrine (hormonal) glands in humans
- discuss the role of the endocrine system in the control of reproduction

Science • Stage 5

Chemical Sciences

Outcomes:
A student:
- explains how models, theories and laws about matter have been refined as new scientific evidence becomes available
- discusses the importance of chemical reactions in the production of a range of substances and how society influences the development of new materials

Science as a Human Endeavour
- Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community
- The values and needs of contemporary society can influence the focus of scientific research

Science Understanding
Year 9 Chemical Sciences
- All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms
- Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction, mass is not created or destroyed
- Chemical reactions, including combustion and reactions of acids, are important in both non-living and living systems and involve energy transfer

Year 10 Chemical Sciences
- The atomic structure and properties of elements are used to organise them in the Periodic Table
- Different types of chemical reactions are used to produce a range of products and can occur at different rates

- Understanding of the structure of the atom has been refined over time by the scientific community

Students:
  - describe the structure of atoms in terms of the nucleus, protons, neutrons and electrons
  - distinguish between elements, using information about the numbers of protons, neutrons and electrons
  - identify that natural radioactivity arises from the decay of the nuclei of atoms releasing particles and energy
  - discuss the benefits and problems associated with medical and industrial uses of nuclear energy [EU]; [SE]; [CCT]
  - outline historical developments of the atomic theory to demonstrate how models and theories have been refined over time through a process of review by the scientific community

- The modern Periodic Table has important predictive value in chemistry

Students:
  - identify the atom as the smallest unit of an element
  - relate the organisation of elements in the Periodic Table to their atomic structure
  - identify that the properties of elements are related to their position in the Periodic Table
  - predict the properties of some common elements using the Periodic Table
  - outline how scientific evidence available at the time, creativity and logical reasoning contributed to the development of the Periodic Table

Science • Stage 5

Chemical Sciences

- In chemical reactions, which can occur at different rates, atoms are rearranged to produce a range of products

Students:

- identify that new substances are formed during chemical reactions by rearranging atoms rather than by creating or destroying them
- identify a range of compounds using their common names and chemical formulae
- classify compounds into groups based on common chemical characteristics
- construct word equations from observations and written descriptions of a range of chemical reactions including:
  - corrosion
  - combustion
  - precipitation
  - the action of acids on metals and acids on carbonates
  - neutralisation
  - decomposition [L]
- describe the reactants and products in the processes of photosynthesis and respiration
- identify that chemical reactions involve energy transfer and can be exothermic or endothermic
- compare combustion and respiration as processes which both release energy but occur at different rates
- identify the effects of factors such as temperature and catalysts on the rate of some common chemical reactions
- discuss how ethical and environmental considerations influence decisions about scientific research related to the development and production of new materials [SE]; [EU]

Additional content:

Students:

- use models to describe the arrangement of electrons in the principal energy levels of common elements
- sort metals into their order of activity
- identify the characteristics that classify substances as either ionic or covalent compounds
- balance a range of common chemical equations
- identify properties of different substances that can be explained in terms of their subatomic structure

Science • Stage 5

Earth and space sciences

Outcomes:
A student:

- describes changing ideas about the structure of the universe to illustrate how models, theories and laws are refined by the scientific community
- explains how scientific knowledge about global patterns of geological activity and interactions in the biosphere can be used to inform decisions related to contemporary issues

Science as a Human Endeavour

- Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community
- People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions
- The values and needs of contemporary society can influence the focus of scientific research

Science Understanding

Year 9 Earth and space sciences

- The theory of plate tectonics explains global patterns of geological activity and continental movement

Year 10 Earth and space sciences

- Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere
- The universe contains features including galaxies, stars and solar systems and the Big Bang theory can be used to explain the origin the universe

- Scientific understanding relating to the Big Bang theory has been refined overtime through a process of review by the scientific community

Students:

  - describe some major features of the universe, including galaxies, stars, nebulae and solar systems
  - use appropriate scales to describe differences in sizes of and distances between, structures making up the universe [N]
  - identify that all objects exert a force of gravity on all other objects in the universe
  - describe using examples how technological developments have provided data and information that has advanced scientific understanding about features of and continuing changes in the universe [ICT]
  - outline how through review processes by the scientific community the range of evidence that supports the Big Bang theory in explaining the origin and age of the universe has been refined
  - describe some recent scientific contributions made by female and male scientists, including Australian examples, in the exploration and study of the universe

- Developments in technology have advanced scientific understanding to explain global patterns of geological activity and continental movement

Students:

  - assess evidence that supports the theory of plate tectonics and suggests crustal plates move over time [CCT]
  - relate movements of Earth's plates to convection currents and gravitational forces
  - use scientific evidence to explain how interactions at plate boundaries may result in earthquakes, volcanic activity and new landforms [N]; [L]

Science • Stage 5

Earth and space sciences

- use examples related to the Asia-Pacific region to show how some technological developments have increased scientific understanding of global patterns in continental movement and geological activity [A]
- describe how some impacts of natural events including cyclones, volcanic eruptions and earthquakes on the atmosphere, hydrosphere, lithosphere and biosphere have influenced the focus of scientific research [SE]

• People use scientific knowledge to evaluate claims, explanations or predictions in relation to interactions involving the biosphere, lithosphere, hydrosphere and atmosphere

Students:

- describe the importance of cycles of materials including carbon, within the biosphere
- demonstrate how different groups in contemporary society may use or weight criteria differently to make decisions about issues involving a major scientific component such as climate change, long-term effects of loss of biodiversity and waste management [EU]; [CCT]
- describe using examples some of the current issues impacting on society that are the result of the effects of human activity on the biosphere, lithosphere, hydrosphere and atmosphere [SE]
- outline recent examples where scientific or technological developments in areas such as low-emissions electricity generation, reduction in atmospheric pollution, the role of deep ocean currents in regulating global climate and marine life have involved teams of specialists from different branches of science, engineering and technology

Additional content:

Students:

• relate colours of stars to their age, distance from Earth and size
• explain why quasars have provided evidence of a changing universe
• discuss the impact of *Voyager* probes and the Hubble Space Telescope on knowledge and understanding of the universe
• describe evidence used to support estimates of time in the universe
• discuss technological developments that have extended the ability of scientists to collect information about and monitor events in the natural world
• discuss the development and implications of international agreements relating to biodiversity and climate change, such as the original 1987 Montreal Protocol, 1992 United Nations Conference on Environment and Development, 1997 Kyoto Protocol and the 2009 United Nations Climate Change Conference
• discuss evidence relating global warming to changes in weather patterns including El Niño and La Niña

Science • Stage 5

Physical sciences

Outcomes:
A student:
- applies models, theories and laws to situations involving energy, force and motion
- explains how science understanding is applied in systems involving energy transfer, transformations and conservation

Science as a Human Endeavour
- The values and needs of contemporary society can influence the focus of scientific research
- Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries

Science Understanding
Year 9 Physical Sciences
- Forms of energy can be transferred in a variety of ways through different mediums

Year 10 Physical Sciences
- Energy conservation in a system can be explained by describing energy transfers and transformations
- The motion of objects can be described and predicted using the laws of physics

- The wave model can be used to explain the transmission of energy

Students:

The wave model
  - identify situations where waves transfer energy
  - qualitatively describe features of waves including wavelength, frequency and speed
  - investigate the production and transmission of sound

Electromagnetic radiation
  - identify examples of different types of radiation that make up the electromagnetic spectrum and their common properties
  - relate the properties of different types of radiation in the electromagnetic spectrum to their uses in everyday life, including communications technology
  - distinguish between the absorption, reflection and refraction of light and identify everyday situations where each occurs [CCT]

- Scientific principles related to force and motion apply to areas of everyday life

Students:
  - describe qualitatively the relationship between force, mass and acceleration
  - explain qualitatively the relationship between distance, speed and time
  - relate qualitatively acceleration to a change in speed and/or direction as a result of a net force
  - analyse qualitatively everyday situations involving motion in terms of Newton's Laws [CCT]

- Technological developments in the efficient use of electricity result from increased scientific understanding

Students:
  - describe voltage, resistance and current using analogies
  - describe qualitatively the relationship between voltage, resistance and current
  - compare the characteristics and applications of series and parallel electrical circuits
  - demonstrate using examples how developments in technology have resulted in increasing

Science • Stage 5

Physical sciences

efficiency of the use of electricity by individuals and society

- An important consideration for society and the environment is energy conservation in a system

Students:

- describe how in energy transfers and transformations, a variety of processes can occur so that usable energy is reduced and the system is not 100% efficient
- describe how engineers and architects employ scientific concepts and principles in designing energy efficient devices and buildings
- discuss viewpoints and choices that need to be considered in making decisions about the use of non-renewable energy resources [SE]; [EU]; [CC]; [CCT]

Additional content:

Students:

- describe quantitatively features of waves including frequency, wavelength and speed using $v = f\lambda$
- relate scattering and dispersion of light to everyday occurrences
- explain the difference between speed and velocity
- describe the relationships between displacement, time, velocity and acceleration both qualitatively and quantitatively using equations of motion
- describe and use quantitatively the relationship between force, mass and acceleration
- apply Newton's laws to space travel
- explain the relationship between voltage, resistance and current using Ohm's Law

8 Years 7–10 Life Skills outcomes and content

A small percentage of students with special education needs may best fulfil curriculum requirements for Science Years 7–10 by undertaking Life Skills outcomes and content.

Specific Life Skills outcomes will be selected on the basis that they meet the particular needs, goals and priorities of each student. Students are not required to complete all outcomes. Outcomes may be demonstrated independently or with support. However, in developing programs teachers need to take into consideration relevant system policies regarding mandatory learning experiences.

In order to provide a relevant and meaningful program of study that reflects the needs, interests and abilities of each student, schools may integrate Science Years 7–10 Life Skills outcomes and content across a variety of school and community contexts.

A range of curriculum adjustments should be explored before a decision is made to access Years 7–10 Life Skills outcomes and content. Information about curriculum adjustments can be found in *Life Skills Years 7–10 Advice on Planning, Programming and Assessment*.

8.1 Years 7–10 Life Skills Outcomes

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Objectives: Students: • Develop knowledge, understanding and skills in working scientifically through: – Questioning and predicting – Planning investigations – Conducting investigations – Processing and analysing data and information – Problem-solving – Communicating • Develop knowledge and understanding of the Biological sciences • Develop knowledge and understanding of the Chemical sciences • Develop knowledge and understanding of the Earth and space sciences • Develop knowledge and understanding of the Physical sciences
Life Skills outcomes: A student:
Working Scientifically
LS 1 works individually and collaboratively to formulate questions, predict outcomes and plan and conduct scientific investigations
Biological sciences
LS 2 collects and analyses data, draws conclusions and communicates these in relation to identified problems LS 3 identifies features of living and non-living things

LS 4 investigates the interactions of living things with each other and the environment LS 5 recognises the functions of systems of organs in living things LS 6 explores ways in which scientific and technological developments have affected human health and interactions with the environment
Chemical sciences
LS 7 identifies the properties of common substances LS 8 investigates some common chemical reactions LS 9 demonstrates an understanding of how common chemicals affect our daily life
Earth and space sciences
LS 10 demonstrates an understanding of some of the features of the Earth LS 11 identifies how features of the Earth are influenced by its position and movement in space LS 12 describes how features of the Earth change over time LS 13 explores the impact of natural and human activity on the Earth's resources and ways to effectively manage our resources
Physical sciences
LS 14 explores a range of forces in everyday situations LS 15 recognises various forms and sources of energy LS 16 relates knowledge of energy transformations to the responsible use of energy in our world

8.2 Years 7–10 Life Skills Content

The Years 7–10 Life Skills content forms the basis for learning opportunities. Students will not be required to complete all of the content to demonstrate achievement of an outcome.

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Science • Life Skills

Working Scientifically

Life Skills outcomes:
A student:

- works individually and collaboratively to formulate questions, predict outcomes and plan and conduct scientific investigations
- collects and analyses data, draws conclusions and communicates these in relation to identified problems

- Questioning and predicting

Students:

  - formulate questions in familiar contexts relating to the natural and made world
  - identify questions that can be investigated scientifically
  - predict the outcome of an investigation, using background knowledge, experience and/or scientific understanding

- Planning investigations

Students:

  - select suitable methods for gathering data, including surveys, field work and research
  - identify scientific equipment and materials and their purposes
  - identify safety rules when using scientific equipment and materials in an investigation [WE]
  - work individually and collaboratively to record aspects of their plan [PSC]
  - recognise variables to be changed, kept the same and measured in an investigation

- Conducting investigations

Students:

  - use a range of techniques, including surveys, field work and research, to gather data and information, using digital technologies as appropriate [ICT]
  - select and use appropriate equipment, measuring tools and methods to make accurate observations and measurements [N]
  - work individually and collaboratively to follow the planned method of an investigation, adjusting procedures as necessary [PSC]
  - follow safety rules when using equipment and tools to conduct investigations [WE]
  - record observations and measurements using appropriate units and abbreviations [L]; [N]

- Processing and analysing data and information

Students:

  - select and use a variety of strategies, including tables, graphs and diagrams, to present data and information, using digital technologies as appropriate [ICT]
  - interpret data and information gathered and draw simple conclusions [N]
  - relate data and information gathered to questions and predictions [CCT]
  - reflect on the strengths and limitations of their investigation [PSC]
  - use their conclusions to identify future questions that may be investigated scientifically

Science • Life Skills

Working Scientifically

- Problem-solving

Students:

- suggest some types of problems with a scientific component
- identify different strategies that could be used to solve an identified problem

- Communicating

Students:

- use a range of strategies to communicate information about an investigation, using digital technologies as appropriate [ICT]

Practical experiences

Where appropriate, students should have the opportunity to develop their skills in Working Scientifically by participating in a range of practical experiences to develop their understanding and demonstrate achievement of Science Life Skills outcomes. The Working Scientifically processes may be integrated into any additional Life Skills content undertaken and can provide students with meaningful opportunities to engage with scientific concepts.

Science • Life Skills

Biological sciences

Life Skills outcomes:
A student:
- identifies features of living and non-living things
- investigates the interactions of living things with each other and the environment
- recognises the functions of systems of organs in living things
- explores ways in which scientific and technological developments have affected human health and interactions with the environment

- There are differences within and between living things

Students:
- recognise living things and non-living things at home, at school and in the community
- identify the major features of living things
- identify a variety of plants and animals in the local environment
- observe changes that occur in a given plant and/or animal over time
- classify a variety of living things according to their observable structural features
- represent classification in a variety of ways such as diagrams and tables [N]; [L]
- identify some microorganisms in the environment and their features such as fungi, bacteria and bread mould
- outline some beneficial and harmful effects that microorganisms can have on living things such as contribute to health; produce useful products; cause disease

- Living things depend on each other and their environment

Students:
- recognise the needs of living things including water, air and food
- identify the features of a variety of living things that make them suited to their environment
- identify that plants use sunlight to make their own food and animals eat plants and other animals
- investigate a simple food chain in the local area, such as caterpillar eats plant, magpie eats caterpillar
- represent this food chain in a variety of ways such as images or flowcharts
- identify the roles of producers (plants), consumers (animals) and decomposers (worms, fungi) in an identified ecosystem (rock pool, garden)
- identify the relationships between plants, animals and their ecosystem such as in a pond
- observe the decomposition process such as building and maintaining a compost heap or worm farm
- communicate the purpose of decomposition such as natural recycling of materials
- identify materials that are recycled within an ecosystem including water and carbon dioxide

- Human activity can impact on the structures and functions of an ecosystem

Students:
- identify the living and non-living parts of their surroundings
- recognise the difference between native and introduced species (plants and animals)
- explore ways that the introduction of plant or animal species has affected a local ecosystem
- identify ways that human activities affect habitats such as by building cities, farms and roads, pollution [SE]

Science • Life Skills

Biological sciences

- investigate how the habitat of an animal or plant may be directly affected by human activity
- identify roles and responsibilities in conserving and maintaining the quality of the local environment such as putting litter in the bin; walking a dog on a lead in a park; keeping cats inside at night; complying with quarantine restrictions when travelling [SE]

• Systems of organs in living things carry out specialised functions

Students:

The skeletal system

- identify organs of the skeletal and muscular system
- recognise the function of the skeletal and muscular system
- investigate how muscles move such as by feeling own bicep when raising and lowering arm; viewing muscles and bones in movement animations
- identify factors that are important in maintaining a healthy skeletal and muscular system

The circulatory system

- identify major organs of the circulatory system
- recognise the function of the circulatory system
- identify a pulse as evidence of a heartbeat
- investigate the effects of exercise on pulse rate
- represent and communicate changes in pulse rate in a variety of ways
- identify factors that are important in maintaining a healthy circulatory system

The digestive system

- identify major organs of the digestive system
- recognise the function of the digestive system
- identify factors that are important in maintaining a healthy digestive system such as the link between inadequate water intake and constipation; balanced diet; exercise

The respiratory system

- identify major organs of the respiratory system
- recognise the function of the respiratory system
- identify factors that are important in maintaining a healthy respiratory system such as avoid breathing harmful substances; exercise

The excretory system

- identify major organs of the excretory system
- recognise the function of the excretory system
- identify urine and faeces as waste products
- identify factors that are important in maintaining a healthy excretory system

The reproductive system

- identify major organs of the human reproductive system
- recognise changes that occur at puberty
- identify factors that are important in maintaining a healthy reproductive system

The nervous system

- identify major organs of the nervous system such as brain and spinal cord
- recognise the importance of the senses in our understanding of our environment
- recognise the importance of the nervous system in coordinating the other systems of the human body
- identify factors that are important in maintaining a healthy nervous system such as

Science • Life Skills

Biological sciences

wearing a bike helmet or seatbelt to protect the spinal cord

Scientific and technological developments

- identify an issue that could affect the functioning of the human body such as eating food that has not been prepared or stored appropriately; eating a balanced diet; maintaining oral hygiene; protecting the skin from sun damage
- investigate how scientific developments have changed/influenced the way people look after their bodies such as use of sunscreen to prevent sunburn; gym equipment to exercise different parts of the body; refrigeration to store food; immunisations to prevent disease; safety helmets and seatbelts [CCT]; [PSC]
- identify some responses of the body to infectious and non-infectious diseases
- recognise how advances in science and technology have improved our understanding of the causes and control of some infectious diseases [CCT]

Science • Life Skills

Chemical sciences

Life Skills outcomes:
A student:
- identifies the properties of common substances
- investigates some common chemical reactions
- demonstrates an understanding of how common chemicals affect our daily life

- Solids, liquids and gases have different properties

Students:
- recognise common materials at home as matter such as a cup, water, table, air
- identify matter as existing as either a solid (ice, desk), a liquid (milk, soft drink, water) or a gas (wind from a fan, air in balloons, bubbles in water)
- recognise that matter can change its state, for example ice cream will melt out of the fridge; boiled water turns to steam; breath turns to condensation on a cold mirror
- investigate the effect of heat on the states of matter such as through evaporation, melting, boiling, condensation and freezing

- Mixtures can be separated using a range of techniques

Students:
- recognise common mixtures that are naturally occurring and that can be made such as sea water, muddy water, cordial, tea containing milk and sugar, rice cooking in water
- identify different ways of separating mixtures such as drain rice or vegetables with a sieve; filter coffee; evaporate water from salt water
- separate the components of some common mixtures through techniques including filtration, decantation, evaporation, crystallisation (dissolve sugar in water and leave in the sun to evaporate into sugar crystals), chromatography (place different coloured lollies on filter paper, add water and observe the food colouring separate) [WE]

- Common chemicals have different uses

Students:
- identify things made from metal such as coins, taps, saucepans, pipes, window frames
- describe some of the properties of metals such as shiny appearance; silver or gold in colour; heats quickly; changes shape without breaking; most are solids; good for conducting electricity
- recognise uses of metals in familiar contexts such as cutlery, cooking utensils, cars, furniture, window frames, door handles
- identify and categorise familiar objects according to whether they are metals or non-metals
- describe the properties of metals in relation to a useful function such as metal as a good conductor to make simple circuits; metal as a poor insulator to keep drinks warm
- describe common uses for a variety of substances such as styrofoam cups, coolers
- investigate the best substance to use for a particular purpose such as the best material to insulate a coffee cup
- identify common chemicals in the home such as vinegar, baking soda, salt, sugar, soap, nail polish remover and bleach
- identify and associate common household chemicals with their uses such as detergents for removing grease; bleach for sanitising
- identify common chemical safety/hazard symbols
- describe the need for safe use and storage of household chemicals including strategies to minimise harm

Science • Life Skills

Chemical sciences

- When a chemical undergoes a chemical change, new substances may be formed

Students:

- recognise that some chemicals change when heated
- recognise that some chemicals are changed, created or disappear when combined
- observe some types of chemical change such as baking a cake, making bread
- recognise that a chemical change has occurred when rust forms on iron materials in the school grounds or at home
- investigate the requirements for rusting including oxygen and water from the air
- identify ways to prevent rusting such as painting or plating
- describe some ways to remove corrosion from metals including using sandpaper, soaking in lemon juice

- There are different types of chemical reactions, which can be used in our everyday life

Students:

Combustion

- identify common things that burn such as paper, cardboard, wood and leaves
- recognise highly combustible materials such as petrol, spray cans, nail polish
- identify the types of energy that are produced by burning things such as heat and light
- recognise that things change when they burn such as paper to ash
- investigate the requirements for combustion such as fuel, high temperature, oxygen from the air
- identify safety issues relating to combustion such as prevention, storage procedures

Reactions of acids

- distinguish between acids and alkalis by observing the colour change when adding red cabbage juice to a variety of household chemicals such as vinegar, floor or window cleaner, soap, lemon juice, milk, shampoo, lemonade or soda water
- investigate the reaction of acids by adding vinegar to baking soda and observing the effects

Science • Life Skills

Earth and space sciences

Life Skills outcomes:
A student:

- demonstrates an understanding of some of the features of the Earth
- identifies how features of the Earth are influenced by its position and movement in space
- describes how features of the Earth change over time
- explores the impact of natural and human activity on the Earth's resources and ways to effectively manage our resources

- The Earth has a variety of features that can be observed

Students:

  - recognise that the Earth is a sphere and is surrounded by air
  - identify some examples of landforms on the Earth such as mountains, volcanoes, oceans, rivers, lakes, swamps, beaches, sand dunes using maps, pictures, interactive media, videos
  - investigate the features of some landforms in the local area

- Features of the Earth are influenced by its position and movement in space

Students:

  - identify that night and day are caused by the rotation of the Earth once every 24 hours
  - recognise that the turning of the Earth is shown by the rising and setting sun
  - explore some effects of interactions between the sun and Earth such as the formation of shadows, seasons, eclipses
  - recognise that the sun is the source of light that is essential for life on the Earth
  - identify the sun as a star
  - identify that there is a cycle to the changes in the appearance of the moon
  - investigate features of the moon using binoculars/telescopes, software/videos, visual and graphic resources
  - investigate some of the features of our solar system such as planets, moons and stars using solar system software, videos, models, visual and graphic resources
  - locate some stars and constellations including the Southern Cross

- Changes on the Earth's surface occur over time as a result of natural processes and human activities

Students:

  - recognise that landforms may change over a long or relatively short period of time
  - identify that factors such as temperature, water and wind can cause changes in landforms
  - identify that changes in landforms are a result of natural processes such as weathering and erosion as well as from human activity
  - investigate strategies to prevent landform erosion or repair landforms after erosion
  - investigate how plate tectonics, volcanoes, tsunamis or earthquakes may change or create a landform

- The Earth is the source of all the resources needed in everyday life and these need to be used carefully

Students:

  - identify the structure of the Earth in terms of core, mantle and crust
  - recognise that the Earth's crust is made of different types of rocks
  - classify some examples of common rocks
  - identify some of the Earth's natural resources such as rocks, minerals, water, fossil fuels

Science • Life Skills

Earth and space sciences

- identify the uses of some natural resources including providing fuel for cars
- distinguish between some natural resources that are non-renewable such as fossil fuels, coal, minerals and those that are renewable, such as water and solar energy
- identify ways to conserve, protect and reduce the use of resources in everyday life [PSC]; [SE]

• Human activity impacts on living and non-living features of the environment

Students:

- identify the ways that human activity can impact on the environment including introduced plants and animals, habitat destruction, increase in soil and river salinity, decline of river health, reduced biodiversity [SE]
- investigate some effects of human activity on the local environment [SE]; [PSC]
- identify how human activity has impacted on the Earth's atmosphere at a global level such as climate change, ozone depletion [SE]
- identify ways that individuals may change their lifestyle to reduce the negative effects of their actions on the biosphere [SE]; [EU]; [PSC]

Science • Life Skills

Physical sciences

Life Skills outcomes:
A student:
- explores a range of forces in everyday situations
- recognises various forms and sources of energy
- relates knowledge of energy transformations to the responsible use of energy in our world

- There are different types of forces which can be experienced in daily life

Students:

Forces
- identify a force as a push or pull
- communicate what happens when a force is applied such as squeezing/stretching, accelerating/decelerating
- identify that a change in motion occurs when a force is applied or removed such as starting/stopping, changing direction
- investigate how technological developments have reduced the harmful impact of forces in everyday life such as safety helmets, seatbelts and airbags

Frictional force
- observe that heat is generated when surfaces rub together such as tyres on roads, rubbing hands together
- identify some of the effects of friction such as wear and tear on shoes and tyres
- identify ways of reducing friction such as greasing or smoothing surfaces

Electrostatic forces
- identify an electrical discharge such as lightning, sparks from taking off an acrylic jumper
- identify materials that can be charged electrically such as plastic, nylon
- investigate the properties of electrical charges including attraction, repulsion

Magnetic forces
- identify a common magnet
- investigate the properties of magnets such as attracts iron or steel
- investigate attraction/repulsion of poles of a magnet
- identify uses of magnets such as fridge magnets, toys, motors, compasses

Gravitational force
- identify gravity as a downward-acting force including objects falling to earth
- investigate the effects of gravity on a variety of objects

- There are different forms of energy, which may be transferred and transformed for different purposes

Students:
- recognise forms of energy we use in our home/school such as heat, light, sound
- recognise changes that occur when energy is used such as turning on a light, turning on the radio, toasting bread
- identify the sources of energy we use in the home/school such as electricity, gas and solar
- recognise that the form of energy can change such as stove (electrical to heat), TV (electrical to sound and light)
- identify potential risks and the safe use of electrical devices
- construct simple circuits
- recognise that electricity cannot flow if the circuit is incomplete such as when a fuse breaks

Science • Life Skills

Physical sciences

- Conservation of energy is important for individuals and society

Students:

- identify why we should conserve our energy sources [SE]
- explore ways in which individuals can reduce their impact on the Earth's energy resources such as car pooling; walking instead of using transport; limiting length of shower; turning electrical appliances off instead of leaving on standby; recycling; water management [SE]
- investigate new technologies and innovations to help conserve the Earth's energy resources such as electric cars, wind farms, solar panels [SE]

9 Continuum of Learning in Science K–10

ⓘ for your information

Stage outcomes and stage statements illustrate the continuum of learning in the *Science K–10 Syllabus.*

9.1 Stage outcomes

✍ consult

Continuum of Learning in Science K–10

Working Scientifically

Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:	**Stage 4 outcomes** A student:	**Stage 5 outcomes** A student:
WS ES1.1 explores their immediate surroundings and what they already know by questioning, observing and communicating	WS 1.1 investigates by comparing what they and others already know, predicting, collecting and recording data, considering evidence and reflecting on their experiences	WS 2.1 investigates their questions and predictions by taking into account scientific information, collecting and analysing data, communicating and reflecting on their evidence and the process undertaken	WS 3.1 poses questions, including testable questions, that they investigate scientifically to draw evidence-based conclusions and develop explanations	4.1 identifies questions and problems that can be tested or researched and makes predictions	5.1 formulates questions or hypotheses in order to investigate a problem
				4.2 describes the purpose of an investigation and produces a plan to investigate questions and problems	5.2 explains the purpose of an investigation and produces a plan to investigate a question, hypothesis or problem
				4.3 follows a sequence of instructions and uses given criteria to undertake a first-hand investigation, individually and in a team	5.3 undertakes a first-hand investigation with safety and competence, individually or in a team

Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:	**Stage 4 outcomes** A student:	**Stage 5 outcomes** A student:
				4.4 processes and analyses data from a first-hand investigation or secondary sources	5.4 processes, analyses and evaluates data from a first-hand investigation or secondary sources
				4.5 applies understanding to suggest possible solutions to an identified problem	5.5 applies understanding to suggest possible solutions to an identified problem
				4.6 presents appropriate information to a given audience	5.6 presents and explains appropriate information to a given audience

Knowledge and understanding

Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:	**Stage 4 outcomes** A student:	**Stage 5 outcomes** A student:
NE ES1.3 observes how their immediate environment provides for the needs of living things and how this affects everyday life	LW S1.3.1 identifies that living things have observable physical features and grow and change	LW S2.3.1 describes how living things can be grouped, have life cycles and are dependent on each other and the environment to survive	LW S3.3.1 describes how structural adaptations of living things enable them to survive in their environment	4.7 relates the structure and function of living things to their survival and reproduction 4.8 explains the contribution of biological understanding and technological advances to finding solutions to contemporary issues that impact on people's lives	5.7 relates explanations of biological concepts to interactions between and within structures and systems 5.8 explains how refinements in scientific knowledge and technological developments have increased understanding and influenced research in the biological sciences
	ES S1.3.2 identifies some physical features of and useful resources in the environment	ES S2.3.2 describes some simple relationships and patterns of change that are observed on the Earth's surface and in space	ES S3.3.2 describes changes at the Earth's surface and Earth's movements in space	4.11 describes the dynamic nature of models, theories and laws in developing scientific understanding of the solar system 4.12 explains how advances in scientific understanding of processes that occur within and on the Earth influence	5.11 describes changing ideas about the structure of the universe to illustrate how models, theories and laws are refined by the scientific community 5.12 explains how scientific knowledge about global patterns of geological activity and interactions in the biosphere

				resource management practices	can be used to inform decisions related to contemporary issues
	PW S1.3.3 identifies some different sources of light and sound and the effects of pushes and pulls on objects	PW S2.3.3 describes how objects are affected by heat and forces	PW S3.3.3 describes the transfer and transformation of electricity and the properties of light	4.13 describes the action of forces in everyday situations 4.14 discusses how scientific understanding of energy transfer and transformations has been applied in the development of technologies used in everyday life	5.13 applies models, theories and laws to situations involving energy, force and motion 5.14 explains how science understanding is applied in systems involving energy transfer, transformations and conservation
ME ES1 4 recognises how familiar objects, products, places and spaces in their immediate environment suit their purpose and are made using some common materials	MW S1.4.1 identifies ways everyday materials can be physically changed and combined for a particular purpose	MW S2.4.1 identifies that heat can cause changes in the physical properties of substances	MW S3.4.1 describes the changes made to everyday materials as reversible or irreversible	4.9 describes the observed properties and behaviour of matter using the motion and arrangement of particles	5.9 explains how models, theories and laws about matter have been refined as new scientific evidence becomes available
	MW S1.4.2 identifies properties of materials they encounter in everyday life and how materials are suitable for their use	MW S2.4.2 describes how the physical properties of natural and processed materials influence their use	MW S3.4.2 describes how the properties of materials determine their use for specific purposes	4.10 explains how scientific understanding of the properties of elements, compounds and mixtures relates to their uses in everyday life	5.10 discusses the importance of chemical reactions in the production of a range of substances and how society influences the development of new materials

Values and attitudes

Early Stage 1 to Stage 3 outcomes A student:	**Stage 4 – 5 outcomes:** A student:
VA ES1-3.6 shows interest and enthusiasm for science and technology in responding to their curiosity, questions and perceived needs, wants and opportunities VA ES1-3.7 develops informed attitudes, based on evidence and reason about current and future applications of science and technology VA ES1-3.8 demonstrates willingness to engage responsibly with local, national and global issues relevant to their lives and to shaping sustainable futures	4/5.15 acknowledges responsibility for and willingness to engage with science related issues relevant to their lives 4/5.16 recognises the role of science in contributing to finding solutions to personal, social and global issues, including considering sustainable futures

Continuum of Learning in Technology K-8

Working Scientifically and Technologically

Early Stage 1 outcomes A student:	**Stage 1 outcomes** A student:	**Stage 2 outcomes** A student:	**Stage 3 outcomes** A student:	**Stage 4 outcomes** A student:
WS ES1.1 explores their immediate surroundings and what they already know by questioning, observing and communicating	WS 1.1 investigates by comparing what they and others already know, predicting, collecting and recording data, considering evidence and reflecting on their experiences	WS 2.1 investigates their questions and predictions by taking into account scientific information, collecting and analysing data, communicating and reflecting on their evidence and the process undertaken	WS 3.1 poses questions, including testable questions, that they investigate scientifically to draw evidence-based conclusions and develop explanations	4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources
WT ES1.2 uses a simple design process to produce solutions with identified purposes	WT 1.2 uses a structured design process, everyday tools, materials, equipment and techniques to produce solutions that respond to identified needs and wants of users/audiences	WT 2.2 applies a design process and uses some specialised tools, equipment, materials and techniques to produce solutions that address specific design criteria	WT 3.2 plans and implements a design process selecting specialised tools, equipment, materials and techniques to produce solutions that consider constraints	4.1.1 applies design processes that respond to needs and opportunities in each design project 4.2.1 generates and communicates creative design ideas and solutions 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources 4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of

				design projects 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project 4.5.1 applies management processes to successfully complete design projects 4.5.2 produces quality solutions that respond to identified needs and opportunities in each design project

Knowledge and understanding

NE ES1.3 observes how their immediate environment provides for the needs of living things, affects everyday life	LW S1.3.1 identifies that living things have observable physical features and grow and change	LW S2.3.1 describes how living things can be grouped, have life cycles and are dependent on each other and the environment to survive	LW S3.3.1 describes how structural adaptations of living things enable them to survive in their environment	4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects
	ES S1.3.2 identifies some physical features of and useful resources in the environment	ES S2.3.2 describes some simple relationships and patterns of change that are observed on the Earth's surface and in space	ES S3.3.2 describes changes at the Earth's surface and Earth's movements in space	
	PW S1.3.3 identifies some different sources of light and sound and the effects of pushes and pulls on objects	PW S2.3.3 describes how objects are affected by heat and forces	PW S3.3.3 describes the transfer and transformation of electricity and the properties of light	Not specifically addressed in outcomes. Energy can be addressed optionally within suitable design projects
	MW S1.4.1 identifies ways everyday materials can be physically changed and combined for a particular purpose	MW S2.4.1 identifies that heat can cause changes in the physical properties of substances	MW S3.4.1 describes the changes made to everyday materials as reversible or irreversible	4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project 4.4.1 explains the impact of innovation and emerging technologies on society and the environment
	MW S1.4.2 identifies properties of materials they encounter in everyday life and how materials are suitable for their use	MW S2.4.2 describes how the physical properties of natural and processed materials influence their use	MW S3.4.2 describe how the properties of materials determine their use for specific purposes	

ME ES1.5 recognises how familiar objects, products, places and spaces in their immediate environment suit their purpose and are made using some common materials	BE S1.5.1 describes the range of places and spaces in their local environment and how they are designed for different purposes	BE S2.5.1 describes ways different built environments are designed and constructed and how people interact within them	BE S3.5.1 describes systems and how social and environmental factors influence the design of built environments	4.1.2 describes factors influencing design in the areas of study of Built Environments, Products and Information and Communications 4.1.3 identifies the roles of designers and their contribution to the improvement of the quality of life 4.4.1 explains the impact of innovation and emerging technologies on society and the environment 4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects
	I S1.5.2 describes the range of familiar information products and how their different purposes influence their design	I S2.5.2 describes ways information products are designed and the factors to consider when people use and interact with them	I S3.5.2 describes information and communication systems and how social influences impact on their design and use	
	P S1.5.3 describes the range of manufactured products in their local environment and how their different purposes influence their design	P S2.5.3 describes ways different products are designed and produced and the ways people interact with them	P S3.5.3 describes systems used to produce or manufacture products and social and environmental influences on product design	

Values and attitudes

Early Stage 1 to Stage 3 outcomes A student:	**Links to Stage 4 outcomes** A student:
VA ES1-3.6 shows interest and enthusiasm for science and technology in responding to their curiosity, questions and perceived needs, wants and opportunities VA ES1-3.7 develops informed attitudes, based on evidence and reason about current and future applications of science and technology VA ES1-3.8 demonstrates willingness to engage responsibly with local, national and global issues relevant to their lives and to shaping sustainable futures	4.1.1 applies design processes that respond to needs and opportunities in each design project 4.1.2 describes factors influencing design in the areas of study of Built Environments, Products and Information and Communications 4.4.1 explains the impact of innovation and emerging technologies on society and the environment 4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects

9.2 Stage Statements

ⓘ for your information

Stage statements are summaries of the knowledge, understanding, skills, values and attitudes that have been developed by students as a consequence of achieving the outcomes for the relevant stage of learning.

✍ consult

Early Stage 1

Students in Early Stage 1 show a growing awareness of, and interest in, the Natural and the Made Environments. They demonstrate confidence in proposing ideas for designs that they develop, through play and modelling. They demonstrate curiosity about living things around them, objects, artefacts, events, phenomena and places.

Early Stage 1 students recognise that science involves exploring and observing the world using the senses. Students investigate scientifically by exploring their immediate surroundings through purposeful play, manipulating, observing, questioning and communicating what they already know, what they observe, what they did and how they feel about it. They respond to questions about familiar objects, engage in discussion and share their observations and ideas.

Students recognise that living things have basic needs including food and water. They describe the daily and seasonal changes in their environment including the weather, and how these affect everyday life. They observe that the way objects move depends on a variety of factors, including their size and shape.

Early Stage 1 students recognise that objects, products and built environments are made of materials that have observable properties. They design, produce and evaluate using a structured series of activities, and through exploration and observation they experience familiar products, spaces and places in relation to their purpose. They reflect on how they feel about what they did and on the usefulness of their final solutions.

Students develop their own ideas, using imagination, and express these ideas orally, pictorially and through modelling. They are unlikely to perceive the steps in a designing and producing process as they often work in situations where these aspects occur at the same time. They identify what they like or dislike about their designs or explorations.

Students show growing awareness of the appropriate use of a range of classroom equipment. They work safely when using equipment, resources and materials. Students develop ideas through the use and manipulation of concrete materials as a means of progressing towards abstract thought.

Early Stage 1 students show interest and enthusiasm in science and technology and begin to appreciate how these can cater to their curiosity and enable them to answer questions about the Natural and the Made Environments.

Stage 1

Students in Stage 1 are developing an awareness of the wider world and are applying their scientific and technological understanding to new and different situations. They are developing skills required to work scientifically, as well as design, produce and evaluate products, information, places and spaces.

Students describe how people use science in their daily lives including when caring for their environment and living things. They describe how science involves asking questions about, and describing changes in, objects and events. Students observe that living things have a variety of external features and that they grow, change and have offspring similar to themselves. They recognise that living things live in different places where their needs are met. Students describe the observable changes in the sky and landscape and they investigate the variety of ways in which the Earth's resources including water are used. They recognise that light and sound are produced by a range of sources and are observed using the senses. They describe how a push or a pull affects how an object moves or changes shape.

Students explore a range of manufactured products and the features of products that make them work. They describe how some familiar products are designed for particular purposes. They describe a range of places and spaces in their local environment and how their different purposes influence their design. Students recognise and use a range of information products and describe how the purpose of information products influences their design.

Students are able to recognise the purpose of an investigation and seek further information as a result of their own curiosity. They conduct guided investigations by following a series of orderly steps. They use their senses to identify similarities and differences. Students show curiosity about the Natural and the Made Environments and seek explanations that enable them to interpret their observations.

Students respond to and pose questions and make predictions about familiar objects and events. They explore and answer questions by participating in different types of guided scientific investigations such as manipulating materials, testing ideas and accessing information sources. Students use informal measurements in the collection and recording of observations, with the assistance of digital technologies where appropriate. They use a range of methods to sort and represent information, compare observations with predictions and through discussion, compare their observations with those of others.

Stage 1 students design, produce and evaluate by exploring and defining a task in response to identified needs and wants. They generate and develop ideas using research and creative techniques, producing solutions using a sequence of simple steps, and evaluating what they did and how their solutions meet the needs of users. Using plans, drawings and models, students begin to generate and select concepts to best meet the design task, and give simple explanations of why they have chosen a certain concept. Students in this stage can draw plans for a design and can explain some of the features and materials to be used. They recognise and discuss with others some of the strengths and limitations of what they have done and identify some changes that could be made to improve plans or models.

Students effectively manipulate materials that are available in the classroom environment, and recognise everyday materials can be physically changed in a variety of ways and that different materials can be combined for a particular purpose.

Students develop confidence in themselves and learn to persevere with activities. They show informed commitment to improving the quality of their environment and gain satisfaction from working scientifically and technologically.

Stage 2

Students in Stage 2 are able to initiate their own investigations as a result of something that has aroused their curiosity. They ask perceptive questions and respond to design tasks in innovative ways. They identify ways of improving their own scientific and technological activities by considering issues such as how well something works, its appearance and how it might affect the environment.

Students group living things on the basis of observable features and describe how they can be distinguished from non-living things. They recognise how living things depend on each other and the environment to survive. Students describe the effects of the Earth's rotation on its axis and observable changes on the Earth's surface as a result of natural processes and human activity. They investigate how forces can be exerted on objects, either by direct contact or from a distance. Students recognise that heat can be produced in different ways and can move from one object to another. They also recognise that a change of state between solid and liquid can be caused by adding or removing heat.

Students describe ways in which people design and produce products and deconstruct them to explore how component parts work together. They describe the ways people interact with, design and produce manufactured products and explore how products are used to express personal and cultural identity. Students describe how the purpose, access and movement within a built environment are considered in the design and construction of places and spaces. They observe how people interact within a place and space and explain how it has been designed to meet the needs of the users. Students use digital technologies to organise and communicate information. They explore how the design of information products can influence people's decisions and opinions.

Students are able, with guidance, to investigate scientifically by identifying questions in familiar contexts and predicting what might happen. They plan and conduct the investigations using appropriate materials, tools or equipment to make and record observations and collect data using formal measurements. Students analyse data using a range of methods including tables and column graphs to represent data and to identify patterns and trends. They compare results with predictions suggesting possible reasons for findings. They reflect on their evidence and the process undertaken and they represent and communicate their ideas and findings in a variety of ways.

Stage 2 students design, produce and evaluate by developing a brief that identifies specific design criteria, using a range of creative and research techniques for developing and communicating design ideas. They develop and apply their own sequence of production steps. Students use their established design criteria in ongoing evaluation of their process, ideas and solutions.

Students also use the processes of working scientifically to inform their designs and to evaluate their solutions when designing and producing. They make suggestions about the selection of some specialised tools, equipment, materials and techniques. They can select and safely use classroom tools, equipment, materials and techniques for particular tasks.

Stage 2 students demonstrate confidence in themselves and a willingness to make decisions. They are responsive to ideas and persevere with activities to completion. Students show informed commitment to improving the quality of the local environment and appreciate the role of scientific and technological contributions to improving the world around them.

Stage 3

Students in Stage 3 are able to undertake investigations in order to satisfy their own curiosity. They demonstrate a willingness to initiate their own investigations which may include designing appropriate fair tests to answer problems or questions developed after considering specific phenomena in their environment.

Students are able to plan and implement a design process independently in order to meet the needs and wants of users or audiences. They are able to develop a design brief in collaboration with others and use self and peer assessment to evaluate the final solution.

Students explain interactions between living things and their environment and how their structural features and adaptations help them to grow and survive the physical conditions of their environment. They recognise that the Earth is part of a larger system centred on the Sun and that sudden geological change or extreme weather conditions can affect the Earth's surface. Students explain the observable properties of solids and liquids and the different types of changes that materials may undergo. They describe how light from a source forms shadows and can be absorbed and reflected. Students explain that energy from a variety of sources can be used to generate electricity and that electrical circuits provide a means of transferring and transforming electricity.

Students explain how production systems are used to produce or manufacture products. They explore changes that have occurred in the design of products over time and explore the social and environmental factors that influence product design. Students investigate systems that support built environments and explain how they are designed to meet the needs of people. They consider how built environments might be designed to respond to social and environmental influences. Students explain how systems can be used to transfer information and support communication. They explore a range of emerging information products and how social influences impact on the design of information products.

Students pose questions to clarify specific problems and predict what the findings of an investigation might be. They select appropriate investigation methods, deciding which variable should be changed and measured in fair tests. Students select from a range of methods to gather data and/or information first hand and from reliable secondary sources, checking observations and measurements by repeating them where appropriate. They accurately observe, measure and record data and use equipment and materials safely, identifying potential risks. Students analyse and interpret their data and information by constructing and using a range of representations to present and describe observations, patterns or relationships to develop shared evidence-based conclusions and explanations. They reflect on their evidence in relation to the process undertaken and suggest improvements to the methods used. They communicate ideas, explanations and processes in a variety of ways.

Stage 3 students develop design criteria that include functional, aesthetic, social and environmental considerations and consider a range of constraints in planning their designing, producing and evaluating. They select appropriate creative and research techniques to generate and develop design ideas and incorporate detailed plans and specifications to communicate design ideas to others. Students produce solutions following their own plans, drawings, models and presentations and continue to evaluate throughout the designing, producing and evaluating process in relation to their established criteria and constraints.

Students in Stage 3 exhibit self direction in their own learning, initiating and persevering with activities to their completion. They are curious about and appreciate the Natural and Made Environments and show informed attitudes to issues related to the application of science and

technology. Stage 3 students willingly engage in local, national and global issues which are relevant to their lives and the maintenance of a sustainable future.

Stage 4

Students in Stage 4 demonstrate an awareness of the contribution of science to everyday life in finding solutions to a range of contemporary issues. These solutions may in turn impact on other areas of society and involve ethical considerations. They acknowledge that science knowledge changes as new evidence becomes available as a result of new discoveries from different lines of research across the disciplines of science. They recognise that this knowledge has significantly changed people's understanding of the world in all areas of human activity including industry, agriculture and marine and terrestrial management.

Students can describe current areas of research, particularly the contributions made by Australian scientists frequently working collaboratively across the science disciplines and how these contributions may affect their own lives. They can give historical examples where creative insights have led to the development of new theories and evidence has been gathered to support these theories. They acknowledge that before scientific findings are accepted as knowledge they must withstand critical scrutiny by other scientists working in the same field. Students have developed a willingness to question reasons for events and phenomena around them. They link experiences in the science classroom to developments in current scientific research and describe how science understanding and skills are used in a range of occupations.

Students are able to describe phenomena in the world around them illustrating their descriptions with everyday examples. They can describe the macroscopic and microscopic features of living things and their interactions. Students can identify that energy appears in many different forms and causes change within systems. They can use scientific models and theories to explain the observed properties of substances. Students can describe the place of the Earth in the universe, the different materials that make up the Earth, their features and the processes that occur over time. They can describe the usefulness of the Earth's resources for society and the beneficial and detrimental effects of their use.

Students identify questions and problems that can be tested or researched scientifically. They form inferences from their observations, propose questions based on their scientific knowledge and methods of exploring these. Students can suggest plausible solutions to problems and with guidance devise their own strategies to test ideas. They can work individually and as a member of a team to develop strategies to find answers to questions or solve a given problem by planning and conducting a range of investigation types. In fair tests they can measure and control variables and select and safely use a range of equipment and technologies to accurately make observations.

Students process and analyse data and information from their own investigations and secondary sources by constructing and using a range of representations including tables, graphs, diagrams and models. Based on this information, they identify relationships and form relevant conclusions.

Students reflect on the method used, evaluate the quality of the data collected and identify improvements to this method. They communicate ideas, findings and solutions using scientific language and representations and use an appropriate method to acknowledge sources of information.

Students acknowledge the continued importance of science in many aspects of their everyday lives. They realise that the knowledge base of science grows continually and they are able to

retain a healthy curiosity about the world around them. They value a scientific problem-solving approach and appreciate the importance of science in contributing to finding solutions to problems related to their lives and a sustainable future.

Stage 5

Students in Stage 5 are able to discuss the influence of scientific discoveries and new technologies on their everyday lives in generating new career opportunities. They recognise that scientific knowledge, including models and theories, is contestable and refined over time through a process of review by the scientific community. Students can use international and Australian examples of scientists' work to illustrate the dynamic nature of science, the work of practising scientists and the effect this work has on society and the environment. They acknowledge that advances in science understanding may depend on developments in technology and that technological advances are frequently linked to scientific discoveries.

Students can use their scientific knowledge to evaluate claims, analyse evidence, make informed decisions and justify judgements and opinions about science related issues. Students discuss the need for evidence to support scientific theories and give examples of how this evidence has been gathered and refined. They can use historical examples to illustrate the scientific process and highlight the impact of scientific and technological advances. Students can illustrate how ethical and cultural influences have affected developments in science and technology. They recognise that the needs of contemporary society can influence the focus of scientific research.

Students show an understanding of interactions within and between structures and systems in the physical, chemical, geological and biological worlds. They identify the transformation and transfer of energy and matter within the global systems involving the biosphere, lithosphere, hydrosphere and atmosphere. Students can apply models, theories and laws to explain global phenomena, and recognise and acknowledge the limitations of these in explaining occurrences and events.

Students can recognise problems, use creativity to suggest solutions, propose questions and design controlled investigations to test hypotheses by identifying dependent and independent variables. They make appropriate decisions on the use of a range of equipment and technologies, including digital technologies, to collect, store and analyse data. Students demonstrate accuracy and consistency in making relevant observations and measurements. They identify and address problems in investigations, evaluate procedures, assess risk and consider ethical issues.

Students process and analyse data and information from their own investigations and secondary sources. They analyse trends, patterns, relationships and inconsistencies in data to draw valid conclusions. Students evaluate their conclusions, identifying sources of uncertainty and possible alternative explanations. They critically analyse the validity of information from secondary sources. Students construct evidence-based arguments to communicate scientific ideas and information using appropriate scientific language and conventions.

Students demonstrate a willingness to make decisions and take responsible actions. They are interested in the world around them and are able to critically analyse the information provided to them about science-related issues. They are confidently able to employ a scientific problem-solving approach and acknowledge their responsibility in conserving, protecting and maintaining the sustainability of the environment for the future.

10 Assessment

10.1 Standards

The Board of Studies *K–10 Curriculum Framework* is a standards-referenced framework that describes, through syllabuses and other documents, the expected learning outcomes for students.

Standards in the framework consist of two interrelated elements:

- outcomes and content in syllabuses showing what is to be learned
- descriptions of levels of achievement of that learning.

Exemplar tasks and student work samples help to elaborate standards.

Syllabus outcomes in Science contribute to a developmental sequence in which students are challenged to acquire new knowledge, understanding and skills.

The standards are typically written for two years of schooling and set high, but realistic, expectations of the quality of learning to be achieved by the end of Years 2, 4, 6, 8 and 10.

Using standards to improve learning

Teachers use standards in Science as a reference point for planning teaching and learning programs and for assessing and reporting student progress. Standards in Science help teachers and students to set targets, monitor achievement, and as a result, make changes to programs and strategies to support and improve each student's progress.

10.2 Assessment for Learning

Assessment for learning is designed to enhance teaching and improve student learning. It gives students opportunities to produce work that leads to development of their knowledge, understanding and skills. Teachers decide how and when to assess student achievement, as they plan the work students will do, using a range of appropriate assessment strategies including self-assessment and peer assessment.

Teachers of Science provide students with opportunities in the context of everyday classroom activities, as well as planned assessment events, to demonstrate their learning.

In summary, *assessment for learning*:

- is an essential and integrated part of teaching and learning
- reflects a belief that all students can improve
- involves setting learning goals with students to encourage growth and development
- involves students in self-assessment and peer assessment
- provides feedback that helps students understand the next steps in learning and plan how to achieve them
- involves teachers, students and parents reflecting on assessment data.

Quality Assessment Practices

Effective assessment for learning informs teachers and students about past, present and future learning. The quality of assessment practices and materials can be judged using the following *assessment for learning* principles. The following Assessment for Learning Principles provide the criteria for judging the quality of assessment materials and practices.

Assessment for learning principles

Assessment for learning:

- promotes learning by emphasising the interactions between learning and manageable assessment strategies
  - teachers reflect on the purposes of assessment and on their assessment strategies
  - assessment activities allow for demonstration of learning outcomes
  - assessment is embedded in learning activities and informs the planning of future learning activities
  - teachers use assessment to identify what a student can already do
- clearly expresses the goals of the learning activity
  - students know and understand the learning goals and the criteria that will be applied to judge the quality of their achievement
  - students receive feedback that helps them make further progress
- helps students learn better, rather than just achieve a better mark
  - assessment is an integral component of the teaching–learning process rather than a separate activity
  - teachers design and select tasks that assess and therefore encourage, deeper learning
  - feedback motivates the learner and helps students to understand that engagement with feedback can lead to improvement
- provides meaningful and constructive feedback
  - feedback is directed to the achievement of standards and away from comparisons with peers
  - feedback is clear about strengths and areas for further development
  - feedback is individualised and provides strategies for improvement
- encourages students to take responsibility for their own learning
  - assessment includes strategies for self-assessment and peer assessment, emphasising the next steps needed for further learning
- is inclusive of all learners
  - assessment against standards provides opportunities for the diverse range of learners to achieve their best
  - assessment activities are accessible and free of bias.

Assessment for students with special education needs

Some students with special education needs will require adjustments to assessment practices in order to demonstrate what they know and can do in relation to syllabus outcomes and content. These may be:

- adjustments to the assessment process, for example additional time, rest breaks, quieter conditions, or the use of a reader and/or scribe or specific technology
- adjustments to assessment tasks, for example rephrasing questions, using simplified language, fewer questions or alternative formats for questions
- alternative formats for responses, for example written point form instead of essays, scaffolded structured responses, short objective questions, multimedia presentations.

Further examples of adjustments to assessment for students with special education needs can be found in *Life Skills Years 7–10: Advice on Planning, Programming and Assessment*.

Life Skills assessment

Each student undertaking the Science Years 7–10 Life Skills course will study selected outcomes and content. The syllabus outcomes and content form the basis of learning opportunities for students.

Assessment should provide opportunities for students to demonstrate achievement in relation to the outcomes and to apply their knowledge, understanding and skills to a range of situations or environments, including the school and the wider community.

Students may demonstrate achievement in relation to Science Years 7–10 Life Skills outcomes independently, in some cases with adjustments, or with support. The type of adjustments and support will vary according to the particular needs of the student and the requirements of the activity.

Further information about the assessment of students undertaking Life Skills outcomes and content can be found in *Life Skills Years 7–10: Advice on Planning, Programming and Assessment*.

10.3 Reporting

Reporting is the process of providing feedback to students, parents and other teachers about student progress.

Teachers use assessment evidence to extend the process of *assessment for learning* into their *assessment of learning*. In a standards-referenced framework teachers make professional judgements about student achievement at key points in the learning cycle. These points may be at the end of a year or stage, when schools may wish to report differentially on the levels of knowledge, understanding and skills demonstrated by students.

Descriptions of student achievement in Science provide schools with a useful tool to report consistent information about student achievement to students and parents and to the next teacher to help plan the next steps in the learning process.

The A–E grade scale provides a common language for reporting by describing observable and measurable features of student achievement at the end of a stage, within the indicative hours of study. Teachers use the descriptions of the standards to make a professional, on-balance judgement, based on available assessment information, to match each student's achievement to a description. The Common Grade Scale (A–E) is used by teachers to report student levels of achievement from Stages 1 to 5.

For students with special education needs, teachers may need to consider, in consultation with their school and sector, the most appropriate method of reporting student achievement. In particular, for those students who are undertaking a special program of study, it may be appropriate to report against the student's individual education plan.

10.4 Choosing assessment strategies

The range of assessment strategies should gather information about the depth of students' understanding, the development of skills as well as the extent of content knowledge. Assessment strategies should allow for flexibility in the design of tasks.

A collaborative approach to assessment develops a shared understanding of syllabus standards and helps teachers make consistent judgements of evidence of student achievement.

When choosing assessment strategies, teachers should consider whether the tasks:

- ensure a variety of types of task that cater for the full range of students
- show a clear relationship between the outcomes, what has been taught and the content being assessed
- inform students about the nature of the task and marking guidelines
- demonstrate validity and reliability and are free from prejudice, discrimination and stereotyping
- provide constructive feedback about what students are able to do and what they need to do in order to improve their level of performance
- allow opportunities for self-assessment and peer assessment.

 consult

Teachers of Science and Technology K–6 and Science Years 7–10 should employ a range of assessment strategies to ensure they gather information regarding the knowledge and understanding that are being acquired and the skills that are being developed. Strategies should be appropriate to the outcomes being addressed, be manageable in number and be supportive of the learning process. Teachers could work collaboratively in planning appropriate assessment strategies. Working collaboratively leads teachers to develop a shared understanding of the syllabus standards and also supports teachers in making consistent and comparable judgements of student achievement in relation to these standards.

In Science and Technology K–6, assessment of student achievement should incorporate measures of students' knowledge, skills and understanding in:

- working scientifically and working technologically
- the natural environment and the made environment.

In Science Years 7–10, assessment of student achievement should incorporate measures of students' knowledge, skills and understanding in:

- working scientifically
- biological, chemical, earth and space and physical sciences

Students indicate their level of understanding and skill development in what they do, what they say and what they write and draw. The most appropriate method or procedure for gathering assessment information is best decided by considering the purpose for which the information will be used and the kind of performance that will provide the information. Tasks given to students for the purpose of gathering assessment information include a variety of types of projects, scientific investigations, oral reports or explanations, tests and practical assignments.

Teachers have the opportunity to observe and record aspects of students' learning in a range of situations. When students are working in groups, teachers are well placed to determine the extent of student interaction and participation. By listening to what students say – including their responses to questions and other input – teachers are able to collect many clues about students' existing understanding and attitudes. The students' responses to questions and comments will often reveal their levels of understanding, interests and attitudes. Records of such observations form valuable additions to information gained using other assessment strategies and enhance teachers' judgement of their students' achievement.

In planning for assessment in Science and Technology K–6 and in Science Years 7–10 it is important for teachers to consider:

- the requirements of the syllabus
- the accessibility of the proposed activity in terms of language requirements
- the appropriateness of the challenge presented to individual students
- resource availability
- how the task will be administered
- the way in which feedback will be provided.

The outcomes of the Science and Technology K–6 and Science Years 7–10 syllabus specify the knowledge, understanding and skills expected to be learned by students as a result of studying the course. These outcomes are central to the decisions teachers make about planning and adjusting the learning program and assessing, monitoring and reporting student progress.

In both Science and Technology K–6 and Science Years 7–10, the school assessment program should consider the following:

- a range of types of strategies appropriate to the outcomes being assessed
- an appropriate number of activities to achieve a balance between obtaining sufficient information and over-assessing
- a variety of activities so that students are given opportunities to demonstrate their level of achievement of outcomes
- valid and reliable activities provide accurate information on each student's achievement
- informing students of the syllabus outcomes addressed and the criteria for assessing learning in each activity
- measuring student achievement in relation to syllabus outcomes
- recording observations in a manageable way using appropriate methods (for example visual representations, grades, marks or comments)
- providing meaningful feedback to students about what they are able to do and what they need to do to assist their learning and improve their level of performance.

An effective assessment program includes assessment for learning and assessment of learning activities. Both forms of assessment are essential and will overlap, but in order to enhance teaching and improve learning, greater attention needs to be paid to assessment for learning.

Possible sources of information for assessment purposes include the following:

- inquiry and design projects in Science and Technology K–6
- students' project journals and comments on their processes of working scientifically
- individual practical tasks such as scientific investigations or design tasks in Science and Technology K–6
- samples of students' work
- explanation and demonstration to others

- questions posed by students
- students' oral and written reports
- short quizzes
- pen-and-paper tests
- comprehension and interpretation exercises
- teacher/student discussion or interviews
- observation of students during learning activities, including listening to students' use of language
- observation of students' participation in a group activity
- consideration of students' portfolios
- peer and self assessment.

Inquiry-based research assignments and projects

Inquiry-based research activities can involve ongoing assessment opportunities addressing a range of demands such as:

- finding and using simple facts such as the planets in order from the sun
- researching definitions, descriptions and biographies
- comparing a range of contrasting views on a topic such (eg atomic theory)
- developing explanations or evaluations of 'cutting-edge' science (eg stem cell research).
- designing and producing an artefact as demonstrating working technologically.

Activities might involve a range of resources including library and/or internet research. Students could then be assessed on their ability to:

- find and use information
- compare information sources for accuracy and relevance
- choose appropriate secondary sources and work critically with them to provide required explanations and evaluations.

In Science Years 7–10, the mandatory student research project in each stage also provides opportunities for students to demonstrate performance across a range of skills outcomes. As students work through their project, their teacher can engage in assessment and feedback on their ability to:

- describe a valid problem to research
- plan and carry out a valid and safe investigation
- accurately observe and/or collect relevant data and information
- analyse observations and collected material
- draw valid conclusions and assess areas for improvement or further research.

Fieldwork activities

Assessment activities might include:

- gathering data from peers, parents or the community on specific questions or issues
- a local environment field trip to gather information.

Students could be assessed on their ability to:

- make and record accurate observations by describing, comparing and contrasting features
- collect and process first-hand data
- draw valid conclusions from analysis of their data

- present their findings using a range of media
- use safe working habits in the field.

Practical work

Assessment activities might include:

- teacher observation of student performance during first-hand investigations
- rotation of students through a range of skills-based activities.

Students could be assessed on their ability to:

- ask questions to be investigated
- identify and investigate a problem
- plan and safely carry out a procedure as an individual or in groups
- display a range of laboratory skills
- select and use appropriate equipment and technology
- make and record accurate observations
- draw valid conclusions
- effectively present their findings.

Assessment for learning should be an integral part of each unit of work. The activities used to gather evidence of learning should be designed to focus on outcomes and show a clear relationship to the syllabus content. A variety of types of strategies should be used to give students the opportunity to demonstrate outcomes in different ways and to improve the validity and reliability of the assessment. They should be used to support student learning and to provide feedback to students that enable them to actively monitor and evaluate their own learning.

The feedback that students receive from completing assessment activities will help teachers and students decide whether the student is ready for the next phase of learning or whether they need further learning experiences to consolidate their knowledge, understanding and skills. Feedback on assessment activities should be:

- provided in a timely manner
- linked to the specific outcomes and marking criteria addressed
- meaningful, constructive and provide students with an indication of their performance relative to the outcomes being assessed and their general progress.

Teachers should consider the effect that assessment and feedback have on student motivation and self-esteem and the importance of the active involvement of students in their own learning.

By employing a standards-references approach, based on specific, observable and/or measurable criteria, consistency of teacher judgement should be enhanced.

11 Glossary of Terms

Many of the terms defined in this glossary refer to terms that have specific relevance for science teaching or the interpretation of the syllabus.

A Glossary of Key Words in the Assessment Support Document for The New Higher School Certificate provides key verbs frequently used to introduce the outcomes and essential content in the syllabus.

Aboriginal or Torres Strait Islander	An Aboriginal or Torres Strait Islander person is someone who: • is of Aboriginal or Torres Strait Islander descent • identifies himself or herself as an Aboriginal or Torres Strait Islander, and • is accepted as such by the Indigenous community in which he or she lives.
biotechnology	The use of living things to make or change products. Gene technology sits within the broader area of biotechnology and includes the discovery of genes, understanding of how genes function and interact and genetic modification or engineering.
content	The substance or subject matter to be studied by students in Science. This is expressed in terms of the knowledge and understanding, skills, values and attitudes. Contexts are an element of content devised by teachers and are the framework within which the learning experiences take place.
context	One of the elements of content chosen by the teacher to encourage students to participate and engage in the learning process. Each learning /unit of work must include contextual frameworks within which the learning experiences take place to assist students to make meaning of the knowledge, understanding, skills, values and attitudes.
control (the control in an experiment)	The sample in an experiment to which all the other samples are compared.
data	Facts or figures that can be used to draw conclusions.
dependent variable	The factor in the experiment that changes as a result of changes to the independent variable; conventionally plotted on the vertical (y) axis of a graph.
design	Provide the steps for an experiment, procedure or investigation.
draw conclusions	Deduce: to arrive at an opinion or judgement based on evidence.
fair test	An investigation where one variable (the independent variable) is changed and all other conditions (controlled variables) are kept the same; what is measured or observed is referred to as the dependent variable.
first-hand investigation	Inquiry based on the direct use of observation or measurement.
hypothesis	A predictive statement which can be tested using a range of methods: most often associated with experimental procedure.
independent variable	The variable that is deliberately changed, often through a series of preset values. Conventionally plotted on the horizontal (x) axis of a graph.
Indigenous peoples	Indigenous refers collectively to the first peoples of the land in international communities.

interactions	Involves the identification of interactions between and within simple and complex systems that leads to a greater understanding of how our world works. An understanding of natural complex systems or the development of successful technologies requires the integration and applications of concepts from more than one science discipline.
investigation	Systematic inquiry.
law	A simple and precise statement that has been shown to be universally reliable. It describes phenomena that occur with unvarying regularity under the same conditions. Laws do not provide explanations, they simply state the relationship between two relevant variables. No scientific law is ever conclusively verified.
model	A mathematical, conceptual or physical representation based on a simplified set of assumptions. Models provide a means of explaining, testing and predicting behaviour within limited conditions. Models are often elaborated to develop theories.
plausible accuracy	Accuracy estimated taking into consideration the evident sources of error and the limitations of the instruments used in making the measurements.
qualitatively account for	To use descriptive explanations involving features, characteristics, properties to identify important components.
quantitative	Involving measured components (chemical formulae or numbers).
relate	To identify connections or associations between ideas and/or relationships between components of systems and structures.
reliability of first-hand data	The degree to which repeated observation and/or measurements taken under identical circumstances will yield the same results.
research	Investigate through the literature or by practical investigations relevant information.
scientific investigation	A systematic inquiry carried out using scientific methods or inquiring into the knowledge and understanding of science.
secondary sources	A range of forms of information and data that have resulted from the investigations of other people, including graphs, diagrams and images.
structure	Entities in which the parts are linked together to form a whole.
sustainability	The patterns of activities that meet the needs of the present generation without prejudicing the ability of future generations to meet their needs.
system	The parts that work together to form a whole.
technologies	The materials, tools and techniques used to solve problems and to expand human control over natural and made resources.
theory	A coherent explanation of a body of experimental evidence, based upon a small number of assumptions. A theory provides predictions that can be tested against observations but is open to doubt and refutation.
validity of first-hand data	The extent to which the processes and resultant data measure what was intended.
variable held constant	Factors that may vary, but for the purposes of an experiment are deliberately held constant so that a valid conclusion is possible.
visual literacy	The ability to decode, interpret, create, question, challenge and evaluate texts that communicate with visual images as well as, or rather than, words.