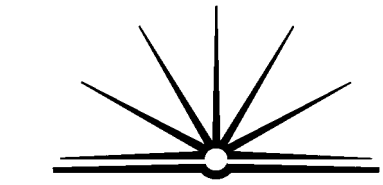

Science
Years 7–10

Syllabus

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Contents

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 way in which learning in the *Science Years 7–10 Syllabus* contributes to curriculum and to the student's achievement of the broad learning outcomes is outlined in the syllabus rationale.

In accordance with the *K–10 Curriculum Framework*, the *Science Years 7–10 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 Years 7–10. It provides structures and processes by which teachers can provide continuity of study for all students, particularly to ensure successful transition through Years 5 to 8 and from Years 10 to 11.

The syllabus also assists students to maximise their achievement in Science through the acquisition of additional knowledge, understanding, skills, values and attitudes. 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

In the K–6 curriculum, students with special education needs are provided for in the following ways:

- through the inclusion of outcomes and content in syllabuses which provide for the full range of students
- through the development of additional advice and programming support for teachers to assist students to access the outcomes of the syllabus
- through the development of specific support documents for students with special education needs
- through teachers and parents planning together to ensure that syllabus outcomes and content reflect the learning needs and priorities of individual students.

Students with special education needs build on their achievements in K–6 as they progress through their secondary study and undertake courses to meet the requirements for the School Certificate.

It is necessary to continue focusing on the needs, interests and abilities of each student when planning a program for secondary schooling. The program will comprise the most appropriate combination of courses, outcomes and content available.

Life Skills
For most students with special education needs, the outcomes and content in sections 6 and 7 of this syllabus will be appropriate but for a small percentage of these students, particularly those with an intellectual disability, it may be determined that these outcomes and content are not appropriate. For these students the Life Skills outcomes and content in section 8 and the Life Skills assessment advice below can provide the basis for developing a relevant and meaningful program.

Access to Life Skills outcomes and content in Years 7–10
A decision to allow a student to access the Science Years 7–10 Life Skills outcomes and content should include parents/carers and be based on careful consideration of the student's competencies and learning needs.

The decision should establish that the outcomes and content in sections 6 and 7 of the *Science Years 7–10 Syllabus* are not appropriate to meet the needs of the student. Consideration should be given to whether modifications to programs and to teaching, including adjustments to learning activities and assessment, would enable the student to access the syllabus outcomes and content.

As part of the decision to allow a student to access the Science Years 7–10 Life Skills outcomes and content, it is important to identify relevant settings, strategies and resource requirements that will assist the student in the learning process. Clear time frames and strategies for monitoring progress, relevant to the age of the student, need to be identified and collaborative plans should be made for future needs.

It is not necessary to seek permission of the Office of the Board of Studies for students to undertake the Science Years 7–10 Life Skills outcomes and content, nor is it necessary to submit planning documentation.

Life Skills assessment

Each student undertaking a Science Years 7–10 Life Skills course will have specified outcomes and content to be studied. The syllabus content listed for each outcome forms the basis of learning opportunities for students.

Assessment should provide opportunities for students to demonstrate achievement in relation to the outcomes and to generalise their knowledge, understanding and skills across 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 or with support. The type of support will vary according to the particular needs of the student and the requirements of the activity. Examples of support may include:

- the provision of extra time
- physical and/or verbal assistance from others
- the provision of technological aids.

2 Rationale

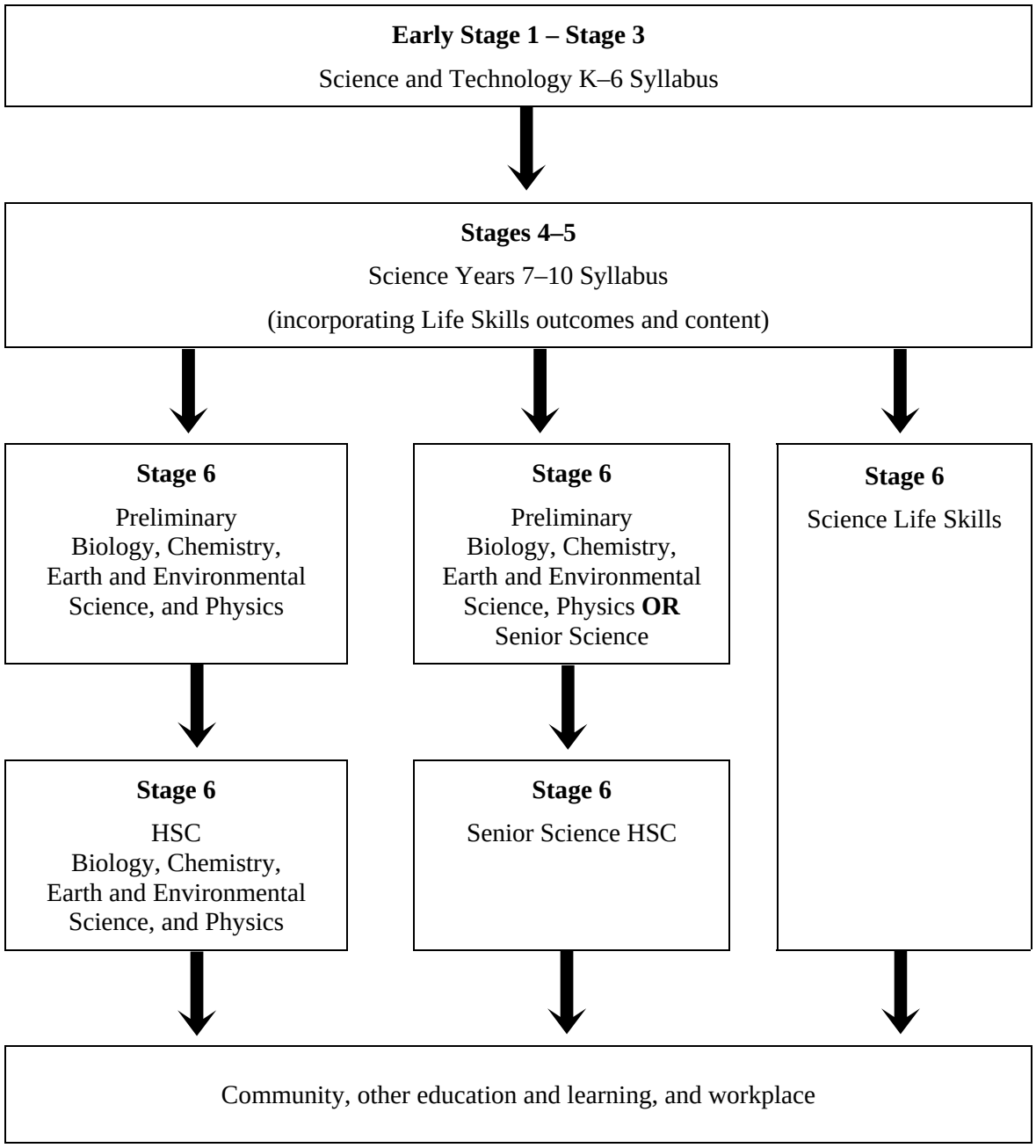
Science provides a distinctive view and way of thinking about the world. The study of science has led to an evolving body of knowledge organised as an interrelated set of models, theories, laws, systems, structures and interactions. It is through this body of knowledge that science provides explanations for a variety of phenomena and enables sense to be made of the biological, physical and technological world. An understanding of science and its social and cultural contexts provides a basis for future choices and ethical decisions about local and global applications and implications 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 Australian scientists to international scientific research. The study of science provides students with the opportunity to examine the impact on their lives of scientific knowledge and its application to their communities and surroundings. This study provides opportunities for students to become independent learners and promotes their development of informed attitudes towards science and the environment.

The study of science provides opportunities for students to develop the skills of working scientifically by engaging them in thinking critically and creatively in problem-solving processes. Students work individually and in teams in planning and conducting investigations. They are encouraged to critically analyse data and information, evaluate issues and problems, develop questions for inquiry and investigation, and draw evidence-based conclusions. Students are called on to apply and communicate their findings, understanding and viewpoints in a scientifically literate way when making decisions about the environment, the natural and technological world.

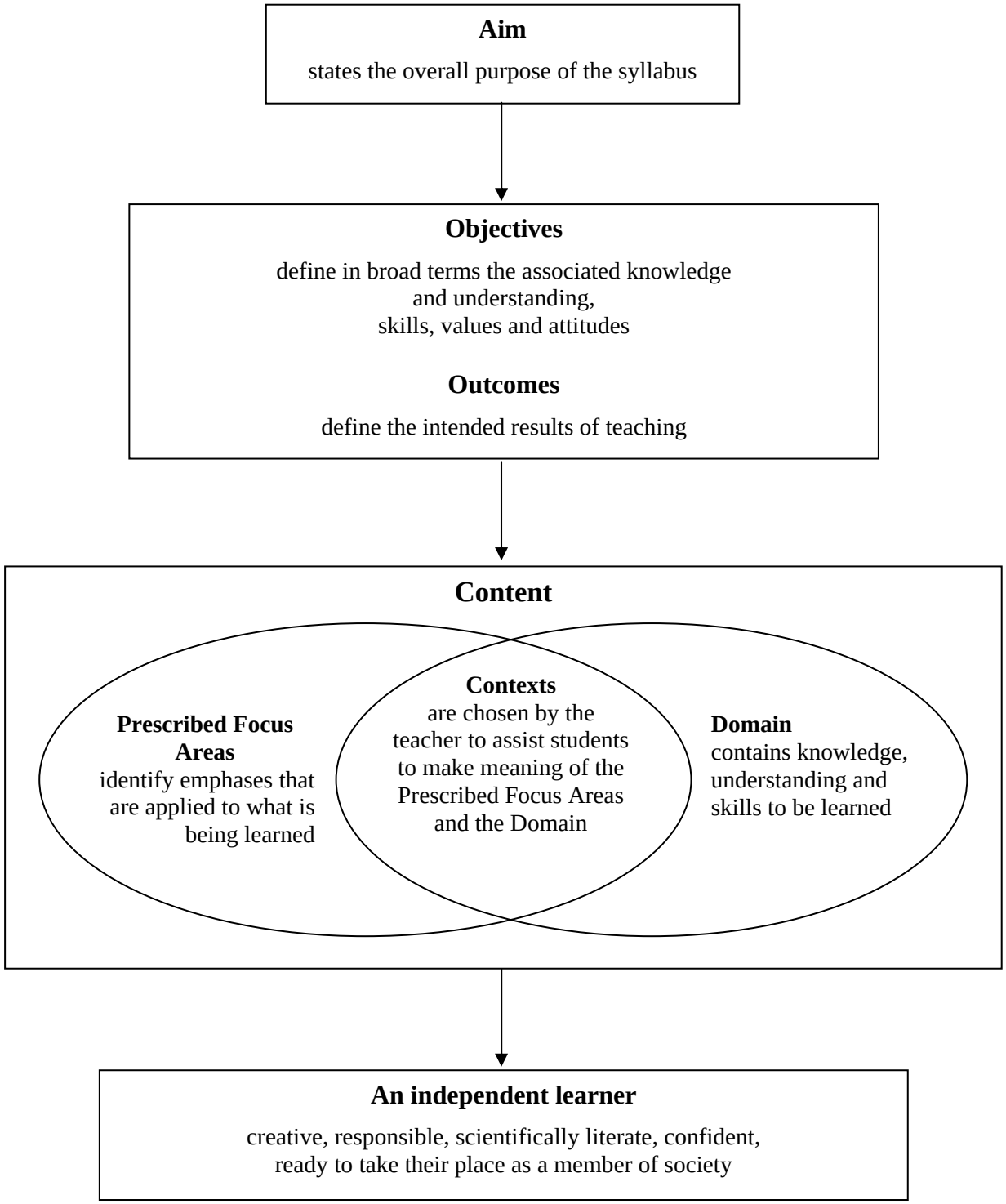
By engaging students in a range of learning experiences that build on prior learning and are set in meaningful and relevant contexts, they are led to a more scientific understanding of their world and the way that scientists work. It is through this inquiry and investigation that students develop a deeper appreciation of scientific endeavour, 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 Years 7–10 Syllabus in the Science K–12 Curriculum



Overview of the Syllabus

The following diagram summarises the relationship between the various elements of the syllabus.



4 Aim

The aim of the *Science Years 7–10 Syllabus* is to provide learning experiences through which students will:

- acquire scientific knowledge and skills and develop understanding about phenomena within and beyond their experience
- develop an appreciation of science as a human activity and apply their understanding to their everyday life
- develop positive values about and attitudes towards themselves, others, lifelong learning, science and the environment.

5 Objectives

Knowledge and Understanding
Students will develop knowledge and understanding of:

- the history of science
- the nature and practice of science
- applications and uses of science
- implications of science for society and the environment
- current issues, research and development
- models, theories and laws, and structures and systems related to the physical world, matter, the living world, and Earth and space
- interactions within the physical world, matter, the living world and Earth and space.

Skills
Students will develop skills in working scientifically through:

- planning investigations
- conducting investigations
- communicating information and understanding
- developing scientific thinking and problem-solving techniques
- working individually and in teams.

Values and Attitudes
Students will develop positive values and attitudes towards themselves, others, learning as a lifelong process, science and the environment.

6 Outcomes

Prescribed Focus Areas

Objective: Students will develop knowledge and understanding of:

- the history of science
- the nature and practice of science
- applications and uses of science
- implications of science for society and the environment
- current issues, research and development.

Stage 4 Outcomes A student:		**Stage 5 Outcomes** A student:	
4.1	identifies historical examples of how scientific knowledge has changed people's understanding of the world	5.1	explains how social factors influence the development and acceptance of scientific ideas
4.2	uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena	5.2	describes the processes that are applied to test and validate models, theories and laws
4.3	identifies areas of everyday life that have been affected by scientific developments	5.3	evaluates the impact of applications of science on society and the environment
4.4	identifies choices made by people with regard to scientific developments	5.4	discusses scientific evidence supporting different viewpoints
4.5	describes areas of current scientific research	5.5	analyses how current research might affect people's lives

Domain: Knowledge and Understanding

Objective: Students will develop knowledge and understanding of:

- models, theories and laws, and structures and systems related to the physical world, matter, the living world, and Earth and space
- interactions within the physical world, matter, the living world and Earth and space.

Stage 4 Outcomes A student:		**Stage 5 Outcomes** A student:	
4.6	identifies and describes energy changes and the action of forces in common situations	5.6	applies models, theories and laws to situations involving energy, force and motion
4.7	describes observed properties of substances using scientific models and theories	5.7	relates properties of elements, compounds and mixtures to scientific models, theories and laws
4.8	describes features of living things	5.8	relates the structure and function of living things to models, theories and laws
4.9	describes the dynamic structure of Earth and its relationship to other parts of our solar system and the universe	5.9	relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time
4.10	identifies factors affecting survival of organisms in an ecosystem	5.10	assesses human impacts on the interaction of biotic and abiotic features of the environment
4.11	identifies where resources are found, and describes ways in which they are used by humans	5.11	analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources
4.12	identifies, using examples, common simple devices and explains why they are used	5.12	relates the interactions involved in using some common technologies to their underlying scientific principles

Domain: Skills

Objective:	Students will develop skills in working scientifically through: • planning investigations • conducting investigations • communicating information and understanding • developing scientific thinking and problem-solving techniques • working individually and in teams.

Stage 4 Outcomes A student:		**Stage 5 Outcomes** A student:	
4.13	clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem	5.13	identifies a problem and independently produces an appropriate investigation plan
4.14	follows a sequence of instructions to undertake a first-hand investigation	5.14	undertakes first-hand investigations independently with safety and competence
4.15	uses given criteria to gather first-hand data	5.15	gathers first-hand data accurately
4.16	accesses information from identified secondary sources	5.16	accesses information from a wide variety of secondary sources
4.17	evaluates the relevance of data and information	5.17	explains trends, patterns and relationships in data and/or information from a variety of sources
4.18	with guidance, presents information to an audience to achieve a particular purpose	5.18	selects and uses appropriate forms of communication to present information to an audience
4.19	draws conclusions based on information available	5.19	uses critical thinking skills in evaluating information and drawing conclusions
4.20	uses an identified strategy to solve problems	5.20	selects and uses appropriate strategies to solve problems
4.21	uses creativity and imagination to suggest plausible solutions to familiar problems	5.21	uses creativity and imagination in the analysis of problems and the development of possible solutions
4.22	undertakes a variety of individual and team tasks with guidance	5.22	plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member

Domain: Values and Attitudes

Objective:	Students will develop positive values and attitudes towards themselves, others, learning as a lifelong process, science and the environment.

Stage 4 and/or 5 Outcomes A student:	
4/5.23	demonstrates confidence and a willingness to make decisions and to take responsible actions
4/5.24	respects differing viewpoints on science issues and is honest, fair and ethical
4/5.25	recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life
4/5.26	recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them
4/5.27	acknowledges their responsibility to conserve, protect and maintain the environment for the future

Life Skills

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

Organisation of Outcomes in Stages

The table below shows the organisation of the Prescribed Focus Areas, Knowledge and Understanding, Skills, Values and Attitudes within Stages 4 and 5, and provides a structural overview of the syllabus.

Stage 4

Prescribed Focus Areas A student:	**Domain:** **Knowledge and Understanding** A student:	**Domain:** **Skills** A student:
4.1 identifies historical examples of how scientific knowledge has changed people's understanding of the world 4.2 uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena 4.3 identifies areas of everyday life that have been affected by scientific developments 4.4 identifies choices made by people with regard to scientific developments 4.5 describes areas of current scientific research	4.6 identifies and describes energy changes and the action of forces in common situations 4.7 describes observed properties of substances using scientific models and theories 4.8 describes features of living things 4.9 describes the dynamic structure of Earth and its relationship to other parts of our solar system and the universe 4.10 identifies factors affecting survival of organisms in an ecosystem 4.11 identifies where resources are found, and describes ways in which they are used by humans 4.12 identifies, using examples, common simple devices and explains why they are used	4.13 clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem 4.14 follows a sequence of instructions to undertake a first-hand investigation 4.15 uses given criteria to gather first-hand data 4.16 accesses information from identified secondary sources 4.17 evaluates the relevance of data and information 4.18 with guidance, presents information to an audience to achieve a particular purpose 4.19 draws conclusions based on information available 4.20 uses an identified strategy to solve problems 4.21 uses creativity and imagination to suggest plausible solutions to familiar problems 4.22 undertakes a variety of individual and team tasks with guidance

Domain:
Values and Attitudes Stage 4 and/or 5
A student:

4/5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions	4/5.24 respects differing viewpoints on science issues and is honest, fair and ethical	4/5.25 recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life

Stage 5

Prescribed Focus Areas A student:	**Domain:** **Knowledge and Understanding** A student:	**Domain:** **Skills** A student:
5.1 explains how social factors influence the development and acceptance of scientific ideas 5.2 describes the processes that are applied to test and validate models, theories and laws 5.3 evaluates the impact of applications of science on society and the environment 5.4 discusses scientific evidence supporting different viewpoints 5.5 analyses how current research might affect people's lives	5.6 applies models, theories and laws to situations involving energy, force and motion 5.7 relates properties of elements, compounds and mixtures to scientific models, theories and laws 5.8 relates the structure and function of living things to models, theories and laws 5.9 relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time 5.10 assesses human impacts on the interaction of biotic and abiotic features of the environment 5.11 analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources 5.12 relates the interactions involved in using some common technologies to their underlying scientific principles	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.20 selects and uses appropriate strategies to solve problems 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member

Domain:
Values and Attitudes Stage 4 and/or 5
A student:

4/5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them

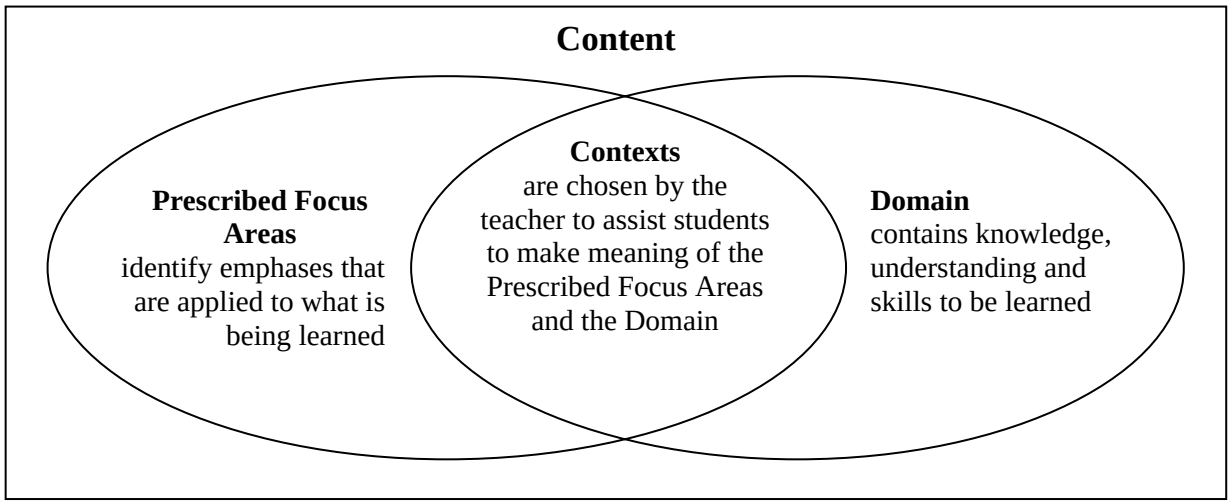
4/5.27 acknowledges their responsibility to conserve, protect and maintain the environment for the future

7 Content

7.1 Organisation of Content

The content comprises three major elements. Each unit of work developed by teachers must include content related to each of these three elements:

- Contexts
- Prescribed Focus Areas
- Domain.



Contexts
Contexts are the framework that teachers devise to assist students to make meaning of the Prescribed Focus Areas and Domain. Contexts are culturally bound and therefore communicate meanings that are culturally shaped or defined. Contexts developed by teachers draw on the framework of society in all aspects of everyday life. The choice of appropriate contexts by teachers for scientific learning should encourage students to recognise and use their current understanding to further develop and apply more specialised scientific understanding and knowledge.

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. The syllabus identifies the purposes for which contexts may be chosen, ie to increase:

- motivation
- conceptual meaning
- scientific literacy
- communication skills
- personal and societal power.

Teachers need to consider carefully their choice of contexts. A context should be chosen after considering factors such as local resources and students' interests, learning history and cultural backgrounds. In Science Years 7–10, contexts should be used to enhance one or more of the following:

Motivation

Contexts can be chosen to motivate students, which will increase the potential for learning. The real-life contexts that interest secondary students vary with age, gender, socioeconomic group and cultural background. For example, the social world of a sixteen-year-old is usually very different from that of most thirteen-year-olds. Research, however, does indicate that many students favour issues and contexts with more immediate relevance over those related to their possible future experiences.

Conceptual meaning

Contexts can be chosen to assist students to develop conceptual meaning. Students develop a greater understanding of the many concepts used in science if they can easily make connections between the things with which they are already familiar (the known) and the knowledge and understanding being presented (the unknown). The importance of making such links in a highly conceptualised subject such as science cannot be overstated. Successful science learning is characterised by the provision of teaching/learning environments that assist students to make these links and by students' recognition of their own interplay in the life situations in which science is involved.

Providing contexts related to conceptual meaning increases the opportunities students have of recognising that the concepts they are trying to understand are relevant to a number of situations other than those immediately apparent to them. Using contexts as a means of making links, either to other scientific concepts or to real-life situations, assists students to develop networks of concepts in networks of contexts, thus reinforcing their learning.

Scientific literacy

Being scientifically literate means that students can apply their knowledge of scientific concepts and processes to the evaluation of issues and problems that may arise and to the decisions that they make in their daily life, about the natural world and changes made to it through human activity.

Contexts should be chosen to develop students' scientific literacy by providing opportunities for them to engage in the recognition and construction of scientific questions and to build confidence and competence in evaluating evidence, drawing conclusions and in communicating their scientific understanding to a variety of audiences. Scientifically literate students' understanding of the nature and practice of science helps them to be questioning of claims made by others about scientific issues and be able to evaluate information presented from a variety of sources including popular media.

Communication skills

For students to communicate scientific information appropriately and effectively, they need experience of the wide variety of texts used in science. Students should be provided with scaffolds to assist them in developing their skills in speaking, listening, reading, writing, viewing and responding in science. For students to develop competence and confidence in the use of scientific language they need to become familiar with the structure and rules, and the more formal definitions, symbolic expressions and conventions used in scientific communication.

Contexts should be chosen which allow teachers to model appropriate texts. Opportunities are needed for students to experiment with the construction and presentation of oral, written and visual materials to achieve a range of purposes, including communicating their understanding of science.

Personal and societal power

In choosing contexts that are particularly relevant to students' own lives, students become confident in their ability to transfer their experiences to new situations. They may discuss aspects of the situation with greater confidence than others who have not encountered that context in their science course. It can also increase students' knowledge and skills, empowering them to confidently make decisions in their own lives and to participate more effectively in the broader community.

In practice, socially realistic contexts for learning science require recognition and inclusion of at least some of the socio-scientific concepts that have been developed.

Prescribed Focus Areas

Prescribed Focus Areas are the emphases that are to be applied to each unit of work that the teacher develops. They contain different curriculum emphases designed to increase students' understanding of: science as an ever-developing body of knowledge; the provisional nature of scientific explanations; the complex relationship between evidence and ideas; and the impact of science on society. Particular Prescribed Focus Areas will be more suitably addressed in some contexts than in others.

Each unit of work must address **at least one** of the Prescribed Focus Areas. Teachers will select the appropriate essential content to achieve the relevant Stage 4 or Stage 5 Prescribed Focus Area outcome. The following Prescribed Focus Areas must be addressed **each year**:

- history of science
- the nature and practice of science
- applications and uses of science
- implications for society and the environment
- current issues, research and development.

History of science

A knowledge of the historical background is important for an adequate understanding of science. Students should develop an understanding of:

- the developmental nature of scientific knowledge and processes
- the part that science has played in shaping society
- how science has been influenced and constrained by societies.

The nature and practice of science

A study of science should enable students to participate in scientific activities and develop an understanding of the nature and practice of science, including the importance of creativity, intuition, logic and objectivity. Students should develop an understanding of the nature of scientific explanations, their provisional character, the development of ideal cases from phenomena and the complex relationship between:

- the study of science for its own sake and the value of curiosity-driven research
- existing scientific views and evidence supporting these
- the processes and methods of exploring, generating, testing and relating ideas
- the stimulation provided by technological advances and the constraints imposed by the limitations of current technology, which necessitates the development of the required technology and technological advances.

Applications and uses of science

Setting science within broader contexts allows students to deal with real problems and applications. The study of science should increase students' knowledge and understanding of:

- the relevance, usefulness and applicability of scientific concepts and principles
- the use of science in developing technological devices and systems
- the contributions of science to society, including Australian achievements.

Implications for society and the environment

Science has an impact on our society and the environment and students need to develop an understanding of the importance of informed values and practices in relation to society and the environment. The study of science should enable students to develop:

- knowledge and understanding about the interrelatedness of people, their cultures and their biophysical surroundings
- skills in making decisions about issues, particularly those currently concerning society and the environment.

Current issues, research and development

In today's society, more information is available to students than ever before about current issues, research and developments in science. The study of science should develop students' understanding of:

- links between classroom experiences and their world
- science as a human endeavour
- career opportunities in science and related fields
- media coverage of scientific events
- ongoing and recent developments in scientific ideas and applications, including recent Australian achievements.

Domain

The Domain is a conceptual framework of knowledge and understanding about phenomena, skills related to carrying out investigations, values about, and attitudes towards, science. The Domain provides a focus for the questions that students ask, based on existing understanding and observations; it provides a methodology for testing the validity of those questions, and seeking general trends and patterns of behaviours.

Knowledge and Understanding

Science presents a particular way of thinking about the world. It utilises leaps of imagination, inference, and deductive and inductive reasoning. Science presumes that the events in the universe occur in consistent patterns that are understandable through careful, systematic study. Units of work developed by teachers will select appropriate knowledge and understanding from:

- models, theories and laws
- structures and systems
- interactions.

The content presented in models, theories and laws, structures and systems and interactions does not represent a teaching or hierarchical sequence. It is expected that teachers will select appropriate content from models, theories and laws, structures and systems and interactions to develop a cohesive course that will assist students to achieve the outcomes of the syllabus.

Models, theories and laws

Science attempts to explain phenomena or predict events by identifying consistent trends and patterns from which can be generated a:

- **model**: mathematical, physical, experimental or logical representation based on a simplified set of assumptions. Models are often elaborated to develop theories
- **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
- **law**: a simple and precise statement that has, at one time, been regarded to be universally valid. It describes phenomena that occur with unvarying regularity under the same conditions.

Structures and systems

Science attempts to provide explanation for phenomena in terms of:

- **structures**: where the focus is on the organisation of parts into a whole (eg atoms in molecules; organs in bodies; genes in chromosomes)
- **systems**: where the focus is on the function of a structure and on the interactions which take place within it (eg chemical reactions; bodily processes; reproduction).

Interactions

Scientific concepts do not exist in isolation from each other. Science 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 application of concepts from more than one science discipline.

Skills

The study of science provides students with the opportunity to develop the skills of working scientifically. In working scientifically students engage in creative and problem-solving processes related to planning and conducting investigations, gathering and processing data, drawing conclusions and communicating their findings. Depending on the context chosen, teachers will select the appropriate skills content to achieve the relevant Stage 4 or Stage 5 outcome. Working scientifically involves students in:

Planning investigations

This involves increasing students' skills in: planning and organising activities; effectively using time and resources; selecting appropriate techniques, materials, specimens and equipment to complete activities; establishing priorities between tasks; and identifying ways of reducing risks in the laboratory and field.

Conducting investigations

This involves increasing students' skills in locating and gathering information for a planned investigation. It includes increasing students' skills in performing first-hand investigations, gathering first-hand data, using science equipment and chemicals safely and accessing and collecting information from secondary sources using a variety of technologies.

Communicating information and understanding

This involves increasing students' skills in organising data and information to explain trends, patterns and relationships and in processing and presenting information to communicate understanding. It includes increasing students' skills in listening, speaking, reading, writing and visual literacy.

Developing scientific thinking and problem-solving techniques

This involves increasing students' skills in identifying issues and problems, using critical thinking skills in drawing evidence-based conclusions, framing possible problem-solving processes and developing creative solutions. It also requires anticipating issues that may arise, devising appropriate strategies to deal with these issues and working through them in a logical and coherent way.

Working individually and in teams

This involves increasing students' skills in identifying appropriate goals and conducting investigations safely and effectively within an agreed time frame to achieve these goals. Being an effective member of a team will increase students' skills in defining, allocating and assuming an increasing variety of roles.

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
- undertaking fieldwork
- using a range of data collection technologies and strategies
- researching by using the library, internet and CD-ROMs
- using 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.

Practical experiences may also incorporate activities such as:

- using computer animations and simulations, video and film resources to capture and analyse information not readily available as a primary source
- using data loggers to collect and record data.

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 may 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. If appropriate, the actual investigation could be completed in the students' own time.

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 4/5.13 – 4/5.22 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.

Values and Attitudes
By reflecting on the past, present and future involvement of science with society, students are encouraged to develop informed values and critical attitudes. These include a responsible regard for both the living and non-living components of the environment, ethical behaviour and a desire for critical evaluation of the consequences of the applications of science.

Students are encouraged to develop attitudes upon which scientific investigations depend, such as curiosity, honesty, flexibility, persistence, critical-mindedness, willingness to suspend judgement, tolerance of uncertainty and acceptance of the provisional status of scientific knowledge. Students need to balance these with commitment, tenacity, occasional inflexibility and a willingness to take risks and make informed judgements. As well as knowing something about science, students need to value and appreciate science and its achievements if they are to become scientifically literate persons and develop positive values about, and positive attitudes towards themselves, others, lifelong learning, science and the environment.

Essential and Additional Content
The essential content has been designed to be realistically 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 is not required as prerequisite knowledge for any course in the Stage 6 Science curriculum. Essential content from either the Preliminary or HSC courses in Science may not be selected as additional content.

Teachers are required to develop units of study to address all of the essential content of the Prescribed Focus Areas and the Domain. 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.

The additional content presented in the syllabus provides suggestions only and should not be considered an exhaustive list. The additional content selected must be based on scientific ideas that are evidence-based. All scientific ideas are theories and must be testable and measurable using the procedures of scientific inquiry.

Life Skills
Life Skills outcomes and content are in section 8.

Cross-curriculum content

Cross-curriculum content assists students to achieve the broad learning outcomes defined in the Board of Studies *K–10 Curriculum Framework*. It is incorporated in the content of the *Science Years 7–10 Syllabus* in the following ways:

Information and Communication Technologies (ICT)

Information and communication technologies content is addressed through students:

- performing first-hand investigations, gathering first-hand data, and accessing and collecting information from secondary sources using a variety of technologies including databases, CD-ROM and the internet
- researching using the library and a range of digital media including the internet
- using a range of data collection technologies and strategies independently
- extracting, reorganising, formatting and reporting information in the form of spreadsheets, databases, flow charts, tables, graphs, diagrams, prose and keys using appropriate technologies
- developing and utilising ethical practices in their use of ICT.

Schools may also use other ICT to facilitate learning in Science. Examples of these include:

- using technology such as computer simulations for modelling to test hypotheses
- using computer animations and simulations, video and film resources to capture and analyse information not readily available as a primary source
- using data loggers to collect and record data.

Work, Employment and Enterprise

The syllabus provides opportunities for students to develop a range of work-related skills including an appreciation of issues around working in teams or working individually, the establishment and maintenance of safe and healthy work environments, as well as the value of lifelong learning.

Students are provided with opportunities to model working scientifically through the development of skills used by those working in science and related areas such as the acquisition and application of a relevant body of knowledge, critical thinking, problem-solving, planning and conducting investigations, as well as communicating information and understanding.

Students can explore future opportunities for science-based vocations from the innovative and creative application of scientific discoveries and related technologies as well as the contributions of Australian males and females working in science-related areas.

Aboriginal and Indigenous

Opportunities to develop understanding of aspects of Aboriginal and Indigenous culture are provided for students as they:

- identify some of the ideas from different cultures (including those of Aboriginal and other Indigenous people) that have contributed to science throughout history
- give examples to show that different cultures or groups within a society (including Aboriginal and other Indigenous people) may use or weight criteria differently to make a decision about an issue involving a major scientific component.

The syllabus also provides opportunities in teaching and learning programs for the inclusion of Aboriginal and Indigenous contexts relevant to areas such as ecology, the environment and astronomy.

Civics and Citizenship

Opportunities for students to broaden their understanding of aspects of civics and citizenship arise through the development of an awareness of a shared cultural heritage derived from the historical development of ideas and concepts in science and the impact of society and culture on these ideas.

Students also examine the local and global implications of current science issues, research and development on society and the environment. Through discussion and debate of current issues students may develop lifelong values and attitudes that underpin ethical behaviour and the desire and skills to actively evaluate the consequences of the applications of science.

Environment

Environmental perspectives are addressed through students' examination and consideration of:

- Australian examples that illustrate the biodiversity and ecology of living things
- the impact of human activities on the environment
- the impact of applications of science on the environment
- impacts on the biosphere of waste from resource use.

Students develop their critical thinking skills and use creativity and imagination to propose solutions to scientific, technological or societal impacts on the natural environment. This reinforces the shared responsibility of all to conserve, protect and maintain the quality and sustainability of the environment for future generations.

Gender

Gender issues are addressed in the syllabus through the flexibility provided in allowing teachers to choose contexts and additional content that stimulate student interest and take account of their learning needs. This provides opportunities for teachers to structure gender-neutral or gender-specific contexts depending on need.

The syllabus also requires students to examine the roles and contributions of women and men in science, providing an opportunity to break down many of the traditional stereotypes.

Key Competencies

Key Competencies are embedded within the objectives and content of the Skills. The content develops students' ability to:

- plan, organise and perform first-hand investigations to test a hypothesis or question that can be researched
- collect, analyse and organise information from first-hand investigations and secondary sources, organising data using a variety of methods including diagrams, tables and spreadsheets, and checking reliability of gathered data and information by making comparisons with observations or information from other sources
- communicate ideas and information using a range of text types including explanation, procedure and report formats to present data and information from first-hand investigations
- identify the nature of issues and problems, framing possible problem-solving strategies and developing creative solutions in a logical, coherent way
- use technology including CD-ROMs and the internet to access information
- work individually and in teams where appropriate, safely, responsibly and effectively with realistic timelines and goals
- use appropriate mathematical processes including appropriate units, graphs, spreadsheets and mathematical procedures and relationships.

Literacy

The *Science Years 7–10 Syllabus* provides opportunities for students to engage in the ongoing development of broad literacy skills as well as more science-specific literacy.

Literacy is the ability to communicate purposefully and appropriately with others in a wide variety of contexts, modes and mediums. Literacy incorporates not only the fundamental skills of speaking, listening, reading and writing but also skills in visual literacy which are developed through viewing and representing a wide range of texts.

The development of students' literacy skills and understanding is the responsibility of all secondary school teachers as different subjects and learning areas make particular demands on students' literacy. In particular, science uses words from everyday language that may have different meanings when used within a scientific context. In the syllabus, students are provided with ongoing opportunities to develop their use of the specific language and terminology of science to communicate their knowledge, understanding and skills to a range of audiences.

The content of the syllabus provides opportunities for student to:

- use the language of science in both oral and written communication of their knowledge and understanding via a range of media
- extract, summarise, collate and critically evaluate information for a range of purposes and audiences
- debate, discuss and evaluate the impact and applications of science in a range of contexts.

Multicultural

Multicultural content assists the development of students' skills, knowledge and understanding applicable to the multicultural and multilingual nature of Australian society.

In Science, students explore some of the different perspectives of individuals, groups, events and issues, identifying examples that show how different societal groups may use or weight criteria when making decisions about issues with a major scientific component.

Through the study of both the history of science and recent scientific developments, including some by Australian scientists, students become aware of the broad cultural character of scientific endeavour.

Numeracy

Numeracy is a fundamental component of learning across all areas of the curriculum. The development and enhancement of students' numeracy skills and understanding is the responsibility of teachers across different learning areas that make specific demands on student numeracy.

In Science, numeracy skills are addressed through students:

- making accurate measurements using a range of appropriate technologies and an appropriate number of trials
- recording and organising data in tables or diagrams using appropriate units
- constructing tables and graphs to clearly and succinctly present information and relationships
- applying mathematical procedures to calculations required in scientific investigations
- extracting information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs and flow diagrams
- expressing mathematical relationships by using symbols and the appropriate units for physical quantities.

The syllabus identifies numerous relationships for which students develop a qualitative understanding. Additional content provides further opportunities for students to broaden and deepen their quantitative understanding of these relationships.

Across the Years 7–10 curriculum there are other areas of cross-curriculum content that all students will experience through the mandatory curriculum. The additional area of cross-curriculum content is Difference and Diversity.

7.2 Content for Stages 4 and 5

The content describes knowledge, understanding and skills that students will continually develop in their study of Science Years 7–10.

Prescribed Focus Areas
Each unit of work must address at least one of the Prescribed Focus Areas. Teachers will select the appropriate essential content to achieve the relevant Stage 4 or Stage 5 Prescribed Focus Area outcome. The essential content described below reflects Prescribed Focus Area knowledge and understanding that students should be able to demonstrate by the end of Stage 5.

<table>
<tr><td colspan="2">Outcome 4.1: A student identifies historical examples of how scientific knowledge has changed people's understanding of the world.
Outcome 5.1: A student explains how social factors influence the development and acceptance of scientific ideas.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.1 the history of science</td><td>a) identify some of the ideas from different cultures (including those of Aboriginal and other Indigenous people) that have contributed to science throughout history
b) describe some models and theories that have been considered in science and then been modified or rejected as a result of available evidence
c) discuss examples where societal, religious or ethical values have had an impact on scientific developments
d) describe historical cases where developments in science have led to the development of new technologies
e) describe historical cases where developments or improvements in technology have transformed science.</td></tr>
<tr><td colspan="2">Outcome 4.2: A student uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena.
Outcome 5.2: A student describes the processes that are applied to test and validate models, theories and laws.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.2 the nature and practice of science</td><td>a) evaluate the role of creativity, curiosity, objectivity and logical reasoning in describing phenomena, carrying out investigations and in the devising and testing of hypotheses
b) distinguish between scientific argument and economic or legal argument
c) apply scientific processes to test the validity of ideas and theories
d) describe how an idea can gain acceptance in the scientific community as either theory or law
e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these
f) give examples that demonstrate the benefits and limitations of using models
g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation.</td></tr>
</table>

Outcome 4.3: A student identifies areas of everyday life that have been affected by scientific developments. **Outcome 5.3**: A student evaluates the impact of applications of science on society and the environment.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.3 the applications and uses of science	a) identify and describe examples of scientific concepts and principles that have been used in technological developments (including Australian examples) b) discuss, using examples, the positive and negative impacts of applications of recent developments in science c) identify and describe examples where technological advances have impacted on science d) give reasons why society should support scientific research.
Outcome 4.4: A student identifies choices made by people with regard to scientific developments. **Outcome 5.4**: A student discusses scientific evidence supporting different viewpoints.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.4 the implications of science for society and the environment	a) discuss viewpoints about some issues with a major scientific component b) give examples to show that different cultures or groups within a society (including Aboriginal and other Indigenous people) may use or weight criteria differently to make a decision about an issue involving a major scientific component c) identify choices that need to be or have been made when considering whether to use particular scientific advances d) discuss the place of social and ethical considerations in scientific practice and in applications of science.
Outcome 4.5: A student describes areas of current scientific research. **Outcome 5.5**: A student analyses how current research might affect people's lives.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.5 current issues, research and developments in science	a) describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions b) evaluate the potential impact of some issues raised in the mass media that require some scientific understanding c) identify scientific skills that can be useful in a broad range of careers d) identify possible career paths in science.

Knowledge and Understanding

Models, theories and laws; Structures and systems

Stage 4

Outcome 4.6: A student identifies and describes energy changes and the action of forces in common situations.

Essential Content

Students learn about:	**Students learn to:**
4.6.1 the law of conservation of energy	a) identify situations or phenomena in which different forms of energy are evident b) use models to describe different forms of energy c) identify objects that possess energy because of their motion (kinetic) or because of other properties (potential) d) qualitatively account for the total energy involved in energy transfers and transformations.
4.6.2 forces	a) identify changes that take place when particular forces are acting b) use the term 'field' in describing forces acting at a distance.
4.6.3 electrical energy	a) associate electricity with energy transfer in a simple circuit b) construct and draw circuits to show transfer of energy.
4.6.4 sound energy	a) describe sound as a form of energy requiring a medium for propagation.
4.6.5 light energy	a) describe light as a form of energy not requiring a medium for propagation.
4.6.6 heat energy	a) identify processes of heat transfer by conduction, convection and radiation.
4.6.7 frictional force	a) describe friction as a contact force which opposes motion b) identify everyday situations where friction acts.
4.6.8 electrostatic force	a) describe ways in which objects acquire an electrostatic charge b) identify everyday situations where the effects of electrostatic forces can be observed c) describe the behaviour of charges when they are brought close to each other.
4.6.9 magnetic force	a) describe the behaviour of magnetic poles when they are brought close to each other b) identify everyday situations in which magnets and electromagnets are used.
4.6.10 gravitational force	a) identify that all objects exert a force of gravity on all other objects in the universe.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Law of conservation of energy	• trace the development of our current ideas about the concept of energy • trace the history of pendulum motion studies and its connection with timekeeping and setting standards of length • distinguish between everyday and scientific meanings of work • identify that when the amount of energy of a body changes work is done or heat energy is transferred.
Forces	• describe characteristics of specific forces in terms of size and direction • describe and use quantitatively the relationship between force, mass and acceleration • apply Newton's laws to space travel • discuss the life, times and achievements of Newton.
Heat energy	• describe how the transfer of heat can be controlled.
Magnetic force	• describe the use of magnetised materials in everyday situations.

Stage 5

Outcome 5.6: A student applies models, theories and laws to situations involving energy, force and motion.

Essential Content

Students learn about:	**Students learn to:**
5.6.1 the wave model	a) identify waves as carriers of energy b) qualitatively describe features of waves including frequency, wavelength and speed c) give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses.
5.6.2 Newton's Laws – motion	a) describe qualitatively the relationship between force, mass and acceleration b) explain qualitatively the relationship between distance, speed and time c) relate qualitatively acceleration to a change in speed and/or direction as a result of a net force d) analyse qualitatively common situations involving motion in terms of Newton's Laws.
5.6.3 electrical energy	a) design, construct and draw circuits containing a number of components b) describe voltage, resistance and current using analogies c) describe qualitatively the relationship between voltage, resistance and current d) compare the characteristics and applications of series and parallel circuits.
5.6.4 light energy	a) distinguish between the absorption, reflection and refraction of light and identify everyday situations where each occurs.
5.6.5 nuclear energy	a) identify that energy and particles may be released from the nuclei of atoms.
5.6.6 gravitational force	a) distinguish between the terms 'mass' and 'weight'.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Wave model	• discuss similarities and differences between transverse and longitudinal wave models • relate the speed of light and the speed of sound to frequency and wavelength • compare different types of radiation making up the electromagnetic spectrum in terms of frequency, wavelength and energy • design and describe ways of enabling or impeding energy transfer by waves • describe quantitatively features of waves including frequency, wavelength and speed using $v = f\lambda$.
Newton's Laws: motion	• explain the difference between speed and velocity • describe the relationships between displacement, time, velocity and acceleration both qualitatively and quantitatively using equations of motion • explain the relationship between velocity and direction of force acting to produce circular motion.
Electrical energy	• explain the relationship between voltage, resistance and current using Ohm's Law.
Light energy	• describe how the structure of the eye allows vision • relate scattering and dispersion of light to everyday occurrences.
Nuclear energy	• discuss similarities and differences between nuclear fission and fusion • explain radioactivity in terms of release of particles and energy.
Gravitational force	• relate qualitatively the force of gravity between two objects to their masses and distance apart.

Stage 4

Outcome 4.7: A student describes observed properties of substances using scientific models and theories.

Essential Content

Students learn about:	**Students learn to:**
4.7.1 the particle model of matter	a) describe the behaviour of matter in terms of particles that are continuously moving and interacting b) describe expansion and contraction of materials in terms of a simple particle model c) relate an increase or decrease in the amount of energy possessed by particles to changes in particle movement.
4.7.2 properties of solids, liquids and gases	a) relate properties of solids, liquids and gases to the particle model of matter b) describe the physical changes that occur during observations of evaporation, condensation, boiling, melting and freezing c) explain density in terms of a simple particle model d) explain the changes in pressure of gases in terms of increases or decreases in frequency of particle collisions.
4.7.3 change of state	a) relate changes of state to the motion of particles as energy is removed or added b) relate energy transfers in melting and freezing, condensation, evaporation and boiling to the particle model.
4.7.4 elements	a) classify elements as metals or non-metals according to their common characteristics b) identify internationally recognised symbols for common elements.
4.7.5 mixtures	a) identify some common mixtures b) identify, using examples, the importance of water as a solvent c) describe aqueous mixtures in terms of solute, solvent and solution d) identify situations where the processes of filtration, sedimentation, sieving, distillation, chromatography, evaporation, condensation, crystallisation and magnetic attraction are appropriate to separate components of a mixture.
4.7.6 compounds and reactions	a) distinguish between elements and compounds b) identify when a chemical reaction is taking place by observing changes in temperature, the appearance of a new substance or the disappearance of an original substance c) distinguish between compounds and mixtures.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Particle theory of matter	• discuss the general applicability of the particle model to a wide range of physical quantities • use simple examples of physical and chemical changes to demonstrate that mass is conserved • describe diffusion in terms of the random movement of particles • identify that forces of cohesion, adhesion and repulsion may exist between particles.
Properties of solids, liquids and gases	• describe sublimation and observe some common examples • give examples where different separation methods are employed to obtain useful substances.
Mixtures	• explain why crystallisation can be used as a method of purification or separation of substances • relate physical and chemical properties of elements and compounds to the arrangement of their atoms • identify common colloids.

Stage 5

Outcome 5.7: A student relates properties of elements, compounds and mixtures to scientific models, theories and laws.

Essential Content

Students learn about:	**Students learn to:**
5.7.1 atomic theory	a) describe features of and the location of protons, neutrons and electrons in the atom b) distinguish between elements, using information about the numbers of protons, neutrons and electrons c) describe an appropriate model that has been developed to describe atomic structure.
5.7.2 elements	a) identify the atom as the smallest unit of an element and distinguish between atoms and molecules b) describe some relationships between elements using the Periodic Table.
5.7.3 compounds and reactions	a) identify that a new compound is formed by rearranging atoms rather than by creating matter b) classify compounds into groups based on common chemical characteristics c) construct word equations from observations and written descriptions of a range of chemical reactions d) identify a range of common compounds using their common names and chemical formulae e) qualitatively describe reactants and products in the following chemical reactions: i) combustion ii) corrosion iii) precipitation iv) acids on metals and acids on carbonates v) neutralisation vi) decomposition f) describe the role of indicators.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Change of state	• relate changes of state to the motion and bonding of particles as energy is removed or added.
Atomic theory	• trace the history of atomic theory • use models to describe the arrangement of electrons in the principal energy levels of common elements • describe the arrangement of electrons in the space around the nucleus • identify properties of different substances that can be explained in terms of their subatomic structure.
Elements	• explain that an atom can combine with other atoms by gaining, losing or sharing electrons • sort metals into their order of activity.
Compounds and reactions	• use internationally recognised symbols to write the formulae for common compounds • identify the characteristics that classify substances as either ionic or covalent compounds • identify the characteristics of organic compounds • identify common reactions involving organic compounds, including esterification and saponification • identify the characteristics of acids, bases and salts • balance a range of common chemical reactions.

Stage 4

Outcome 4.8: A student describes features of living things.	
Essential Content	
Students learn about:	**Students learn to:**
4.8.1 cell theory	a) identify that living things are made of cells b) identify and describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast c) identify that substances move into and out of cells d) distinguish between unicellular and multicellular organisms.
4.8.2 classification	a) classify living things according to structural features and identify that they have patterns of similarities and differences b) identify a range of plants and animals using simple keys.
4.8.3 unicellular organisms	a) identify the beneficial and harmful effects that microorganisms can have on living things and the environment b) explain that reproduction in unicellular organisms takes place by cell division.
4.8.4 multicellular organisms	a) identify that there is a wide range of multicellular organisms b) identify that tissues, organs and organ systems in multicellular organisms consist of different types of cells c) explain why multicellular organisms require specialised organs and systems d) identify the materials required by multicellular organisms for the processes of respiration and photosynthesis e) describe the role of the root, stem and leaf in maintaining flowering plants as functioning organisms.
4.8.5 humans	a) describe the role of the digestive, circulatory, excretory, skeletal and respiratory systems in maintaining humans as functioning organisms.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Cell theory	• identify those substances that are needed by living cells and explain why each is needed • identify the role of diffusion and osmosis in the movement of substances into and out of cells.
Classification	• identify that living things can be divided into a number of major kingdoms • discuss the concept of a species • design simple keys to identify a range of living things • classify organisms as being autotrophic or heterotrophic.
Multicellular organisms	• identify the separate components of the digestive, respiratory, excretory, circulatory, skeletal, nervous and/or endocrine systems and describe the function of each • describe the gaseous exchange systems of other species of animals • identify the structure and function of the vascular tissues (xylem and phloem) in plants • relate the location of the chloroplasts to their role in the process of photosynthesis.
Humans	• describe the nutritional requirements for maintaining humans as functioning organisms.

Stage 5

Outcome 5.8: A student relates the structure and function of living things to models, theories and laws.	
Essential Content	
Students learn about:	**Students learn to:**
5.8.1 cell theory	a) explain that systems in multicellular organisms serve the needs of cells b) identify the role of cell division in growth, repair and reproduction in multicellular organisms.
5.8.2 the Watson-Crick model of DNA	a) explain the advantages of DNA replicating exactly b) explain the advantages and disadvantages of DNA mutating c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves d) identify that genes are part of DNA e) identify the role of genes and environmental factors in determining the features of an organism.
5.8.3 the theory of evolution and natural selection	a) discuss evidence that present-day organisms have evolved from organisms in the distant past b) relate natural selection to the theory of evolution.
5.8.4 humans	a) describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms b) describe some responses of body systems to infectious and non-infectious diseases c) relate the organs involved in human reproductive systems to their function.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Cell theory	• describe cell processes that transfer genetic information from generation to generation during cell reproduction • identify the role of mitosis and cell differentiation during the production of new cells for growth and replacement of damaged cells • identify and describe function of mitochondria in respiration and chloroplasts in photosynthesis.
Watson-Crick model of DNA	• 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 evidence to support the theory that genetic information is passed on from generation to generation.
Theory of evolution by natural selection	• research the interactions between Aboriginal peoples and the Australian megafauna • discuss possible reasons for the evolution of Australia's unique flora and fauna • research case studies of extinct species and species at risk of extinction • describe the impact of mass extinction on species diversity.
Humans	• describe the range of functions carried out by various endocrine (hormonal) glands in humans • identify that abnormal cell function may result in disease • discuss the role of the endocrine system in the control of reproduction, including the control of the menstrual cycle • discuss the impact on the health of Aboriginal peoples brought on by changes since the arrival of Europeans.

Stage 4

Outcome 4.9: A student describes the dynamic structure of Earth and its relationship to other parts of our solar system and the universe.

Essential Content

Students learn about:	Students learn to:
4.9.1 the Newtonian model of the solar system	a) describe qualitatively relative sizes, distances and movements of components of our solar system b) describe relative movements of the planets, moons and sun c) explain night and day in terms of Earth's rotation d) explain the seasons in terms of the tilt of Earth's axis and its revolution around the sun.
4.9.2 components of the universe	a) describe some major features of the universe, including galaxies, stars, nebulae and solar systems b) use appropriate scales to describe differences in sizes of, and distances between, structures making up the universe.
4.9.3 the structure of Earth	a) describe the inner structure of the Earth in terms of core, mantle, crust and lithosphere.
4.9.4 the atmosphere	a) identify gases that comprise the greater percentage of air and explain the difference between Earth's atmosphere and space b) describe the importance of atmospheric gases, including ozone and greenhouse gases, to life on Earth.
4.9.5 the hydrosphere	a) describe the water cycle in terms of the physical processes involved b) describe the effect of the forces of the sun and moon on the hydrosphere.
4.9.6 the lithosphere	a) identify that rocks are composed of minerals b) explain the breaking down of rocks in terms of physical and chemical changes c) relate the formation of landforms to weathering, erosion and deposition d) describe the origins of sedimentary, igneous and metamorphic rocks.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	Students learn to:
Newtonian model of the solar system	• relate the model of the solar system to the observed sky • examine information collected to assist in predicting events such as appearances of comets, eclipses and other solar system phenomena • collate information gained from planetary research to support theories on the formation of the solar system • compare the planetary geology found within the solar system • research the historical development of the present model of the solar system, including the work of Copernicus, Galileo, Kepler and Newton.
Components of the universe	• explain how different cultures have interpreted constellations • compare time scales used to describe features in the solar system, including orbits of moons and planets.
Atmosphere	• discuss some methods used to obtain information about changes in the atmosphere • relate changes in atmospheric conditions to weather phenomena and energy transfer processes • describe the history and application of the idea of air pressure.
Hydrosphere	• compare physical features of the oceanic waters at different depths and temperatures.
Lithosphere	• describe how weathering and erosion have led to different soil types • identify and distinguish between common sedimentary, igneous and metamorphic rocks • identify relationships between heat energy, friction and pressure and relate these to the formation of metamorphic and igneous rocks • explain the formation of sedimentary rocks as compaction of sediment followed by chemical changes.

Stage 5

Outcome 5.9: A student relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time.

Essential Content

Students learn about:	**Students learn to:**
5.9.1 the big bang theory	a) discuss current scientific thinking about the origin of the universe b) identify that some types of electromagnetic radiation are used to provide information about the universe c) describe some of the difficulties in obtaining information about the universe.
5.9.2 the theory of plate tectonics	a) discuss evidence that suggests crustal plates move over time.
5.9.3 components of the universe	a) relate some major features of the universe to theories about the formation of the universe b) describe some changes that are likely to take place during the life of a star.
5.9.4 natural events	a) identify that geological history can be interpreted from the formation, by sediments, of horizontal layers in which the oldest are at the base and the youngest at the top b) describe conditions under which fossils form c) relate the fossil record to the age of Earth and the time over which life has been evolving d) relate movements of Earth's plates to convection currents in the mantle and to gravitational forces e) explain how interactions at plate boundaries may result in earthquakes, volcanic activity and new landforms f) explain some impacts of natural events including cyclones, volcanic eruptions and earthquakes on the atmosphere, hydrosphere, lithosphere and/or biosphere.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Big bang theory	• compare the big bang theory with other theories of the development of the universe • consider interactions between various features of the universe and hypotheses on past and future developments in the universe • investigate the ways in which different societies have described changes in the universe observed over recorded time • describe evidence used to support estimates of time in the universe.
Theory of plate tectonics	• explain how information from seismic activity has helped to produce a model to describe Earth's structure • discuss the contributions of scientists who provided models to explain processes affecting Earth's structure and behaviour.
Components of the universe	• 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.
Natural events	• research evidence which supports the concept that Earth's surface and atmosphere have changed over the history of Earth • describe major changes in the physical history of some of the major natural features of Earth and relate these to a time scale • explain that earthquakes and volcanoes can be produced by processes other than plate boundary interactions.

Knowledge and Understanding

Interactions

Stage 4

Outcome 4.10: A student identifies factors affecting survival of organisms in an ecosystem.	
Essential Content	
Students learn about:	**Students learn to:**
4.10 ecosystems	a) describe some adaptations of living things to factors in their environment b) describe, using examples of food chains and food webs from Australian ecosystems, how producers, consumers and decomposers are related c) describe the roles of photosynthesis and respiration in ecosystems d) discuss some effects of bushfires, drought and flood on Australian ecosystems.
Outcome 4.11: A student identifies where resources are found, and describes ways in which they are used by humans.	
Essential Content	
Students learn about:	**Students learn to:**
4.11 natural resources	a) distinguish between natural and made resources b) give examples of resources from living things and resources extracted from the air, Earth and oceans c) identify fossil fuels and describe some of their uses d) identify renewable and non-renewable sources of energy.
Outcome 4.12: A student identifies, using examples, common simple devices and explains why they are used.	
Essential Content	
Students learn about:	**Students learn to:**
4.12 technology	a) identify that technologies make tasks easier or more convenient b) identify a variety of energy transformations in everyday devices involving electrical, sound, light and/or heat energy.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Ecosystems	• identify factors that affect the size of populations of organisms, including: competition for resources; predators; birth and death rates.
Resources	• identify differences in properties of the components of selected mixtures that allow these mixtures to be separated into their components • research Aboriginal people's use of natural materials (including ochres and natural dyes), artefacts and weapons, shelter and housing, and cloth and string production • compare advantages and disadvantages of producing and using synthetic materials.
Technology	• identify some advantages of levers, pulleys, gears and inclined planes • analyse various simple machines in terms of energy input and output and work done • examine the human body and relate movement to the concept of simple machines • trace the history of the development of particular devices or technologies such as circuitry through to microcircuitry • describe some traditional technologies used and developed by different indigenous peoples.

Stage 5

Outcome 5.10: A student assesses human impacts on the interaction of biotic and abiotic features of the environment.	
Essential Content	
Students learn about:	**Students learn to:**
5.10 ecosystems	a) distinguish between biotic and abiotic features of the local environment b) describe the importance of cycles of materials in ecosystems c) describe some impacts of human activities on ecosystems.
Outcome 5.11: A student analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources.	
Essential Content	
Students learn about:	**Students learn to:**
5.11.1 energy resources	a) discuss the importance of energy as a resource b) identify properties that make some natural resources economically important and describe their uses.
5.11.2 waste from resource use	a) relate pollution to contamination by unwanted substances b) identify excessive use of fossil fuels as a contributing factor to a greenhouse effect c) discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality and sustainability of the environment.
Outcome 5.12: A student relates the interactions involved in using some common technologies to their underlying scientific principles.	
Essential Content	
Students learn about:	**Students learn to:**
5.12 technology	a) describe some everyday uses and effects of electromagnetic radiation, including applications in communications technology b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy c) describe some benefits and problems of using biotechnology d) describe ways in which technology has increased the variety of made resources.

Additional Content is not prerequisite knowledge for following stages but may be used to broaden and deepen students' knowledge, understanding and skills in Stage 4 and/or Stage 5.

Students learn about:	**Students learn to:**
Ecosystems	• discuss the Convention on Biodiversity with particular reference to Articles 8 and 10 • research how Aboriginal belief systems relate to environmental management • describe how the land management practices and techniques of Aboriginal and non-Aboriginal peoples have changed the environment • discuss evidence for and against relating global warming to changes in weather patterns including El Niño and La Niña.
Resources	• 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 • identify a variety of synthetic materials and relate their properties to their uses, eg plastics and some ceramics.
Technology	• discuss, using examples, how developments in electronics have changed technology, and identify some applications • describe some medical applications of electromagnetic radiation • discuss technological developments that have extended the ability of scientists to collect information about, and monitor events in, the natural and physical worlds.

Skills

Teachers will select the appropriate essential content to achieve the relevant Stage 4 or Stage 5 skills outcome. The essential content described below reflects skills that students should be able to demonstrate by the end of Stage 5.

Outcome 4.13: A student clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem. **Outcome 5.13**: A student identifies a problem and independently produces an appropriate investigation plan.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.13.1 identifying data sources	a) describe a problem and develop an hypothesis or question that can be tested or researched b) propose possible sources of data and/or information relevant to the investigation c) identify what type of information or data need to be collected d) justify why particular types of data or information are to be collected e) identify the appropriate units to be used in collecting data f) recommend the use of an appropriate technology or strategy for collecting data or gathering information g) formulate a means of recording the data to be gathered or the information to be collected.
4/5.13.2 planning first-hand investigations	a) identify variables that need to be held constant if reliable first-hand data is to be collected b) specify the dependent and independent variables when planning controlled experiments c) describe a logical procedure for undertaking a simple or controlled experiment to collect valid first-hand data d) establish an appropriate timeline for an investigation.
4/5.13.3 choosing equipment or resources	a) identify advantages and limitations of using particular laboratory and field equipment for a specific task b) select appropriate equipment (including safety equipment) and/or resources to perform the task c) describe ways to reduce the risk to themselves and others when working in the laboratory or field.

<table>
<tr><td colspan="2">Outcome 4.14: A student follows a sequence of instructions to undertake a first-hand investigation.
Outcome 5.14: A student undertakes first-hand investigations independently with safety and competence.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.14 performing first-hand investigations</td><td>a) follow the planned procedure when performing an investigation
b) use time and resources effectively
c) safely and efficiently construct, assemble and manipulate identified equipment
d) record data using the appropriate units
e) evaluate and modify experimental procedures
f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment.</td></tr>
<tr><td colspan="2">Outcome 4.15: A student uses given criteria to gather first-hand data.
Outcome 5.15: A student gathers first-hand data accurately.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.15 gathering first-hand information</td><td>a) make and record observations and measurements accurately
b) use independently a range of data collection strategies and technologies such as data loggers.</td></tr>
<tr><td colspan="2">Outcome 4.16: A student accesses information from identified secondary sources.
Outcome 5.16: A student accesses information from a wide variety of secondary sources.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.16 gathering information from secondary sources</td><td>a) use a range of sources, including databases, CD-ROMs and the internet, to access information
b) use a variety of techniques, such as keywords, skimming and scanning to identify appropriate information
c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources
d) summarise information from identified oral and written secondary sources.</td></tr>
</table>

<table>
<tr><td colspan="2">Outcome 4.17: A student evaluates the relevance of data and information.
Outcome 5.17: A student explains trends, patterns and relationships in data and/or information from a variety of sources.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.17 processing information</td><td>a) collate information from a number of sources
b) distinguish between relevant and irrelevant information
c) check the reliability of gathered data and information by comparing them with observations or information from other sources
d) organise data using a variety of methods including diagrams, tables, spreadsheets and databases
e) critically analyse the accuracy of scientific information presented in mass media
f) identify trends, patterns, relationships and contradictions in data and information
g) apply mathematical concepts and computer based technologies to assist analysis of data and information.</td></tr>
<tr><td colspan="2">Outcome 4.18: A student with guidance, presents information to an audience to achieve a particular purpose.
Outcome 5.18: A student selects and uses appropriate forms of communication to present information to an audience.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.18 presenting information</td><td>a) select, and use appropriately, types of texts for different purposes and contexts including a discussion, explanation, procedure, exposition, recount, report, response or experimental record for oral or written presentation
b) select and use an appropriate medium to present data and information
c) select and use an appropriate method to acknowledge sources of information
d) use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities
e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly
f) select and draw the appropriate type of graph (from column graph, histogram, divided bar, sector or line graph) or diagram to convey information and relationships clearly and accurately.</td></tr>
</table>

<table>
<tr><td colspan="2">Outcome 4.19: A student draws conclusions based on information available.
Outcome 5.19: A student uses critical thinking skills in evaluating information and drawing conclusions.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.19 thinking critically</td><td>a) justify inferences in light of gathered information
b) identify data which supports or discounts an hypothesis, a question being investigated or a proposed solution to a problem
c) predict outcomes and generate plausible explanations directly related to observations made
d) make generalisations in relation to a relevant set of observations or experimental results
e) anticipate and/or respond to problems as they arise in practical situations
f) use models, including mathematical ones, to explain phenomena or make predictions
g) use cause and effect relationships to explain ideas.</td></tr>
<tr><td colspan="2">Outcome 4.20: A student uses an identified strategy to solve problems.
Outcome 5.20: A student selects and uses appropriate strategies to solve problems.</td></tr>
<tr><td colspan="2">Essential Content</td></tr>
<tr><td>Students learn about:</td><td>Students learn to:</td></tr>
<tr><td>4/5.20 problem-solving</td><td>a) identify the nature of a presented problem
b) describe different strategies that could be employed to solve an identified problem
c) use identified strategies to develop a range of possible solutions to a particular problem
d) evaluate the appropriateness of different strategies for solving an identified problem.</td></tr>
</table>

Outcome 4.21: A student uses creativity and imagination to suggest plausible solutions to familiar problems. **Outcome 5.21**: A student uses creativity and imagination in the analysis of problems and the development of possible solutions.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.21 the use of creativity and imagination	a) seek evidence to support claims b) evaluate evidence for reliability and validity c) produce creative solutions for problems d) propose ideas that demonstrate coherence and logical progression e) apply critical thinking in the consideration of proposals f) formulate cause and effect relationships.
Outcome 4.22: A student undertakes a variety of individual and team tasks with guidance. **Outcome 5.22**: A student plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.	
Essential Content	
Students learn about:	**Students learn to:**
4/5.22.1 working individually	a) independently plan and conduct investigations, communicate information and understanding and solve problems b) set and work to realistic timelines and goals c) accept responsibility for maintenance of a safe working environment for themselves and others d) evaluate the effectiveness of their performance in completing tasks.
4/5.22.2 working in teams	a) identify the specific roles needed when working in a team b) match the tasks to the team members according to the requirements of the task and the skills of the individual c) negotiate and allocate individual roles to members of the team d) accept specific roles in a team while planning and conducting investigations, communicating information and understanding and solving problems e) set and work to realistic timelines and goals as a team f) accept personal responsibility for maintenance of a safe working environment for the team g) monitor progress of the team towards completion of a task h) evaluate the process used by the team and effectiveness of the team in completing the task.

Life Skills

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

8 Life Skills Outcomes and Content

The Board of Studies recognises that a small percentage of students with special education needs may best fulfil the mandatory curriculum requirements for Science by undertaking Life Skills outcomes and content. (Requirements for access to Life Skills outcomes and content are detailed in section 1.2.)

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.

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 Life Skills outcomes and content across a variety of school and community contexts.

8.1 Outcomes

Objectives Students will develop:	**Outcomes** A student:
knowledge and understanding of the history, nature and practice of science, applications and uses of science, implications of science for society and the environment, current issues, research and development	LS.1 recognises some scientific developments that have changed our world LS.2 recognises that the process of science involves conducting investigations LS.3 explores the influence of science on our daily lives LS.4 explores the impact of science on people and/or the environment LS.5 investigates a current issue in science
knowledge and understanding of models, theories and laws and structures and systems related to the physical world, matter, the living world and Earth and space	LS.6 recognises some forms and sources of energy LS.7 explores the ways that energy is used in our daily lives LS.8 recognises common substances LS.9 recognises characteristics of and changes in living things LS.10 identifies some features of the Earth LS.11 recognises some features of the solar system and beyond

Objectives Students will develop:	**Outcomes** A student:
knowledge and understanding of interactions within the physical world, matter, the living world and Earth and space	LS.12 observes a range of physical interactions LS.13 observes a range of chemical interactions LS.14 recognises that living things depend upon each other and on their environments LS.15 explores the impact of human activity on the Earth's resources LS.16 describes the impact of human activity on living systems
skills in working scientifically through planning investigations, conducting investigations, communicating information and understanding, developing scientific thinking and problem-solving techniques, and working individually and in teams	LS.17 participates in the development of a plan to carry out an investigation LS.18 participates in an investigation LS.19 communicates information about an investigation LS.20 suggests a way to solve a problem LS.21 undertakes a variety of team and individual tasks

Outcomes LS.17 to LS.21 refer to the skills that enhance learning in Science and are integrated throughout the content. Specific content related to these skills can be found on pages 21–22.

8.2 Content

The content forms the basis for learning opportunities. Content will be selected on the basis that it meets the needs, goals and priorities of each student. Students are not required to complete all of the content to demonstrate achievement of an outcome.

The examples provided are suggestions only.

<table>
<tr><td colspan="2">Outcome LS.1: A student recognises some scientific developments that have changed our world.</td></tr>
<tr><td>Students learn about:
significant developments that have contributed to the progress of science throughout history</td><td>Students learn to:
participate as part of a team in an investigation of a significant scientific development eg lighting: candle to kerosene lamp to gas lighting to electric light bulb; binoculars: glass to lenses to binoculars
communicate information about the investigation.</td></tr>
<tr><td colspan="2">Outcome LS.2: A student recognises that the process of science involves conducting investigations.</td></tr>
<tr><td>Students learn about:
the scientific process
observing
questioning
planning
participating
communicating</td><td>Students learn to:
participate as part of a team in a scientific investigation of an observed phenomenon in the local school environment eg observe grass being mowed, question why grass has to be mowed, plan investigation of plant growth, undertake a planned investigation to measure and record plant growth
communicate information about the investigation.</td></tr>
<tr><td colspan="2">Outcome LS.3: A student explores the influence of science on our daily lives.</td></tr>
<tr><td>Students learn about:
technological developments that have changed our daily lives
mobile phones
motor cars
vacuum cleaners
switches
planning an investigation</td><td>Students learn to:
participate individually or as part of a team in an investigation of how a technological development has changed the way we live eg mobile phones
participate as part of a team in planning and undertaking an investigation into changes in the way we communicate eg from two people talking, to letter writing, to telegraph, to phone, to satellites to mobile phones
communicate information about the investigation.</td></tr>
<tr><td colspan="2">Outcome LS.4: A student explores the impact of science on people and/or the environment.</td></tr>
<tr><td>Students learn about:
how science may affect our daily living and the environment in which we live</td><td>Students learn to:
participate as part of a team in an investigation into the impact of a scientific development on people and on their environment eg motor car: providing greater mobility, convenience, safety issues relating to the use of the motor car, pollution and resource depletion associated with the use of the car
communicate information about the investigation.</td></tr>
</table>

Outcome LS.5: A student investigates a current issue in science.	
Students learn about:	**Students learn to:**
• identifying and analysing issues that arise from scientific developments – transplants – salinity – radiation from power lines/mobile phones – pesticides	• locate and gather information about an issue of interest to students *eg the advantages and disadvantages of using pesticides and alternative solution to the problems of eliminating pests* • suggest ways to solve problems which may be identified • communicate the information collected.
Outcome LS.6: A student recognises some forms and sources of energy.	
Students learn about:	**Students learn to:**
• energy as an agent of change	• recognise changes that occur when energy is used *eg turn on light, turn on radio, toasting bread* • recognise things don't happen if there is no energy source *eg blackouts, torch without batteries.*
• types of energy	• recognise forms of energy we use in our home/school *eg heat, light, sound* • recognise that the form of energy can change *eg stove (electrical to heat), TV (electrical to sound and light).*
• sources of energy	• identify the sources of energy we use in the home/school *eg electricity, gas.*
• other sources of energy used in the wider community	• identify other sources of energy *eg wind, sun.*
Outcome LS.7: A student explores the ways energy is used in our daily lives.	
Students learn about:	**Students learn to:**
• the use of energy within the home	• participate individually or as part of a team in an investigation into how a specific form of energy is used in the home *eg electricity – batteries/mains* • communicate information about the investigation.
• the use of energy in the wider community	• identify energy use in the wider community *eg electricity, solar, wind.*

Outcome LS.8: A student recognises common substances.	
Students learn about:	**Students learn to:**
• the nature of matter	• recognise common materials at home as matter *eg cup, water, table, air.*
• the states of matter	• use their senses to identify matter as existing as either a solid (ice, the 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 *eg ice cream will melt out of fridge, boiled water turns to steam, breath on a cold mirror*
	• participate as part of a team in an investigation to determine the effect of heat on the states of matter *eg heat ice until it melts, boil water until it evaporates, make ice blocks from cordial*
	• communicate information about how heat changes the states of matter.
• mixtures and separation techniques	• recognise common mixtures that are natural and made *eg cordial, muddy water, food like rice cooking in water, tea containing milk and sugar, sea water*
	• explore the different ways of separating mixtures *eg use a sieve to drain rice or vegetables, filter coffee, evaporate water from salt water.*
• common elements	• recognise things made from metal *eg coins, tap, saucepan, pipes, window frames*
	• identify some metals found around them *eg aluminium in foil, copper in water pipes, gold and silver in jewellery, iron in nails*
	• recognise some of the properties of metals *eg shiny appearance, silver or gold in colour, heat quickly, change shape without breaking, most are solids, good for carrying electricity*
	• recognise uses of metals in the home *eg cutlery, cooking utensils, cars, furniture, window frames, door handles*
	• identify some non-metals in the home *eg carbon in pencil lead, fluoride in toothpaste.*
• common chemicals	• identify common chemicals in the home *eg vinegar, salt, baking soda, sugar, soap.*
• indicators	• make an indicator (plant dyes) by boiling in water *eg red cabbage, nasturtium, red bottle brush*
	• use indicator to observe the colour changes that take place when indicators are added to household chemicals *eg vinegar, baking soda, fruit juices, soap, detergent*
	• communicate information about the colour changes observed in different solutions.
• safe use and storage of household chemicals	• recognise the need for safe use and storage of household chemicals
	• identify strategies for handling and storage of household chemicals.
• food groups – carbohydrates – proteins – fats and oils – vitamins – minerals	• recognise that the foods we eat are mixtures *eg sugar in lollies, starch in bread, fats in chips and biscuits, proteins in meat, fish and chicken*
	• identify the food groups we eat in common foods *eg ham and lettuce sandwich, starch in bread, fats in butter or oils in margarine, protein in ham, vitamin in lettuce.*

Outcome LS.9: A student recognises characteristics of and changes in living things.	
Students learn about:	**Students learn to:**
• characteristics of living things	• recognise living things at home, at school and in the community • recognise non-living things at home, at school and in the community • recognise some characteristics of living things.
• the needs of living things	• recognise the needs of living things *eg animal: needs to drink, needs to eat; plant: needs fertiliser, needs water*.
• changes that occur in living things over time	• observe changes that occur in an animal over time • observe changes that occur in a plant over time.
• importance of light and water to plants	• recognise the parts of a plant • participate as part of a team in an investigation to explore the effect of light on a plant over time *eg plant in dark/light, plants grow towards light* • communicate information about the investigation into plants and light • participate as part of a team in an investigation into a plant's use of water *eg transpiration, storage* • communicate information about the investigation into a plant's use of water.
• the large variety of plants	• identify plants in the school/local environment • participate as part of a team in an investigation into native plants growing in the local area • communicate information about the native plants growing in the local area.
• the human body	• recognise visible body parts *eg arms, head.*
• the skin	• recognise the skin as the covering of the body • participate individually or as part of a team in an investigation into the function and care of skin *eg protection from UV – sunscreen use* • communicate information about strategies for skin care.
• the skeletal and muscular system	• recognise muscles and bones as the organs that let us move • observe muscles and bones *eg feel biceps, look at bones/meat from butcher.*
• the circulatory system	• locate a pulse point • recognise a pulse as evidence of heartbeat • participate individually or as part of a team in an investigation to see the effect of exercise on pulse rate • communicate information about the effects of exercise on pulse rate • recognise the heart as a key organ of the body • discuss health issues related to heart health *eg exercise, weight.*

Students learn about:	**Students learn to:**
• the digestive system	• identify some significant organs of the digestive system
	• participate individually or as part of a team in an investigation of the purpose and care of teeth
	• recognise that food is changed as it goes through the body
	• discuss the importance of adequate intake of water *eg the link between inadequate water intake and constipation.*
• the respiratory system	• recognise people need air
	• identify some significant organs of the respiratory system
	• discuss health issues related to breathing *eg asthma, smoking, pollution.*
• the excretory system	• identify urine as a waste product
	• identify major organs of excretory system
	• discuss the importance of adequate intake of water *eg infections, dehydration.*
• the nervous system	• explore the environment using the senses *eg touch: texture, hot/cold; taste: sweet, sour; sight: light/dark; hearing: loud/soft; smell: pleasant, unpleasant*
	• recognise the importance of the senses in our understanding of our environment
	• identify significant organs of the nervous system *eg brain, spinal cord*
	• discuss consequences and prevention of damage to these organs *eg safety helmets, wheelchair safety.*
• the reproductive system	• recognise changes that occur at puberty
	• identify the significant parts of the human reproductive system.
• the large variety of animals in our world	• recognise animals in the school/local environment
	• recognise native animals that live in the school/local environment
	• participate as part of a team in an investigation of the characteristics of a specific animal or group of animals
	• communicate information about a specific animal or group of animals.
• unusual living things	• identify some unusual living things *eg fungi, bacteria, bread mould, mushrooms*
	• recognise that these organisms may be useful or harmful
	• identify important hygiene issues to prevent diseases *eg food storage, hand washing.*

Outcome LS.10: A student identifies some features of the Earth.	
Students learn about:	**Students learn to:**
• the surface structure of the Earth – mountains – oceans – rivers – swamps – beaches – lakes – sand dunes	• recognise the Earth as a sphere • identify the land features of the local area • participate individually or as part of a team in an investigation of the features of local landforms • communicate information about the features of a local landform • identify features of the Earth *eg using maps, pictures, interactive media, videos.*
• the composition of the surface of the Earth	• identify the different components of the Earth's surface *eg soil, rocks, sand, water, ice.*
• landforms	• participate individually or as part of a team in an investigation of a particular landform *eg volcano, lake, river, beach* • communicate information about a particular landform on Earth.
• landform change over time	• recognise that landforms change • identify why these change occur *eg weathering, erosion* • identify strategies to prevent landform erosion or repair landforms after erosion.
• soil and its composition	• identify some of the components of soil *eg particles of broken-down rock, water, air spaces, plant fragments/roots, animals* • recognise the importance of soil for plants.
• the atmosphere	• recognise the Earth is surrounded by air • recognise that changes take place in the air around us *eg temperature, humidity, wind speed, clouds, rain* • measure changes that takes place in the air in their local environment over a period of time *eg temperature, humidity, air pressure, rainfall* • communicate information about local weather changes over a period of time • recognise weather is different in different places *eg using weather maps, weather reports.*

Outcome LS.11: A student recognises some features of the solar system and beyond.	
Students learn about:	**Students learn to:**
• night and day	• recognise night and day
	• recognise that light on the Earth comes from the sun
	• recognise that the Earth turns *eg rising and setting sun*
	• recognise that it takes the Earth 24 hours to turn once.
• solar system	• participate individually or as part of a team in an investigation of some of the features of our solar system *eg using solar system software, videos, models, resources from space travel*
	• communicate information about the features of our solar system.
• the sun	• recognise the sun is in the sky
	• explore the interaction between the sun and the earth *eg shadows, seasons*.
• heat from the sun	• recognise the sun as a source of heat *eg hot in sun, cool in shade*
	• explore ways people adapt to or use the sun's heat *eg colours of clothes or cars, sporting and leisure activities, buildings, gardening, landscaping*
	• communicate information about the ways people adapt to and use the sun's heat.
• moon	• recognise the moon in the sky
	• investigate features of the moon *eg using binoculars/telescopes, software/videos, resources from space travel.*
• stars	• recognise a star
	• investigate stars and constellations and their movement *eg using software, videos, telescopes and binoculars*.
Outcome LS.12: A student observes a range of physical interactions.	
Students learn about:	**Students learn to:**
• forces	• identify a force as a push or pull
	• identify what happens when a force is applied *eg starting/stopping, changes in direction/shape*
	• communicate information about the effects of forces.
• magnetic forces	• identify a common magnet
	• recognise that magnets can be different shapes
	• investigate the properties of magnets *eg attracts iron or steel, attraction/repulsion*
	• identify uses of magnets *eg fridge magnet, toys, motors, compass (Earth as a giant magnet).*
• electrostatic forces	• identify an electrical discharge *eg lightning, car 'zaps'*
	• identify materials that can be charged electrically *eg plastic, nylon*
	• investigate the properties of electrical charges and related safety issues *eg attraction, repulsion*.

Students learn about:	**Students learn to:**
• friction	• observe that heat is generated when surfaces touch *eg tyres on roads, rubbing hands together*
	• identify some of the effects of friction *eg shoes wear out, tyres wear out*
	• identify ways of reducing friction *eg greasing, smooth surfaces.*
• gravity	• identify gravity as a downward-acting force *eg objects fall to earth*
	• investigate the effects of gravity *eg weights of objects, gravity keeps us on Earth.*
Outcome LS.13: A student observes a range of chemical interactions.	
Students learn about:	**Students learn to:**
• combustion	• recognise common things that burn *eg paper and cardboard, wood and leaves*
	• recognise highly combustible materials *eg petrol, spray cans, nail polish*
	• identify the types of energy that are produced by burning things *eg heat and light*
	• recognise that things change when they burn *eg paper to ash*
	• investigate the requirements for combustion *eg fuel, high temperature, oxygen from the air*
	• identify safety issues relating to combustion *eg prevention, storage, procedures.*
• rusting and corrosion	• recognise rust on iron materials in the school grounds or at home
	• investigate the requirements for rusting
	• identify ways to prevent rusting
	• recognise some metals corrode
	• identify examples of corrosion in metals found in the school environment or at home *eg aluminium frames, copper piping*
	• recognise that corrosion changes the appearance of a metal
	• identify ways to remove corrosion from metals *eg using sandpapers, soaking in lemon juice.*
• chemical changes	• recognise that some chemicals change when heated
	• investigate a chemical change *eg bake a cake, make bread, fizz bombs.*

Outcome LS.14: A student recognises that living things depend upon each other and on their environments.	
Students learn about:	**Students learn to:**
• food chains	• recognise that living things need food • identify living things that make their own food *eg green plants* • recognise living things that eat plants • recognise living things that eat other animals • identify living things that eat both plants and other animals • identify living things that cause dead plants and animals and their wastes to decay • participate individually or as part of a team in an investigation of a simple food chain in the local area *eg caterpillar eats tomato, magpies eat the caterpillar* • communicate information about some simple food chains • recognise that decay occurs *eg building and maintaining a compost heap.*
• natural cycles	• identify materials that are recycled within an ecosystem *eg water, oxygen/carbon dioxide.*
• investigating a local ecosystem	• participate individually or as part of a team in an investigation of a local ecosystem including: – physical factors – producers (plants) – consumers (animals) • communicate information about a local ecosystem.
Outcome LS.15: A student explores the impact of human activity on the Earth's resources.	
Students learn about:	**Students learn to:**
• natural resources	• identify some natural resources *eg rocks/minerals, water, oil* • identify the uses of some natural resources • recognise that some natural resources are non-renewable *eg coal, minerals* • recognise that some natural resources are renewable *eg trees, plant foods, sunlight.*
• the effect of human activity on the environment	• recognise that human activity affects natural resources • participate individually or as part of a team in an investigation of the effect that human activity has had on the local environment *eg mining, salinity, building, roads* • communicate information about the effect that human activity has had in the local environment.
• ways to conserve or monitor the resources of the earth	• explore ways in which people can reduce the quantity of resources used *eg recycling, water management.*

Outcome LS.16: A student describes the impact of human activity on living systems.	
Students learn about:	**Students learn to:**
• habitat destruction	• recognise that humans destroy habitats *eg building cities, farms, roads, tourist resorts.*
• the effect of human waste products on natural systems	• recognise that human activities produce waste *eg rubbish, sewage* • identify waste products in the local area *eg water runoff, industrial waste* • assess the impact of waste products in the local environment *eg visit the local sewage works, examine water quality* • explore ways in which people can reduce the impact of rubbish.
• the effect of feral and domestic animals on the native fauna and their environment	• recognise feral and domestic animals *eg foxes, cats, rabbits, carp* • identify native animals that may be affected by the introduction/presence of feral/domestic animals *eg possums, frogs, parrots* • explore ways in which native animals have been affected by feral or domestic animals in the local environment *eg loss of food sources, habitat loss* • explore ways in which individuals can lessen the impact of feral and domestic animals *eg bells on cats, providing breeding boxes.*
• the effect of noxious weeds on natural systems	• identify plants that are weeds in the local area *eg lantana, Paterson's curse* • identify ways in which weeds affect natural systems *eg native species disappear, loss of food sources* • identify ways in which individuals can reduce noxious weeds *eg proper disposal of garden waste, regeneration activities.*
• the effects of human activity on a global scale	• recognise that there are global issues affecting natural systems *eg greenhouse effect, ozone depletion.*

9 Continuum of Learning in Science K–12

Stage outcomes and stage statements illustrate the continuum of learning in the *Science Years 7–10 Syllabus*.

9.1 Stage Outcomes

While the syllabuses from Kindergarten to Year 12 may use different ways to organise the content, there are clear underpinnings of knowledge and understanding, skills, values and attitudes from one stage to another.

The continuum uses the course outcomes to map the transition from Early Stage 1 to Stage 6 in terms of the Prescribed Focus Areas, knowledge and understanding, skills and values and attitudes.

Prescribed Focus Areas

The continuum is evident across each of the stages in the ways in which students demonstrate the knowledge, understanding and skills they have developed about each Prescribed Focus Area.

PFA	Early Stage 1 – Stage 1	Stages 2–3	Stage 4	Stage 5	Stage 6: HSC
	A student:	A student:	A student:	A student:	A student:
History	appreciates contributions made by individuals, groups, cultures and communities to scientific and technological understanding	appreciates contributions made by individuals, groups, cultures and communities to scientific and technological understanding	identifies historical examples of how scientific knowledge has changed people's understanding of the world	explains how social factors influence the development and acceptance of scientific ideas	evaluates (discusses) how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking
Nature and practice	exhibits curiosity and responsiveness to scientific ideas and the gathering of evidence related to these ideas	exhibits curiosity and responsiveness to scientific ideas and the gathering of evidence related to these ideas	uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena	describes the processes that are applied to test and validate models, theories and laws	analyses the ways in which models, theories and laws in (area specified) have been tested and validated (applies the processes that have been used to test and validate models, theories and laws to investigations)
Applications and uses	initiates scientific and technological tasks and challenges and perseveres with them to their completion	initiates scientific and technological tasks and challenges and perseveres with them to their completion	identifies areas of everyday life that have been affected by scientific developments	evaluates the impact of applications of science on society and the environment	assesses the impact of particular advances in (area specified) on the development of technologies
Implications for society and the environment	shows informed commitment to improving the quality of society and the environment through science and technological activities	shows informed commitment to improving the quality of society and the environment through science and technological activities	identifies choices made by people with regard to scientific developments	discusses scientific evidence supporting different viewpoints	assesses the impact of applications of (area specified) on society and the environment
Current issues, research and developments	appreciates the significance of Australian scientific and technological expertise across gender and cultural groups exhibits curiosity and responsiveness to scientific and technological ideas and evidence	appreciates the significance of Australian scientific and technological expertise across gender and cultural groups exhibits curiosity and responsiveness to scientific and technological ideas and evidence	describes areas of current scientific research	analyses how current research might affect people's lives	identifies possible future directions of (area specified) research

Knowledge and Understanding

	Early Stage 1	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
	A student:	A student:	A student:	A student:	A student:	A student:	The outcomes of the Stage 6 in Biology, Chemistry, Earth and Environmental Science, Physics and Senior Science build upon the foundations laid in Stage 5 to extend students' knowledge and understanding in specific areas.
Models, theories and laws; Structures and systems	explores and identifies ways some forms of energy are used in their daily lives	identifies and describes different ways some forms of energy are used in the community	identifies various forms and sources of energy	identifies and applies processes involved in manipulating, using and changing the form of energy	identifies and describes energy changes and the action of forces in common situations	applies models, theories and laws to situations involving energy, force and motion	
				recognises that the Earth is the source of most materials and resources, and describes phenomena and processes, both natural and human, that form and change the Earth over time	describes observed properties of substances using scientific models and theories	relates properties of elements, compounds and mixtures to scientific models, theories and laws	
	identifies ways in which living things are different and have different needs	identifies and describes ways in which living things grow and change	identifies and describes the structure and function of living things and ways in which living things interact with other living things and their environment		describes features of living things	relates the structure and function of living things to models, theories and laws	
			identifies some of the features of the solar system and describes interactions that affect conditions on Earth	describe phenomena and processes, both natural and human that form and change the Earth over time	describes the dynamic structure of Earth and its relationship to other parts of our solar system and the universe	relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time	
	explores and identifies ways the environment influences their daily lives	identifies and describes ways in which people and other living things depend upon the Earth and its environments	identifies and describes the structure and function of living things and the ways in which living things interact with other living things and their environment	identifies, describes and evaluates the interactions between living things and their effects on the environment	identifies factors affecting survival of organisms in an ecosystem	assesses human impacts on the interaction of biotic and abiotic features of the environment	
Interactions				recognises that the Earth is the source of most materials and resources	identifies where resources are found, and describes ways in which they are used by humans	analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources	
			creates and evaluates products and services considering aesthetic and functional factors	creates and evaluates products and services, demonstrating consideration of sustainability, aesthetic, cultural, safety and functional issues	identifies, using examples, common simple devices and explains why they are used	relates the interactions involved in using some common technologies to their underlying scientific principles	

Skills

The K–12 continuum is also evident in the skills developed from Stage 1 through to Stage 6, and focuses on continually increasing students' expertise in planning and conducting investigations, communicating information and understanding, developing scientific thinking and problem-solving techniques, and working individually and in teams.

	Early Stage 1	Stage 1	Stage 2
Skill	A student:	A student:	A student:
Planning investigations	generates own ideas and designs through trial and error, play, modelling and making identifies a limited range of equipment, computer-based technology, materials and other resources when undertaking exploration	develops own design ideas in response to an investigation of needs and wants selects a range of equipment, computer-based technology, materials and other resources to undertake investigation tasks	develops ideas using drawings and models selects a range of equipment, computer-based technology, materials and other resources with developing skill to enhance investigation tasks
Conducting investigations	investigates their surroundings by observing, questioning and exploring generates own ideas through trial and error, play, modelling and making uses a limited range of equipment, computer-based technology, materials and other resources when undertaking production tasks	conducts guided investigations by observing, questioning, predicting and collecting data implements own design ideas in response to an investigation of needs and wants uses a range of equipment, computer-based technology, materials and other resources to undertake an investigation task	conducts investigations by observing, questioning, predicting, testing and collecting data implements ideas, uses drawings, models and prototypes uses a range of equipment, computer-based technology, materials and other resources to enhance investigation tasks
Communicating information and understanding	investigates their surroundings by reporting recognises and uses various means of communication	conducts guided investigations by recording data creates a range of information products and communicates using a variety of media	conducts investigations by recording and analysing data creates information products demonstrating an understanding of the needs of particular audiences
Developing scientific thinking and problem-solving techniques		conducts guided investigations by suggesting possible explanations	conducts investigations by drawing conclusions
Working individually and in teams			

	Stage 3	Stage 4	Stage 5	Stage 6: HSC
Skill	A student:	A student:	A student:	A student:
Planning investigations	conducts their own investigations based on the results of planning evaluates and selects a range of equipment, computer-based technology, materials and other resources to meet requirements and constraints of an investigation task	clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem	identifies a problem and independently produces an appropriate investigation plan	justifies the appropriateness of a particular investigation plan
Conducting investigations	conducts their own investigations based on observing, questioning, predicting, testing and collecting data uses a range of equipment, computer-based technology, materials and other resources to meet the requirements and constraints of investigation tasks	follows a sequence of instructions to undertake a first-hand investigation uses given criteria to gather first-hand data accesses information from identified secondary sources	undertakes first-hand investigations independently with safety and competence gathers first-hand data accurately accesses information from a wide variety of secondary sources	evaluates ways in which accuracy and reliability could be improved in investigations
Communicating information and understanding	conducts their own investigations based on the results of recording and analysing data creates information products and processes, demonstrating consideration of the type of media, form, audience and ethical issues	evaluates the relevance of data and information with guidance, presents information to a audience to achieve a particular purpose	explains trends, patterns and relationships in data and/or information from a variety of sources selects and uses appropriate forms of communication to present information to an audience	uses terminology and reporting styles appropriately and successfully to communicate information and understanding
Developing scientific thinking and problem-solving techniques	conducts their own investigations and makes judgements based on the results of drawing conclusions	draws conclusions based on information available uses an identified strategy to solve problems uses creativity and imagination to suggest plausible solutions to familiar problems	uses critical thinking skills in evaluating information and drawing conclusions selects and uses appropriate strategies to solve problems uses creativity and imagination in the analysis of problems and the development of possible solutions	assesses the validity of conclusions from gathered data and information
Working individually and in teams	works cooperatively with others in groups on scientific and technological tasks and challenges	undertakes a variety of individual and team tasks with guidance	plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member	explains why an investigation is best undertaken individually or by a team

Values and Attitudes

By reflecting on the past, present and future involvement of science in society, students are encouraged to develop positive values and informed critical attitudes. In Stages 1–3 the main focus is developing positive values and attitudes towards themselves and others, and towards science and technology. In Stages 4 and 5, these are broadened to include lifelong learning and the environment. Stage 6 consolidates those values and attitudes developed in earlier Stages to encourage students to justify both ethical behaviour and a desire for the critical evaluation of the consequences of applications of science.

Again, this continuum can be exemplified through the outcomes.

	Stages 1–3	Stages 4–5	Stage 6: HSC
Students will develop positive values about and attitudes towards:	A student:	A student:	A student:
themselves	demonstrates confidence in themselves and a willingness to make decisions when investigating, designing, making and using technology gains satisfaction from their efforts to investigate, to design, to make, and to use technology	demonstrates confidence and a willingness to make decisions and to take responsible actions	justifies informed values about, and attitudes towards, both the living and non-living components of the environment, ethical behaviour and a desire for critical evaluation of the consequences of the applications of science
others	works cooperatively with others in groups on scientific and technological tasks and challenges	respects differing viewpoints on science issues and is honest, fair and ethical	
learning as a lifelong process	exhibits curiosity and responsiveness to scientific and technological ideas and evidence initiates and perseveres with investigations, and takes tasks to their completion	recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life	
science and technology	appreciates contributions made by individuals, groups, cultures and communities to scientific and technological understanding appreciates the significance of Australian scientific and technological expertise across gender and cultural groups	recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them	
the environment	shows informed commitment to improving the quality of society and the environment through science and technology activities	acknowledges their responsibility to conserve, protect and maintain the environment for the future	

9.2 Stage Statements

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.

Early Stage 1
Students who have achieved Early Stage 1 show a growing awareness of, and interest in, the natural and made environment. They demonstrate confidence in proposing ideas for designs they develop through play and modelling. They demonstrate curiosity about artefacts, events, phenomena, places and living things around them.

Early Stage 1 students use play to explore ideas, manipulate materials and trial solutions. They develop and begin to refine their understanding of environments, materials, equipment and other resources through trial and error. They ask questions, suggest ideas, propose their own explanations and are able to report verbally and graphically on their actions and observations.

Students in this stage use their senses to observe features of their immediate environment and to explore the properties of a range of common materials. They identify and group living and non-living things according to some common characteristics. Students explore and identify the needs of people and other living things.

They recognise the use of some forms of energy and their ideas about energy are beginning to develop as they experience energy in different contexts.

Students generate their own ideas, using make-believe, and express these verbally, pictorially and through modelling. They are unlikely to perceive the steps in a designing and making 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 in Early Stage 1 recognise that information can come from a variety of sources, including other people and from different media, eg books and videos. They demonstrate an awareness of a range of uses for computer-based technology as well as showing an emerging confidence in their ability to explore and use computer-based technologies with assistance, to create text, images and play games.

Students show growing awareness of the appropriate use and maintenance of a range of classroom equipment. They give reasons for safe working practices and organisational procedures related to the use of equipment, resources and materials. Students develop ideas through the use and manipulation of concrete materials as a means of progressing towards abstract thought.

Stage 1

Students who have achieved 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 starting to develop the social skills required to investigate, design and make products and services.

Students are starting to appreciate the dependence of living things and their environments. They recognise that people create products, services and environments to meet their own needs. They build on their existing understanding of some of the forms of energy.

Students are able to interpret information and make predictions based on their own observations. They are better able to accept that the result of a test may be different from what was originally expected.

Students are able to recognise the purpose of an investigation and seek further information as a result of their own curiosity. They begin to see that an investigation is a series of orderly steps. They use their senses to identify similarities and differences. Students show curiosity about natural and made environments and seek explanations that allow them to interpret their observations.

Using plans, drawings and models, Stage 1 students begin to generate and select ideas to best meet design task objectives, and give simple explanations of why they have chosen a certain idea. Students in this stage can draw plans for a design and can explain some of the features and materials to be used. They can write labels and simple explanations when creating images.

Students 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, eg appearance. They make comparisons about what they like and dislike about familiar products, systems or environments.

Students effectively manipulate materials that are available in the classroom environment, and show a growing awareness of the different properties of such materials and how they affect the way in which the materials are used. They recognise that some materials occur naturally, while others are made.

Students have a developing awareness of a range of media and information products. They are able to use computer technology to start, open files or applications, save and shut down. They are able to use computer-based technologies where appropriate for a given task.

They are able to identify the different forms of technology in their immediate environments and explain how they help us. They safely use, maintain and store equipment such as scissors, magnifying glasses, computers and disks.

Stage 2

Students who have achieved 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 develop the capacity to ask questions to clarify understanding. They predict outcomes by proposing explanations and testing to see if their predicted outcomes eventuate. As students develop skills in predicting, testing, recording results and drawing conclusions, they begin to form understanding about 'fair testing' that takes into account the need for consistent conditions except for one variable, in order to ensure accurate results.

Students who have achieved Stage 2 are able to explore ideas for investigations and their design proposals in order to identify where decisions still need to be made, and to suggest possible courses of action. Students may suggest modifications to improve their initial proposals, including the selection of different solutions to arrive at a suitable outcome.

Students are able to explore the properties, capabilities and working characteristics of both natural and manufactured materials and components. They recognise that materials are varied and have different properties that affect their use. They can select, maintain and safely use classroom tools and equipment, hardware and software and justify their selection for particular tasks.

Students give consideration to issues such as function and aesthetics when designing and evaluating products, services and environments. They can identify some limitations when carrying out a design task. Students develop plans that show some consideration of the types and quantities of materials required and an awareness of the need for accuracy in a plan for production purposes.

Students recognise the function of some hardware and software and are able to select and use these to meet the requirements of a task. They can discuss the possibilities and limitations of using a range of technology including computer-based technology.

Students are developing a capacity to understand relationships in the natural world. They can identify and describe some aspects of the structure and function of living things and some of the ways living things interact. They can also identify and describe some of the interactions of the Earth with other parts of the solar system. Students in this stage devise systems that inform or utilise their understanding of some forms of energy.

Students also demonstrate a greater understanding of and control over a design process. They recognise the importance of evaluation throughout a design cycle.

Stage 3

Students who have achieved Stage 3 are able to undertake investigations independently in order to satisfy their own curiosity. They demonstrate a willingness to initiate their own investigations; this might include designing appropriate fair tests to evaluate a range of possible explanations for the results of their investigations.

Students select and use appropriate language, structures and media and demonstrate skills in critically examining and communicating scientific and technological ideas and issues. Students can relate their scientific and technological understanding to new tasks or different situations.

Students research and investigate to identify phenomena and processes that have influenced the Earth over time. They build on their existing understanding of forms of energy.

Students are aware of the skills and processes involved in designing and making, investigating and using technology. They manage the design process including aspects of time management, design constraints and needs of the target audience. At this stage, they can make decisions involving some conflicting interests or issues, eg ethical, aesthetic, environmental and cultural.

Students use two and three-dimensional drawings and models to develop and modify their design ideas and to communicate details to others. They recognise and use some conventions and symbols related to developing plans and diagrams, such as measurements and some use of scale. They can observe the form and detail of objects carefully in order to produce accurate drawings from different views and they reflect on their drawings, sketches or computer models.

Students are aware of a range of issues related to scientific and technological achievements. They are capable of acquiring information from a variety of sources and are able to experiment with new techniques and skills as technologies change.

Students identify emerging trends by using data, diagrams and a range of tools and equipment to assist with observations.

Students recognise that computer-based technologies have a wide range of applications in society and can identify and describe some of the effects of such technologies on individuals and communities. Students who have achieved Stage 3 can confidently and competently use a range of computer-based hardware and applications. Students at this stage can identify alternative uses and can be creative in adapting available software to the requirements of a task.

Students reflect on the methods used and the positive and negative results of technological and scientific activity both throughout their own projects and in personal, local and global contexts.

Stage 4

Students who have achieved Stage 4 demonstrate an awareness of the impact of science on everyday life now, and in the past. They acknowledge that science continues to be a changing body of knowledge influenced by new discoveries and different lines of research which are, in turn, influenced by societal, ethical and religious pressures.

They can describe current areas of research, particularly the contributions made by Australian scientists and how these may affect their own lives. Students can explain the need for evidence to support scientific theories and can give historical examples where this evidence has been produced or gathered. 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 these developments will affect their futures.

Students are able to describe phenomena in the world around them illustrating their descriptions with everyday examples. They can describe the features of living things and the observed properties of substances using scientific models and theories.

Students can describe the place of the Earth in the universe, the different factors that make up our environment on Earth, their functions and interactions. They can describe the usefulness of these as resources for society and the beneficial and detrimental effects of their use.

Students recognise, select and safely use a range of equipment and technologies, to accurately make observations. They form inferences from their observations, propose hypotheses and methods of exploring these. They follow sequential instructions to perform first hand investigations and understand how to work scientifically. They can suggest plausible solutions to problems and, with help, can devise their own strategies to test ideas. They can work individually and as a member of a team to develop strategies to solve a given problem.

With guidance they can identify variables to be held constant in an investigation to obtain appropriate data. They use a range of methods to present data including tables, graphs and diagrams and, based on this information, form relevant conclusions. When working with others, students recognise that different team members may have to perform different tasks and accept their individual responsibilities to meet the team’s goal.

Students can access and evaluate the relevance of information from a range of identified secondary sources. They use standard practice to acknowledge these sources of information. They utilise Information and Communication Technologies to collate information and use a range of formats to present findings to an audience.

Stage 5

Students who have achieved Stage 5 are able to discuss the impact of scientific discoveries and new technologies on everyday life and future society. They can analyse evidence, make informed decisions and justify judgements and opinions relating to scientific endeavour.

Students construct an informed view when making decisions on the use of new technologies and discoveries and when assessing the scientific claims of others. They 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.

Students discuss the need for evidence to support scientific theories and give examples where this evidence has been produced or gathered. They can use historical examples to illustrate the scientific process, highlight the role of scientific developments on the progress of society and illustrate the social, ethical and cultural influences on progress in science.

Students show an understanding of structures, systems and interactions of the physical, chemical, geological and biological world. They can apply models, theories and laws to explain phenomena, and recognise and acknowledge the limitations of each in explaining occurrences and events. Students can identify, describe and analyse the impacts of the use of resources and discuss the need for and methods of ensuring the conservation, protection and maintenance of the Earth's resources.

Students can recognise problems, use creativity to suggest solutions, propose hypotheses, design controlled investigations to test hypotheses, identify dependent and independent variables and carry out procedures to bring about an appropriate conclusion.

They can conduct these investigations safely, both independently and in teams. They make appropriate decisions on the use of a range of equipment and technologies, including Information and Communication Technologies, to collect, store and analyse data. They demonstrate accuracy and consistency in making relevant observations. They anticipate problems in investigations, evaluate procedures and modify where necessary.

Students are able to identify trends, patterns and qualitative relationships in data and process and analyse results to reach valid conclusions. They can critically analyse results and conclusions for reliability and validity. They use a variety of formats to communicate their findings and scientific understanding to an audience.

Stage 6

At the end of Stage 6, students have extended their knowledge of structures and systems to understand the fundamental concepts and interrelationships in particular branches of science. They can assess the impact that major advances have on the development of technologies, on society and on the environment.

They can critically analyse the opinions of others, and examples of scientific research from the past and present day, to make judgements on their validity. They can explain how models, theories and laws have been developed and tested as new evidence comes to light. Students can use their knowledge and can process information to predict future directions in scientific research.

Students accept that science is an ever-changing field of endeavour and recognise the positive contributions made by, and the responsibilities of, scientists to society and the environment. They can express informed opinions and display a positive attitude to the role and methods of scientific research.

Students use creativity, deductive and inductive reasoning and research to design and conduct investigations to test possible solutions to problems. Their investigations are reliable and valid and are confidently conducted individually and in teams. Students select, construct and use appropriate equipment to collect data with a high standard of accuracy. They can carry out a risk assessment to ensure the safety of themselves and others around them.

Students can analyse results giving logical conclusions and suggest future lines of investigation. They evaluate and justify their own ideas, methods and conclusions and those of recognised scientists. They can display findings from primary and secondary information in a wide range of formats and communicate their ideas succinctly. They use scientific terminology appropriately when communicating ideas.

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 learnt
- 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, 10 and 12.

Using standards to improve learning
Teachers will be able to use standards in Science as a reference point for planning teaching and learning programs, and for assessing and reporting student progress. Standards in Science will 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 in Science is designed to enhance teaching and improve learning. It is assessment that gives students opportunities to produce the work that leads to development of their knowledge, understanding and skills. *Assessment for learning* involves teachers in deciding 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 will 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
- helps students know and recognise the standards they are aiming for
- 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 in reflecting on assessment data.

Quality Assessment Practices

The following *Assessment for Learning Principles* provide the criteria for judging the quality of assessment materials and practices.

Assessment for learning:

- **emphasises the interactions between learning and manageable assessment strategies that promote learning**
  In practice, this means:
  – 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 for the student and teacher the goals of the learning activity**
  In practice, this means:
  – students 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.

- **reflects a view of learning in which assessment helps students learn better, rather than just achieve a better mark**
  In practice, this means:
  – teachers use tasks that assess, and therefore encourage, deeper learning
  – feedback is given in a way that motivates the learner and helps students to understand that mistakes are a part of learning and can lead to improvement
  – assessment is an integral component of the teaching-learning process rather than being a separate activity.

- **provides ways for students to use feedback from assessment**
  In practice, this means:
  – feedback is directed to the achievement of standards and away from comparisons with peers
  – feedback is clear and constructive about strengths and weaknesses
  – feedback is individualised and linked to opportunities for improvement.

- **helps students take responsibility for their own learning**
  In practice, this means:
  – assessment includes strategies for self-assessment and peer assessment emphasising the next steps needed for further learning.

- **is inclusive of all learners**
  In practice, this means:
  – assessment against standards provides opportunities for all learners to achieve their best
  – assessment activities are free of bias.

10.3 Reporting

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

Teachers can use evidence gathered from assessment to extend the process of *assessment for learning* into their *assessment of learning*. In a standards-referenced framework this involves teachers in making professional judgements about student achievement at key points in the learning cycle. These 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 levels of achievement for Stage 4 and Stage 5 in Science have been developed to provide schools with a useful tool to report consistent information about student achievement to students and parents, and to the next teacher to help to plan the next steps in the learning process. These describe observable and measurable features of student achievement at the end of a stage, within the indicative hours of study. Descriptions of levels of achievement provide a common language for reporting.

At Stage 5 there are six levels of achievement. Level 6 describes a very high level of achievement in relation to course objectives and outcomes. Level 2 describes satisfactory achievement, while the level 1 description will help identify students who are progressing towards the outcomes for the stage.

At the end of Year 10, teachers of Science Years 7–10 will make an on-balance judgement, based on the available assessment evidence, to match each student's achievement to a level description. This level will be reported on the student's School Certificate Record of Achievement.

At Stage 4 there are four levels of achievement. Level 4 describes a very high level of achievement; levels 2 and 3 describe satisfactory and high achievement that should provide a solid foundation for the next stage of learning. The level 1 description will help identify students who are progressing towards the outcomes for the stage.

For students undertaking Life Skills outcomes and content in Years 7–10, the content listed for each identified Life Skills outcome forms the basis of the learning opportunities for these students. It also provides examples of activities on which teachers can base judgements to report student progress in relation to individual learning goals.

10.4 Choosing Assessment Strategies

Planning for assessment is integral to programming for teaching and learning. In a standards-referenced framework, teachers assess student performance on tasks in relation to syllabus outcomes and make on-balance judgements about student achievement. Assessment relies on the professional judgement of the teacher and is based on reliable data acquired in a fair and challenging environment, from multiple performances in a variety of contexts. Assessment is fundamental for furthering student learning.

In planning programs, teachers, individually and collaboratively, review the syllabus and standards materials. They use these materials to describe for themselves what students should know and be able to do at a particular stage, and they consider the kinds of evidence their students could produce to show they have learnt what they needed to learn.

Students are provided with a description of the learning expected to be accomplished, opportunities to discuss the criteria on which judgements will be based, time to learn, and where possible, examples of what that learning looks like.

Assessment is used to determine the students' initial knowledge, understanding and skills, to monitor student progress and to collect information to report student achievement. The assessment cycle is continuous; students receive and give themselves feedback on what they have learnt, and what needs to be done to continue their learning. Students gain information about their learning through feedback from teachers and from self-assessment and peer assessment. The challenge and complexity of assessment tasks increase to enable students to develop evaluative independence as they assess their own knowledge, understanding and skills, and determine ways to improve their learning.

Teachers of Science should employ a range of assessment strategies to ensure that information is being gathered 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 planning for assessment in Science 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.

In planning for assessment, teachers of Science need to consider how results will be recorded, with a view to ensuring that there is sufficient and appropriate information collected for making an on-balance holistic judgement of the standard achieved by the student at the end of the stage. The evidence collected should enable teachers of Science to make consistent judgements to meet the various reporting requirements that the system, school and community may have.

Inquiry-based research assignments and projects
Inquiry-based research activities can involve ongoing assessment opportunities addressing a range of demands such as:
- finding 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 as atomic theory
- developing explanations or evaluations of 'cutting-edge' science such as stem cell research.

Activities might involve a range of resources including library and/or internet research. Students could then be assessed on their ability to:
- find information
- compare information sources for accuracy and relevance
- choose appropriate secondary sources and work critically with them to provide required explanations and evaluations.

The mandatory student research project 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 such as biotic and abiotic features.

Students could be assessed on their ability to:
- make and record accurate observations by describing, comparing and contrasting features
- collect and process 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:
- identify and investigate a problem
- plan and carry out a procedure safely 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.

Teamwork
Assessment might be based on:
- the choices students make in regard to roles and responsibilities to meet assessment requirements
- the approaches students take to solve problems.

Presentations
Assessment activities might include:
- presenting material which has been gathered, processed and analysed
- recounting an experimental procedure or the results obtained
- making prepared or impromptu oral presentations
- presenting role-plays
- preparing poster presentations
- making video/audio tapes and computer presentations
- presenting displays and models.

Students could be assessed on their ability to demonstrate effective use of presentation methods and technologies appropriate to an identified audience.

Peer assessment
Science encourages the active involvement of students in the learning process.

Opportunities exist for individual and collaborative work. Activities involving peer assessment might include:
- reflecting on a peer presentation
- evaluating the contribution of individuals to a group task such as practical work, field work and group research work in terms of:
  - staying on task
  - contributing constructive comments
  - suggesting improvements or areas for further study.

Self-assessment
In Science students are encouraged to acquire basic skills to become self-directed learners.

Opportunities exist for students to reflect on their progress towards the achievement of the syllabus outcomes. This reflection provides the basis for improving their learning. Developing self-assessment skills is an ongoing process, becoming increasingly more sophisticated and self-initiated as a student progresses. It can involve the use of self-paced, self-marking worksheets that give students opportunities to assess their own progress.

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.
content	The substance or subject matter of what is to be studied by students over Stages 4 and 5 in Science. This is expressed in terms of the knowledge and understanding, skills, values and attitudes of the area being studied (organised in the Domain), the emphases given (organised as Prescribed Focus Areas), and the framework within which the learning experiences take place (organised as Contexts).
context	One of the three areas of content chosen by the teacher to encourage students to participate and engage in the learning process, identify and extend connections between their learning and their experiences, increase scientific literacy, develop communication skills, and/or increase their personal and societal power in a broad range of situations.
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.
domain	The conceptual framework of knowledge and understanding, skills, values and attitudes of the area being studied, which along with contexts and prescribed focus areas, comprise the content of the *Science Years 7–10 Syllabus*.
draw conclusions	Deduce: to arrive at an opinion or judgement based on evidence.
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.
outcome	Outcome statements express the specific intended results of the teaching of the syllabus. They provide clear statements of the knowledge and understanding, skills, values and attitudes expected to be gained by most students as a result of the effective teaching and learning of Science by the end of Stages 4 and 5.
plausible accuracy	Accuracy estimated taking into consideration the evident sources of error and the limitations of the instruments used in making the measurements.
Prescribed Focus Area	One of the three areas of content that identify the different curriculum emphases or purposes. They are designed to increase students' understanding of science as an ever-developing body of knowledge, the provisional nature of scientific explanations, the complex relationship between evidence and ideas, and the impact of science on society.
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 with 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.