Year 10 Science

Australian Curriculum in Queensland

April 2013 (amended April 2015)

Queensland Government
Queensland Studies Authority
www.qsa.qld.edu.au
Queensland Studies Authority
150270

Amendments notice: April 2015

Accessing current QCAA resources

Resources referred to in this document may have been updated or replaced.

Please always check the QCAA website for the most current resources to support the implementation of the Australian Curriculum: Science: www.qcaa.qld.edu.au/13658.html.

Summary of amendments, April 2015

- Section 2.2.1 Year 10 standards elaborations
  Table 4: The Year 10 standards elaborations removed; replaced with link to updated standards elaborations on the QCAA website; subsequent tables renumbered.
- Appendix 1: Science standards elaborations terms table removed.
  Updated term definitions are available as part of the standards elaborations web documents.
- Table of contents updated.

Year 10 Science — Australian Curriculum in Queensland

Queensland Studies Authority
Level 7, 154 Melbourne Street, South Brisbane
PO Box 307 Spring Hill QLD 4004 Australia

Phone: (07) 3864 0299
Fax: (07) 3221 2553
Email: office@qsa.qld.edu.au
Website: www.qsa.qld.edu.au

Contents

1. Overview

Year 10 Science: Australian Curriculum in Queensland provides an overview of the Australian Curriculum learning area within the context of a Kindergarten to Year 12 approach. It supports teachers' capacity by providing clarity about the focus of teaching and learning and the development of assessment to determine the quality of student learning. It maintains flexibility for schools to design curriculum that suits their specific contexts and scope for school authorities and school priorities to inform practice.

This document includes:

Curriculum requirements
Rationale
Aims
Australian Curriculum content
Achievement standards
Requirements are taken directly from the Australian Curriculum: Science (v4.1) developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA). This material is presented in blue text. Links to Australian Curriculum support materials are also provided where appropriate.

Advice, guidelines and resources
Planning teaching and learning
Standards elaborations, A to E
Assessment advice and guidelines
Reporting advice and guidelines
Advice, guidelines and resources are based on the Australian Curriculum Year level descriptions and organisation sections. They have been developed by the Queensland Studies Authority (QSA) to assist teachers in their planning and assessment and include links to Queensland-developed supporting resources, exemplars and templates.

1.1 Rationale

Science provides an empirical way of answering interesting and important questions about the biological, physical and technological world. The knowledge it produces has proved to be a reliable basis for action in our personal, social and economic lives. Science is a dynamic, collaborative and creative human endeavour arising from our desire to make sense of our world through exploring the unknown, investigating universal mysteries, making predictions and solving problems. Science aims to understand a large number of observations in terms of a much smaller number of broad principles. Science knowledge is contestable and is revised, refined and extended as new evidence arises.

The Australian Curriculum: Science provides opportunities for students to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, of science's contribution to our culture and society, and its applications in our lives. The curriculum supports students to develop the scientific knowledge, understandings and skills to make informed decisions about local, national and global issues and to participate, if they so wish, in science-related careers.

In addition to its practical applications, learning science is a valuable pursuit in its own right. Students can experience the joy of scientific discovery and nurture their natural curiosity about the world around them. In doing this, they develop critical and creative thinking skills and challenge themselves to identify questions and draw evidence-based conclusions using scientific methods. The wider benefits of this "scientific literacy" are well established, including giving students the capability to investigate the natural world and changes made to it through human activity.

The science curriculum promotes six overarching ideas that highlight certain common approaches to a scientific view of the world and which can be applied to many of the areas of science understanding. These overarching ideas are patterns, order and organisation; form and function; stability and change; systems; scale and measurement; and matter and energy.

1.2 Aims

The Australian Curriculum: Science aims to ensure that students develop:

- an interest in science as a means of expanding their curiosity and willingness to explore, ask questions about and speculate on the changing world in which they live
- an understanding of the vision that science provides of the nature of living things, of the Earth and its place in the cosmos, and of the physical and chemical processes that explain the behaviour of all material things
- an understanding of the nature of scientific inquiry and the ability to use a range of scientific inquiry methods, including questioning; planning and conducting experiments and investigations based on ethical principles; collecting and analysing data; evaluating results; and drawing critical, evidence-based conclusions
- an ability to communicate scientific understanding and findings to a range of audiences, to justify ideas on the basis of evidence, and to evaluate and debate scientific arguments and claims
- an ability to solve problems and make informed, evidence-based decisions about current and future applications of science while taking into account ethical and social implications of decisions
- an understanding of historical and cultural contributions to science as well as contemporary science issues and activities and an understanding of the diversity of careers related to science
- a solid foundation of knowledge of the biological, chemical, physical, Earth and space sciences, including being able to select and integrate the scientific knowledge and methods needed to explain and predict phenomena, to apply that understanding to new situations and events, and to appreciate the dynamic nature of science knowledge.

1.3 Science in Queensland K–12

The K–12 curriculum in Queensland is aligned to the goals for Australian schooling, as expressed in the *Melbourne Declaration on Educational Goals for Young Australians*[*]. These goals are:

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

* Ministerial Council on Education, Employment, Training and Youth Affairs 2008, Melbourne Declaration on Educational Goals for Young Australians, viewed October 2012, <www.curriculum.edu.au/verve/_resources/National_Declaration_on_the_Educational_Goals_for_Young_Australians.pdf>.

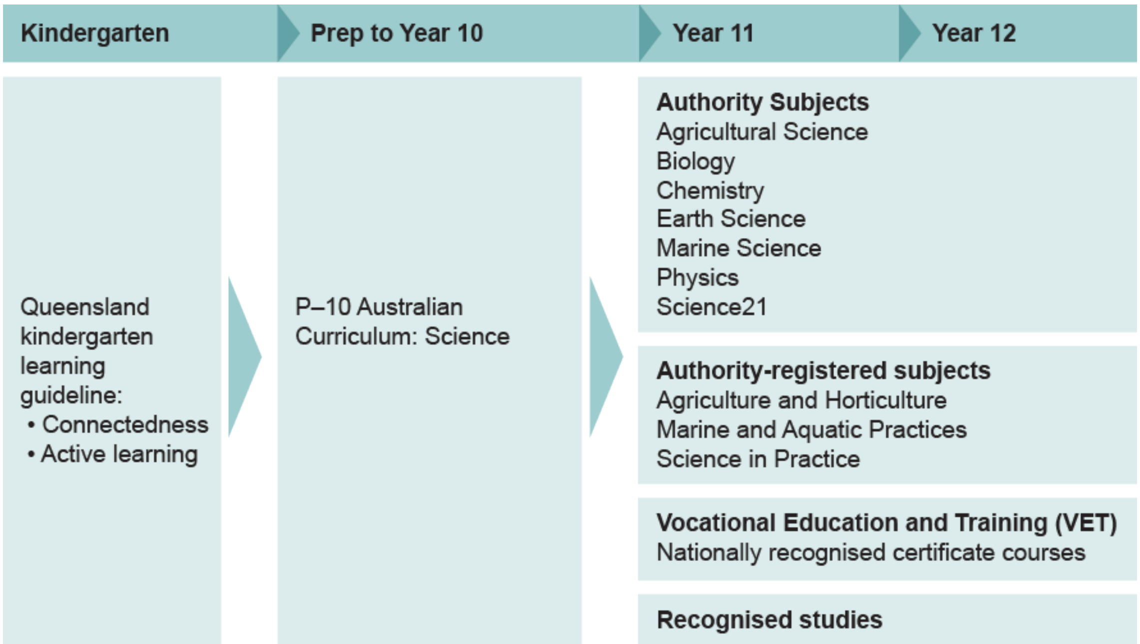
To achieve these goals, the declaration commits to the development of a world-class curriculum that will enable every student to develop:

- a solid foundation of understanding, skills and values on which further learning and adult life can be built
- deep knowledge, understanding, skills and values that will enable advanced learning and an ability to create new ideas and translate them into practical applications
- general capabilities that underpin flexible and analytical thinking, a capacity to work with others and an ability to move across subject disciplines to develop new expertise.

There is an expectation that students will have learning opportunities in Australian Curriculum: Science across P–10.

Figure 1 below shows the progression of the Science learning area K–12 in Queensland, and includes the *Queensland kindergarten learning guideline*, the Prep to Year 10 Australian Curriculum and the current Queensland senior secondary courses.

Figure 1: K–12 Science Curriculum



2. Curriculum

The Australian Curriculum sets out what all young people should be taught through the specification of curriculum content and achievement standards.

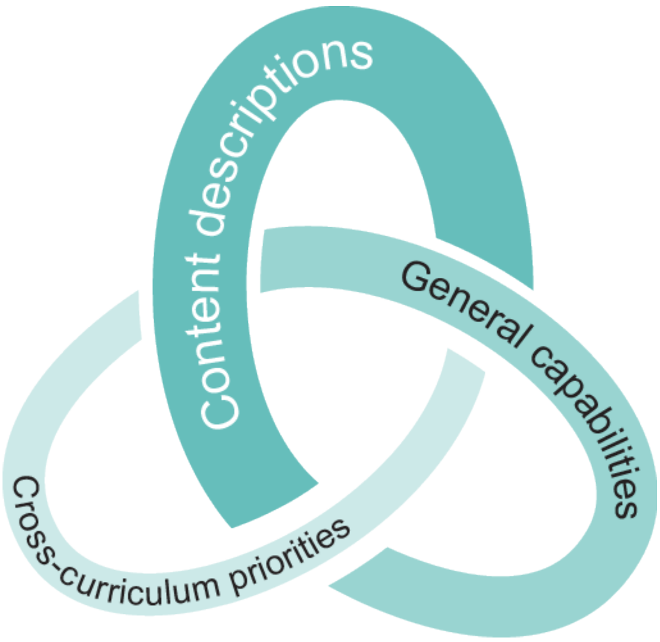
The Australian Curriculum content and achievement standards are the mandatory aspects of the Australian Curriculum.

2.1 Australian Curriculum content

The Australian Curriculum content has three components: content descriptions (section 2.1.1), general capabilities (section 2.1.2) and cross-curriculum priorities (section 2.1.3).

Schools design their programs to give students opportunities to develop their knowledge, understanding and skills in each of the three components.

Figure 2: Three components of the Australian Curriculum: Science



Content descriptions: Disciplinary learning (section 2.1.1)

The Australian Curriculum: Science content descriptions describe the knowledge, understanding and skills that teachers are expected to teach and students are expected to learn.

The content in Science is organised as:

- **strands**: Science Understanding, Science as a Human Endeavour, and Science Inquiry Skills. They describe what is to be taught and learnt
- **sub-strands**: a sequence of development for knowledge, understanding and skills across year levels and within the content strands.

Content elaborations: illustrate and exemplify content. These elaborations are not a requirement for the teaching of the Australian Curriculum.

Cross-curriculum priorities: Contemporary issues (section 2.1.3)

The three cross-curriculum priorities provide contexts for learning:

- **Aboriginal and Torres Strait Islander histories and cultures** — to gain a deeper understanding of, and appreciation for, Aboriginal and Torres Strait Islander histories and cultures and the impact they have had, and continue to have, on our world
- **Asia and Australia's engagement with Asia** — to develop a better understanding and appreciation of Australia's economic, political and cultural interconnections to Asia
- **Sustainability** — to develop an appreciation for more sustainable patterns of living, and to build capacities for thinking, valuing and acting that are necessary to create a more sustainable future.

General capabilities: Essential 21st-century skills (section 2.1.2)

These seven capabilities can be divided into two groups:

- **capabilities that support students to be successful learners** — Literacy, Numeracy, Information and communication technology (ICT) capability, and Critical and creative thinking
- **capabilities that develop ways of being, behaving and learning to live with others** — Personal and social capability, Ethical understanding and Intercultural understanding.

2.1.1 Australian Curriculum: Science Year 10 content descriptions

The content descriptions at each year level set out the knowledge, understanding, skills and processes that teachers are expected to teach and students are expected to learn. They do not prescribe approaches to teaching.

The Australian Curriculum: Science has three interrelated strands: *Science Understanding, Science as a Human Endeavour* and *Science Inquiry Skills*.

Together, the three strands of the science curriculum provide students with understanding, knowledge and skills through which they can develop a scientific view of the world. Students are challenged to explore science, its concepts, nature and uses through clearly described inquiry processes.

The content in the Science Understanding strand is described by year level. The content in the Science as a Human Endeavour and Science Inquiry Skills strands is described in two-year bands.

Each strand is organised by sub-strands that provide more detail about the content.

Table 1: Strands and sub-strands

Science Understanding	Science as a Human Endeavour	Science Inquiry Skills
Biological sciences (P–10)	Nature and development of science (P–10)	Questioning and predicting (P–10)
Chemical sciences (P–10)	Use and influence of science (1–10)	Planning and conducting (P–10)
Earth and space sciences (P–10)		Processing and analysing data and information (P–10)
Physical sciences (P–10)		Evaluating (1–10)
		Communicating (P–10)

Teaching and learning programs should integrate all three strands. (See section 2.3 Planning in the Science learning area)

Australian Curriculum: Science Year 10 strands, sub-strands and content descriptions

Science Understanding	Science as a Human Endeavour	Science Inquiry Skills
Biological sciences	**Nature and development of science**	**Questioning and predicting**
The transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184)	Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community (ACSHE191)	Formulate questions or hypotheses that can be investigated scientifically (ACSIS198)
The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence (ACSSU185)	Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE192)	**Planning and conducting**
Chemical sciences	**Use and influence of science**	Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS199)
The atomic structure and properties of elements are used to organise them in the Periodic Table (ACSSU186)	People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions (ACSHE194)	Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS200)
Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSU187)	Advances in science and emerging sciences and technologies can significantly affect people’s lives, including generating new career opportunities (ACSHE195)	**Processing and analysing data and information**
Earth and space sciences	The values and needs of contemporary society can influence the focus of scientific research (ACSHE230)	Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS203)
The universe contains features including galaxies, stars and solar systems and the Big Bang theory can be used to explain the origin of the universe (ACSSU188)		Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS204)
Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere (ACSSU189)		**Evaluating**
Physical sciences		Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS205)
Energy conservation in a system can be explained by describing energy transfers and transformations (ACSSU190)		

Science Understanding	Science as a Human Endeavour	Science Inquiry Skills
The motion of objects can be described and predicted using the laws of physics (ACSSU229)		Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems (ACSIS206)
		Communicating
		Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS208)†

Content elaborations

Content elaborations illustrate and exemplify content and assist teachers in developing a common understanding of the content descriptions. The elaborations are *not a requirement* for the teaching of the Australian Curriculum. They are not individualised teaching points intended to be taught to all students.

2.1.2 General capabilities

The general capabilities are embedded in the content descriptions. The seven capabilities can be divided into two broad groups. These broad groups include capabilities that:

- support students to be successful learners: Literacy, Numeracy, Information and communication technology (ICT) capability, and Critical and creative thinking
- develop ways of being, behaving and learning to live with others: Personal and social capability, Ethical understanding and Intercultural understanding.

Each of the general capabilities can be relevant to teaching and learning in Science and explicit teaching of the capabilities should be incorporated in teaching and learning activities where appropriate.

See also: www.australiancurriculum.edu.au/GeneralCapabilities/Overview/General-capabilities-in-the-Australian-Curriculum

† Codes included with the Australian Curriculum content descriptions relate to hyperlinks into the Australian Curriculum website <www.australiancurriculum.edu.au/Science/Curriculum/F-10>. Each unique identifier provides the user with the content description, content elaboration, and links to general capabilities, cross-curriculum priorities and modes.

Table 2: General capabilities that support students to be successful learners are embedded in the Science content descriptions where appropriate.

	Definition	In Science	Links
Literacy	Students become literate as they develop the knowledge, skills and dispositions to interpret and use language confidently for learning and communicating in and out of school and for participating effectively in society. Literacy involves students in listening to, reading, viewing, speaking, writing and creating oral, print, visual and digital texts, and using and modifying language for different purposes in a range of contexts.	Students develop literacy capability as they learn how to construct an understanding of how scientific knowledge is produced; to explore, analyse and communicate scientific information, concepts and ideas; and to plan, conduct and communicate investigations. Scientific texts that students are required to comprehend and compose include those that provide information, describe events and phenomena, recount experiments, present and evaluate data, give explanations and present opinions or claims. Language structures are used to link information and ideas, give explanations, formulate hypotheses and construct evidence-based arguments. By learning the literacy of science students understand that language varies according to context and they increase their ability to use language flexibly. Scientific vocabulary is often technical and includes specific terms for concepts and features of the world, as well as terms that encapsulate an entire process in a single word, such as 'photosynthesis'. Students learn to understand that much scientific information is presented in the form of diagrams, flow charts, tables and graphs.	ACARA Literacy capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Literacy/Introduction/Introduction QSA Literacy Indicators www.qsa.qld.edu.au/17929.html
Numeracy	Students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.	Many elements of numeracy are evident in the Science Curriculum, particularly in *Science Inquiry Skills*. These include practical measurement and the collection, representation and interpretation of data from investigations. Students are introduced to measurement, first using informal units then formal units. Later they consider issues of uncertainty and reliability in measurement. As students progress, they collect both qualitative and quantitative data, which is analysed and represented in graphical forms. Students learn data analysis skills, including identifying trends and patterns from numerical data and graphs. In later years, numeracy demands include the statistical analysis of data, including issues relating to accuracy, and linear mathematical relationships to calculate and predict values.	ACARA Numeracy capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Numeracy/Introduction/Introduction QSA Numeracy Indicators www.qsa.qld.edu.au/17929.html

	Definition	In Science	Links
ICT capability	Students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. ICT capability involves students in learning to make the most of the technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment.	Students develop ICT capability when they research science concepts and applications, investigate scientific phenomena, and communicate their scientific understandings. In particular, they employ their ICT capability to access information; collect, analyse and represent data; model and interpret concepts and relationships; and communicate science ideas, processes and information. Digital technology can be used to represent scientific phenomena in ways that improve students' understanding of concepts, ideas and information. Digital aids such as animations and simulations provide opportunities to view phenomena and test predictions that cannot be investigated through practical experiments in the classroom and may enhance students' understanding and engagement with science.	ACARA ICT capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Information-and-Communication-Technology-capability/Introduction/Introduction
Critical and creative thinking	Students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are integral to activities that require students to think broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation in all learning areas at school and in their lives beyond school.	Students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use them when seeking new pathways or solutions. In the Science learning area, critical and creative thinking are embedded in the skills of posing questions, making predictions, speculating, solving problems through investigation, making evidence-based decisions, and analysing and evaluating evidence. Students develop understandings of concepts through active inquiry that involves planning and selecting appropriate information, and evaluating sources of information to formulate conclusions. Creative thinking enables the development of ideas that are new to the individual, and this is intrinsic to the development of scientific understanding. Scientific inquiry promotes critical and creative thinking by encouraging flexibility and open-mindedness as students speculate about their observations of the world. Students' conceptual understanding becomes more sophisticated as they actively acquire an increasingly scientific view of their world.	ACARA Critical and creative thinking capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Critical-and-creative-thinking/Introduction/Introduction

Table 3: General capabilities that develop ways of being, behaving and learning to live with others are embedded in the Science content descriptions where appropriate.

	Definition	In Science	Links
Personal and social capability	Students develop personal and social capability as they learn to understand themselves and others, and manage their relationships, lives, work and learning more effectively. The personal and social capability involves students in a range of practices including recognising and regulating emotions, developing empathy for and understanding of others, establishing positive relationships, making responsible decisions, working effectively in teams and handling challenging situations constructively.	Students develop personal and social capability as they engage in science inquiry, learn how scientific knowledge informs and is applied in their daily lives, and explore how scientific debate provides a means of contributing to their communities. This includes developing skills in communication, initiative taking, goal setting, interacting with others and decision making, and the capacity to work independently and collaboratively. The Science learning area enhances personal and social capability by expanding students' capacity to question, solve problems, explore and display curiosity. Students use their scientific knowledge to make informed choices about issues that impact their lives such as health and nutrition and environmental change, and consider the application of science to meet a range of personal and social needs.	ACARA Personal and social capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Personal-and-social-capability/Introduction/Introduction

	Definition	In Science	Links
Ethical understanding	Students develop the capability to behave ethically as they identify and investigate the nature of ethical concepts, values, character traits and principles, and understand how reasoning can assist ethical judgment. Ethical understanding involves students in building a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others.	Students develop the capacity to form and make ethical judgments in relation to experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and explore and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate claims and to inform ethical decisions about a range of social, environmental and personal issues, for example, land use or the treatment of animals.	ACARA Ethical understanding capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Ethical-understanding/Introduction/Introduction
Intercultural understanding	Students develop intercultural understanding as they learn to value their own cultures, languages and beliefs, and those of others. They come to understand how personal, group and national identities are shaped, and the variable and changing nature of culture. The capability involves students in learning about and engaging with diverse cultures in ways that recognise commonalities and differences, create connections with others and cultivate mutual respect.	There are opportunities in the Science learning area to develop intercultural understanding. Students learn to appreciate the contribution that diverse cultural perspectives have made to the development, breadth and diversity of science knowledge and applications. Students become aware that the raising of some debates within culturally diverse groups requires cultural sensitivity. They recognise that increasingly scientists work in culturally diverse teams and engage with culturally diverse communities to address issues of international importance.	ACARA Intercultural understanding capability continua www.australiancurriculum.edu.au/GeneralCapabilities/Intercultural-understanding/Introduction/Introduction

2.1.3 Cross-curriculum priorities

The Australian Curriculum gives special attention to three cross-curriculum priorities about which young Australians should learn in all learning areas. The priorities provide contexts for learning. The three priorities are Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia’s engagement with Asia, and Sustainability.

Aboriginal and Torres Strait Islander histories and cultures	Asia and Australia's engagement with Asia	Sustainability
The Australian Curriculum: Science values Aboriginal and Torres Strait Islander histories and cultures. It acknowledges that Aboriginal and Torres Strait Islander Peoples have longstanding scientific knowledge traditions. Students will have opportunities to learn that Aboriginal and Torres Strait Islander Peoples have developed knowledge about the world through observation, using all the senses; through prediction and hypothesis; through testing (trial and error); and through making generalisations within specific contexts. These scientific methods have been practised and transmitted from one generation to the next. Students will develop an understanding that Aboriginal and Torres Strait Islander Peoples have particular ways of knowing the world and continue to be innovative in providing significant contributions to development in science. They will investigate examples of Aboriginal and Torres Strait Islander science and the ways traditional knowledge and western scientific knowledge can be complementary.	In the Australian Curriculum: Science, the priority of Asia and Australia’s engagement with Asia provides rich and engaging contexts for developing students’ science knowledge, understanding and skills. The Australian Curriculum: Science provides opportunities for students to recognise that people from the Asia region have made and continue to make significant contributions to the development of science understandings and their applications. It enables students to recognise that the Asia region includes diverse environments and to appreciate that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world. In this learning area, students appreciate that the Asia region plays an important role in scientific research and development. These can include research and development in areas such as medicine, natural resource management, nanotechnologies, communication technologies and natural disaster prediction and management.	In the Australian Curriculum: Science the priority of sustainability provides authentic contexts for exploring, investigating and understanding chemical, biological, physical and Earth and space systems. The Australian Curriculum: Science explores a wide range of systems that operate at different time and spatial scales. By investigating the relationships between systems and system components and how systems respond to change, students develop an appreciation for the interconnectedness of Earth’s biosphere, geosphere, hydrosphere and atmosphere, Relationships including cycles and cause and effect are explored, and students develop observation and analysis skills to examine these relationships in the world around them. In this learning area, students appreciate that science provides the basis for decision making in many areas of society and that these decisions can impact on the Earth system. They understand the importance of using science to predict possible effects of human and other activity and to develop management plans or alternative technologies that minimise these effects.
For further information and resources to support planning to include the cross-curriculum priority Aboriginal and Torres Strait Islander histories and cultures, see: www.qsa.qld.edu.au/downloads/aust_curric/ac_ccp_atsi_cultures_science.pdf	For further information and resources to support planning to include the cross-curriculum priority Asia and Australia’s engagement with Asia, see: www.asiaeducation.edu.au/aust_curr_strategy_landing_page.html	For further information and resources to support planning to include the cross-curriculum priority Sustainability, see: www.australiancurriculum.edu.au/CrossCurriculumPriorities

2.2 Achievement standards

The Australian Curriculum is standards-based.

The Australian Curriculum achievement standards are a mandatory aspect of the Australian Curriculum for schools to implement.

The Australian Curriculum achievement standards are organised as Understanding and Skills and describe a broad sequence of expected learning, across P–10. The achievement standard emphasises the depth of conceptual understanding, the sophistication of skills and the ability to apply essential knowledge students typically demonstrate *at the end of each teaching and learning year*. The achievement standard should be read in conjunction with the content descriptions.

Figure 3: By the end of Year 10, students are expected to typically know and be able to do the following:

Understanding dimension	
By the end of Year 10, students analyse how the periodic table organises elements and use it to make predictions about the properties of elements. They explain how chemical reactions are used to produce particular products and how different factors influence the rate of reactions. They explain the concept of energy conservation and represent energy transfer and transformation within systems. They apply relationships between force, mass and acceleration to predict changes in the motion of objects. Students describe and analyse interactions and cycles within and between Earth's spheres. They evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.	The Understanding dimension relates to concepts underpinning and connecting knowledge in a learning area and the ability to appropriately select and apply knowledge to solve problems in that learning area.
Skills dimension	
Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.	The Skills dimension relates to the specific techniques, strategies and processes in a learning area.

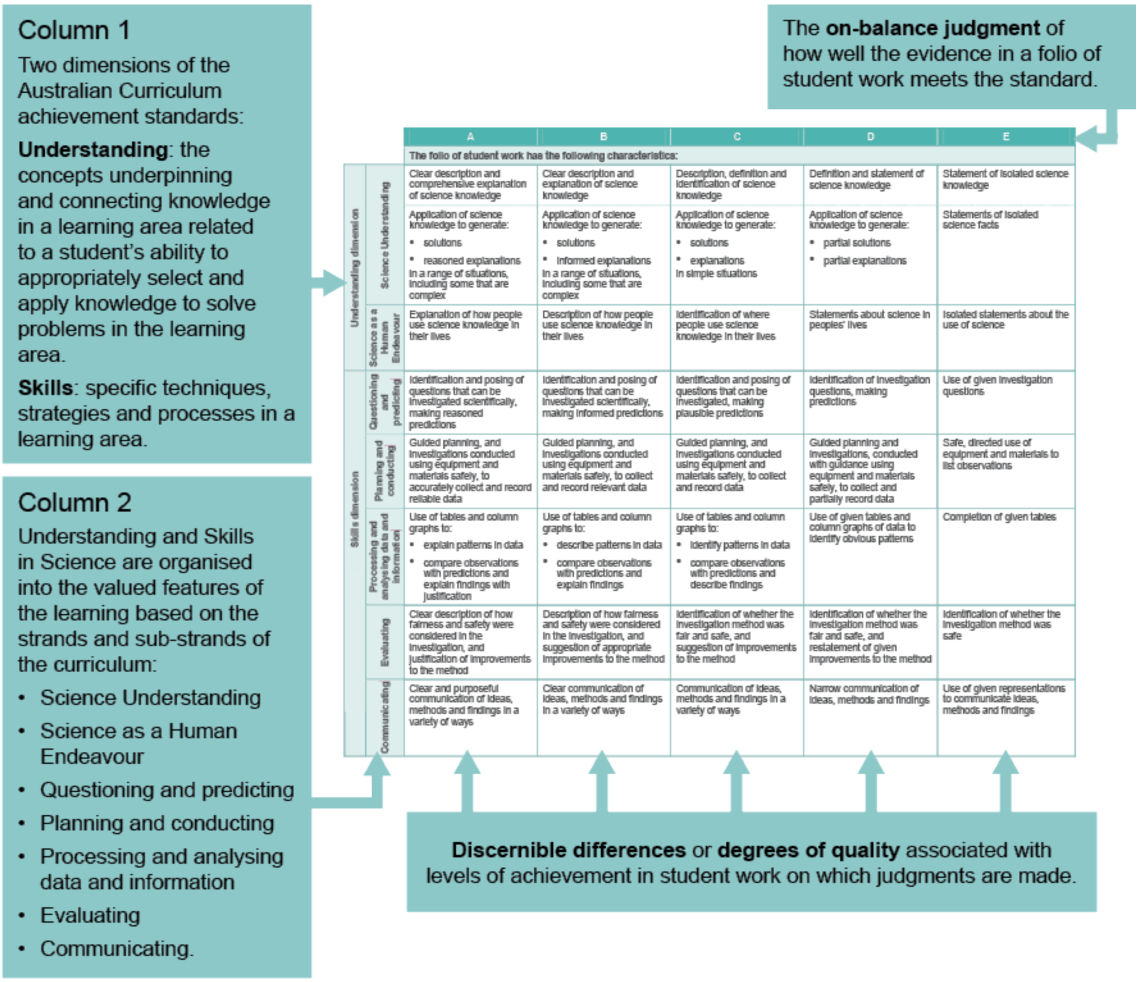
2.2.1 Year 10 standard elaborations

The Year 10 standard elaborations provide a basis for judging *how well* students have demonstrated what they know, understand and can do using the Australian Curriculum achievement standard. It is a resource to assist teachers to make consistent and comparable evidence-based A to E judgments. The standard elaborations should be used in conjunction with the Australian Curriculum achievement standard and content descriptions for the relevant year level.

Teachers can use the standard elaborations to:

- match the evidence of learning in a folio or collection of student work gathered over the reporting period to determine how well a student has achieved against the achievement standard on a five-point scale (See section 4)
- inform the development of an assessment program and individual assessments (See section 3.3)
- inform the development of task-specific standards (See sections 3.4 and 3.5)

The structure of the Science standard elaborations



		A	B	C	D	E
		The folio of student work has the following characteristics:				
Understanding dimension	Science Understanding	Clear description and comprehensive explanation of science knowledge	Clear description and explanation of science knowledge	Description, definition and identification of science knowledge	Definition and statement of science knowledge	Statement of isolated science knowledge
		Application of science knowledge to generate: • solutions • reasoned explanations in a range of situations, including some that are complex	Application of science knowledge to generate: • solutions • informed explanations in a range of situations, including some that are complex	Application of science knowledge to generate: • solutions • explanations in simple situations	Application of science knowledge to generate: • partial solutions • partial explanations	Statements of isolated science facts
	Science as a Human Endeavour	Explanation of how people use science knowledge in their lives	Description of how people use science knowledge in their lives	Identification of where people use science knowledge in their lives	Statements about science in peoples' lives	Isolated statements about the use of science
Skills dimension	Questioning and predicting	Identification and posing of questions that can be investigated scientifically, making reasoned predictions	Identification and posing of questions that can be investigated scientifically, making informed predictions	Identification and posing of questions that can be investigated, making plausible predictions	Identification of investigation questions, making predictions	Use of given investigation questions
	Planning and conducting	Guided planning, and investigations conducted using equipment and materials safely, to accurately collect and record reliable data	Guided planning, and investigations conducted using equipment and materials safely, to collect and record relevant data	Guided planning, and investigations conducted using equipment and materials safely, to collect and record data	Guided planning and investigations, conducted with guidance using equipment and materials safely, to collect and partially record data	Safe, directed use of equipment and materials to list observations
	Processing and analysing data and information	Use of tables and column graphs to: • explain patterns in data • compare observations with predictions and explain findings with justification	Use of tables and column graphs to: • describe patterns in data • compare observations with predictions and explain findings	Use of tables and column graphs to: • identify patterns in data • compare observations with predictions and describe findings	Use of given tables and column graphs of data to identify obvious patterns	Completion of given tables
	Evaluating	Clear description of how fairness and safety were considered in the investigation, and justification of improvements to the method	Description of how fairness and safety were considered in the investigation, and suggestion of appropriate improvements to the method	Identification of whether the investigation method was fair and safe, and suggestion of improvements to the method	Identification of whether the investigation method was fair and safe, and restatement of given improvements to the method	Identification of whether the investigation method was safe
	Communicating	Clear and purposeful communication of ideas, methods and findings in a variety of ways	Clear communication of ideas, methods and findings in a variety of ways	Communication of ideas, methods and findings in a variety of ways	Narrow communication of ideas, methods and findings	Use of given representations to communicate ideas, methods and findings

Amendment: April 2015

Standards elaborations have been updated and are available from the QCAA website in both Word and PDF formats: www.qcaa.qld.edu.au/27953.html.

2.3 Planning in the Science learning area

Schools plan their curriculum and assessment using the Australian Curriculum content descriptions and achievement standards.

Curriculum and assessment planning within schools occurs at three levels:

- Whole school plan
  www.qsa.qld.edu.au/downloads/p_10/ac_plan_implementing.pdf
- Year level plan / Multiple year level plan
  www.qsa.qld.edu.au/downloads/p_10/ac_p10_year_level_planning.pdf
  www.qsa.qld.edu.au/downloads/p_10/ac_p10_multi_year_level_plan.pdf
- Unit overview / Unit overview planning for multiple year levels
  www.qsa.qld.edu.au/downloads/p_10/ac_p10_unit_overview_planning.pdf
  www.qsa.qld.edu.au/downloads/p_10/ac_p10_multi_unit_overview_plan.pdf

For planning templates and Year 10 Science exemplar year and unit plans, see:
www.qsa.qld.edu.au/yr10-science-resources.html

2.3.1 Time allocation

Indicative time allocations support schools in planning teaching and learning experiences using the Australian Curriculum: Science. Schools may decide to timetable more hours for a learning area.

The indicative time allocations are presented as two sets of minimum hours per year that provide reasonable flexibility. In Year 10, the minimum number of hours for teaching, learning and assessment per year for the Australian Curriculum: Science is:

- at least 105 hours per year where there are 35 teaching weeks available in the year
- at least 114 hours per year where there are 38 teaching weeks available in the year.

See www.qsa.qld.edu.au/downloads/early_middle/ac_time_alloc_entitlement_advice.pdf

2.3.2 Principles for effective planning

The principles that underpin effective curriculum and assessment planning include:

- High expectations for all students — High student expectations are built on differentiation of teaching and learning for all students in single and multiple year-level contexts.
- Alignment of teaching and learning, and assessment and reporting — Curriculum and assessment planning is thoughtful and ensures that all parts are connected. Plans are reviewed regularly to inform future planning, teaching, learning and assessment.
- Standards- and school-based assessment for learning — Teachers use standards to build a shared understanding of the qualities found in student work, and to communicate student achievement to students, parents/carers and the system.
- Balance of informed prescription and teacher professional judgment — Teachers exercise their professional judgment and make decisions about teaching and learning in their school within the context of the Australian Curriculum and system and sector priorities.

2.3.3 Elements of effective planning for alignment

Curriculum and assessment planning is guided by five interdependent elements of professional practice. These five elements can be used in any sequence but all should be considered:

- Identify curriculum
- Develop assessment
- Sequence teaching and learning
- Make judgments
- Use feedback

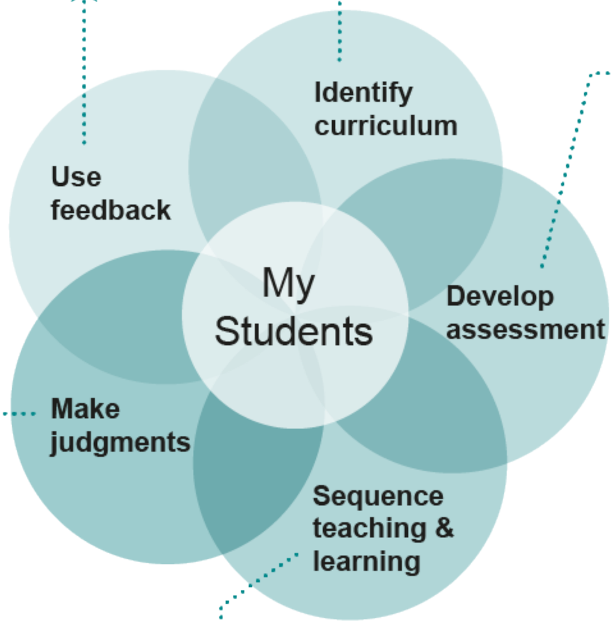
Figure 4: The five elements for effective curriculum and assessment planning

Use feedback
(sections 3.6 and 4)

Students receive regular feedback through monitoring, which provides ongoing feedback as part of the teaching and learning process. Formal feedback is provided to students and their parents/carers at the time of reporting. Teachers use feedback to inform their planning for teaching and learning.

Identify curriculum (section 2.3.4)

The Australian Curriculum content and achievement standards are the basis for planning teaching, learning and assessment.



Develop assessment
(section 3)

Assessment is an integral part of teaching and learning. The assessment provides the evidence of student learning on which judgments can be made against the achievement standard.

Make judgments
(sections 2.2, 3.5 and 4.2)

Judgment about evidence of student learning is made against the Australian Curriculum content and achievement standard. The standard elaborations assist teachers in making judgments A to E and in identifying the task-specific standards.

Sequence teaching and learning
(section 2.3.6)

The selection and sequence of learning experiences and teaching strategies support student learning of the curriculum content and work towards providing evidence of achievement through assessment.

Planning that considers these five elements strengthens alignment and ensures that:

- what is taught informs how it is taught, how students are assessed and how the learning is reported
- what is assessed relates directly to what students have had an opportunity to learn
- specific feedback, based on what has been learnt and assessed, provides a basis for decisions about continuous improvement in teaching and learning
- what is reported to students, parents/carers and other teachers aligns with what has been learnt.

2.3.4 Identifying curriculum

Year 10 Science teaching and learning programs are developed from the:

- Year 10 Australian Curriculum: Science content descriptions to:
  - determine the scope of learning and ensure all required learning is included
  - identify relevant general capabilities
  - determine appropriate contexts for teaching and learning, including the cross-curriculum priorities
- Year 10 Australian Curriculum: Science achievement standard to identify the expected and valued qualities of student work.

When planning a teaching and learning program, consider:

- What am I required to teach?
- What should students have the opportunity to learn?
- What are the expected and valued qualities of student work?

See the Science scope and sequence developed by the Australian Curriculum, Assessment and Reporting Authority available at: www.australiancurriculum.edu.au/science/Glossary.

2.3.5 Developing assessment

Assessment provides the evidence of learning. An assessment program is planned at the same time as the teaching and learning program and is developed using the content descriptions and achievement standard.

When developing assessment, consider:

- What evidence of student learning do I need to collect?
- How and when will I collect the evidence of student learning?

See section 3 for advice about developing an assessment program.

2.3.6 Sequencing teaching and learning

Learning experiences and teaching strategies are selected and sequenced to support active engagement in learning and to provide opportunities for students to engage with all aspects of the curriculum content to develop their understanding and skills.

When sequencing teaching and learning, consider:

- How will I sequence teaching strategies and learning experiences to cover the curriculum content, ensure depth of learning and support student success in the assessment?
- How do I include opportunities for all my students to learn?

Build on concepts and skills

The content descriptions are organised in strands and sub-strands in order to ensure that learning is appropriately ordered. The content in the Science Understanding strand is described by year level. The content in the Science as a Human Endeavour and Science Inquiry Skills strands is described in two-year bands. A concept or skill introduced at one year level may be revisited, strengthened and extended at later year levels as needed.

Integrate Science Understanding, Science as a Human Endeavour and Science Inquiry Skills

The Year level description provides an overview of the content to be covered. It emphasises the interrelated nature of the three strands in Science and that the strands should be taught in an integrated way.

Identify the aspects of the overarching ideas

In the Australian Curriculum: Science, six overarching ideas support the coherence and developmental sequence of science knowledge within and across year levels. The overarching ideas frame the development of concepts in the Science Understanding strand, support key aspects of the Science Inquiry Skills strand and contribute to developing students' appreciation of the nature of science.

The six overarching ideas that frame the Australian Curriculum: Science are:

1. Patterns, order and organisation

An important aspect of science is recognising patterns in the world around us, and ordering and organising phenomena at different scales. As students progress from Foundation to Year 10, they build skills and understanding that will help them to observe and describe patterns at different scales, and develop and use classifications to organise events and phenomena and make predictions. Classifying objects and events into groups (such as solid/liquid/gas or living/non-living) and developing criteria for those groupings relies on making observations and identifying patterns of similarity and difference. As students progress through the primary years, they become more proficient in identifying and describing the relationships that underpin patterns, including cause and effect. Students increasingly recognise that scale plays an important role in the observation of patterns; some patterns may only be evident at certain time and spatial scales. For example, the pattern of day and night is not evident over the time scale of an hour.

2. Form and function

Many aspects of science are concerned with the relationships between form (the nature or make-up of an aspect of an object or organism) and function (the use of that aspect). As students progress from Foundation to Year 10, they see that the functions of both living and non-living objects rely on their forms. Their understanding of forms such as the features of living things or the nature of a range of materials, and their related functions or uses, is initially based on observable behaviours and physical properties. In later years, students recognise that function frequently relies on form and that this relationship can be examined at many scales. They apply an understanding of microscopic and atomic structures, interactions of force and flows of energy and matter to describe relationships between form and function.

3. Stability and change

Many areas of science involve the recognition, description and prediction of stability and change. Early in their schooling, students recognise that in their observations of the world around them, some properties and phenomena appear to remain stable or constant over time, whereas others change. As they progress from Foundation to Year 10, they also recognise that phenomena (such as properties of objects and relationships between living things) can appear to be stable at one spatial or time scale, but at a larger or smaller scale may be seen to be changing. They begin to appreciate that stability can be the result of competing, but balanced forces. Students become increasingly adept at quantifying change through measurement and looking for patterns of change by representing and analysing data in tables or graphs.

4. Scale and measurement

Quantification of time and spatial scale is critical to the development of science understanding as it enables the comparison of observations. Students often find it difficult to work with scales that are outside their everyday experience - these include the huge distances in space, the incredibly small size of atoms and the slow processes that occur over geological time. As students progress from Foundation to Year 10, their understanding of relative sizes and rates of change develops and they are able to conceptualise events and phenomena at a wider range of scales. They progress from working with scales related to their everyday experiences and comparing events and phenomena using relative language (such as 'bigger' or 'faster') and informal measurement, to working with scales beyond human experience and quantifying magnitudes, rates of change and comparisons using formal units of measurement.

5. Matter and energy

Many aspects of science involve identifying, describing and measuring transfers of energy and/or matter. As students progress through Foundation to Year 10, they become increasingly able to explain phenomena in terms of the flow of matter and energy. Initially, students focus on direct experience and observation of phenomena and materials. They are introduced to the ways in which objects and living things change and begin to recognise the role of energy and matter in these changes. In later years, they are introduced to more abstract notions of particles, forces and energy transfer and transformation. They use these understandings to describe and model phenomena and processes involving matter and energy.

6. Systems

Science frequently involves thinking, modelling and analysing in terms of systems in order to understand, explain and predict events and phenomena. As students progress through Foundation to Year 10, they explore, describe and analyse increasingly complex systems.

Initially, students identify the observable components of a clearly identified ‘whole’ such as features of plants and animals and parts of mixtures. Over Years 3 to 6 they learn to identify and describe relationships between components within simple systems, and they begin to appreciate that components within living and non-living systems are interdependent. In Years 7 to 10 they are introduced to the processes and underlying phenomena that structure systems such as ecosystems, body systems and the carbon cycle. They recognise that within systems, interactions between components can involve forces and changes acting in opposing directions and that for a system to be in a steady state, these factors need to be in a state of balance or equilibrium. They are increasingly aware that systems can exist as components within larger systems, and that one important part of thinking about systems is identifying boundaries, inputs and outputs.

To see the sequential development of concepts from Prep to Year 10, refer to the Science scope and sequence developed by the Australian Curriculum, Assessment and Reporting Authority available at: www.australiancurriculum.edu.au/science/Glossary.

Include the general capabilities

The general capabilities are relevant to teaching and learning in Science, and explicit teaching of the capabilities should be incorporated in teaching and learning activities where appropriate. Section 2.1.2 outlines how the general capabilities are an integral part of a Science program.

Plan an inquiry-based teaching and learning program

The Science curriculum emphasises inquiry-based teaching and learning through which students conduct primary and/or secondary research. Inquiry-based learning is a process and a way of thinking and problem-solving.

Develop key inquiry questions

When developing the questions that will shape the inquiry, students need to have hands-on or observational experience with the materials or phenomenon. Questions naturally arise from every-day experiences. Questions for inquiry can be investigated or answered by conducting research.

Develop and embed meaningful contexts

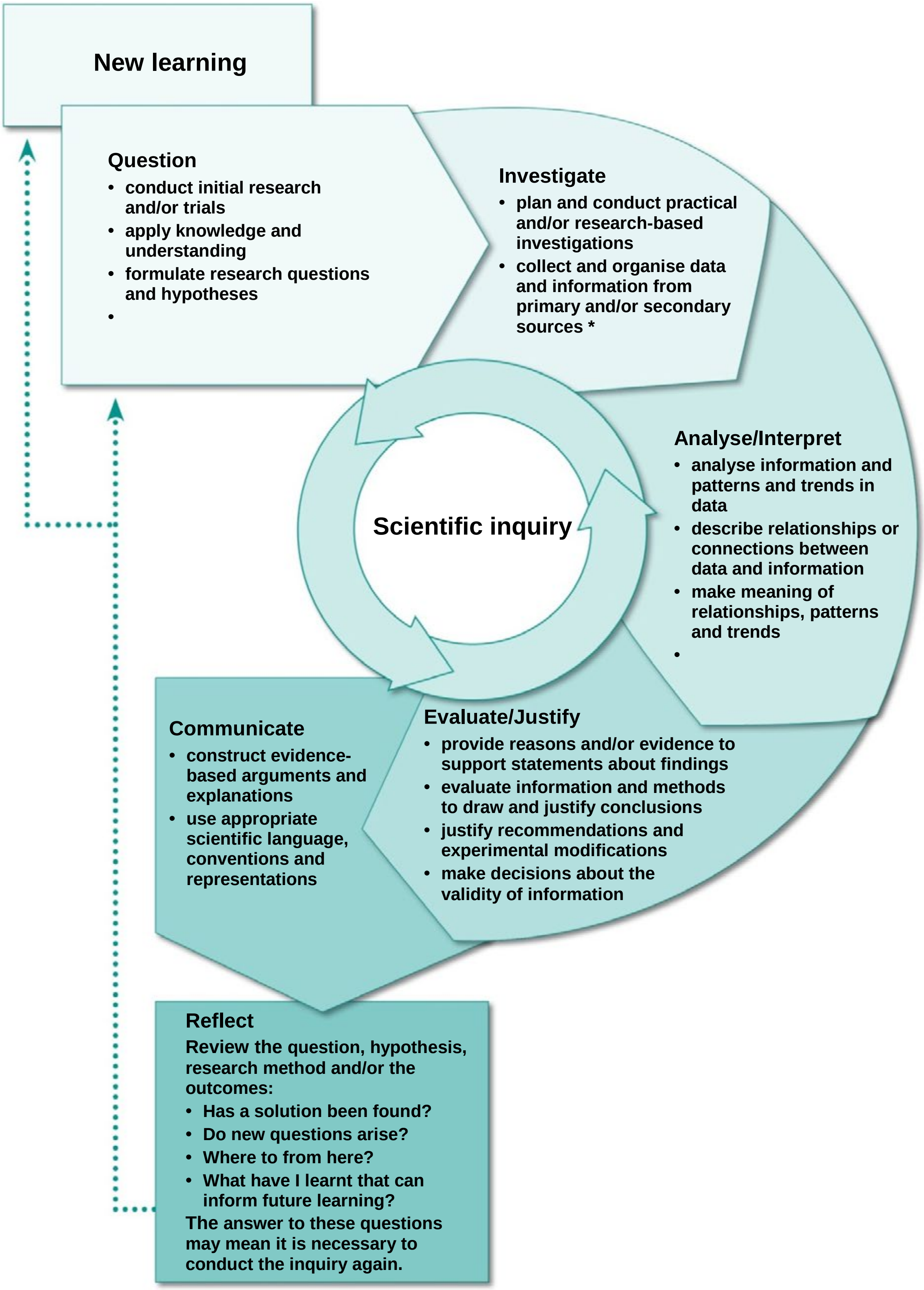
Inquiry-based programs provide students with opportunities to learn in circumstances that are relevant and interesting to them. In Science, a balanced and engaging approach to teaching will typically involve context, exploration, explanation and application. This requires a context or point of relevance through which students can make sense of the ideas they are learning.

Schools develop learning contexts to suit the content to be taught and their students' interests and learning needs. It is important to actively engage students in learning that is relevant and of interest to them. The focus or context for learning should connect with issues of personal or social relevance to students. The cross-curriculum priorities provide rich and engaging contexts and should be incorporated where appropriate. (See section 2.1.3 for information about the priorities).

Use a model for sequencing scientific inquiry

Figure 5 outlines a model for sequencing scientific inquiry. An inquiry sequence can be applied to a topic or context for investigation and link to the thinking processes and skills of Science. Using an inquiry model assists students to complete an investigation and to develop an understanding of the processes involved.

Figure 5: A model for sequencing scientific inquiry in Years 7–10



* In Science, a primary source is information created by the person or persons directly involved in a study or observing an event. A secondary source is information that has been compiled from primary sources by a person or persons not directly involved in the original study or event, e.g. texts found on websites, magazines or textbooks.

The guiding principles for teaching inquiry are:

- Effective inquiry is a skill — the inquiry approach requires explicit teaching.
- Inquiry is recursive and iterative in nature and involves reflection and critical thinking at all stages.
- There are different levels of inquiry ranging from verification (where the problem and answer are given) to open inquiry (where all of the steps are open or negotiated). The level of openness of an activity can be categorised as shown in Table 4.

Table 4: Levels of openness of inquiry‡

Level	Problem	Equipment	Procedure	Answer	Common name
0	Given	Given	Given	Given	Verification
1	Given	Given	Given	Open	Guided inquiry
2a	Given	Given	Open/Negotiated	Open	Open guided inquiry
2b	Given	Open/Negotiated	Open/Negotiated	Open	Open guided inquiry
3	Open/Negotiated	Open/Negotiated	Open/Negotiated	Open	Open inquiry

The level of openness is largely determined by the nature of the task and the context in which it is being undertaken. Students require opportunities to learn and exercise self-control. However, open investigations should not be equated with minimal guidance where learners are expected to discover or construct essential information for themselves.

‡ Adapted from Hackling, M 2005, "Working Scientifically: Implementing and assessing open investigation work in science", Western Australia Department of Education and Training, p. 2, accessed 5 Mar 2013, <www.det.wa.edu.au/education/science/teach/workingscientificallyrevised.pdf>.

2.3.7 Educational equity

Equity means fair treatment of all. In developing teaching, learning and assessment programs, teachers provide opportunities for all students to demonstrate what they know and what they can do.

See the QSA *Equity statement*:
www.qsa.qld.edu.au/downloads/approach/qsa_equity_statement.pdf

Catering for diversity

Schools and school sectors determine which students require special provisions, applying principles of participation and equity. Consideration should be given to:

- adjustments and supports for students who have been identified as having specific educational requirements to make participation possible in all or part of the teaching and learning experiences and assessments
- interpreter or educational devices (e.g. pictures, electronic whiteboards, interactive devices) to assist students for whom English is not their first language and who are assessed as not achieving a reading level appropriate to complete the assessment.

In exceptional circumstances, the school, in consultation with staff and parents/carers, may make decisions about the level of student engagement with a particular assessment, according to school sector policy.

Inclusive strategies

Adjustments to teaching, learning and assessment can be grouped into five broad areas: *timing, scheduling, setting, presentation* and *response*.

Teachers consider the inclusive strategies to make adjustments to teaching and learning experiences and assessments to enable all students to demonstrate their knowledge, skills or competencies.

The inclusive strategies should be considered in combination when planning, developing and documenting the adjustment of learning experiences and assessment. For example, when planning an assessment, the teacher may need to consider adjusting the timing, setting, presentation and response to ensure the student is given the opportunities to demonstrate their learning.

Evaluating the use and effectiveness of any adjustment is necessary to ensure meaningful student participation and achievement.

Further information and resources about inclusive strategies, see:
www.qsa.qld.edu.au/18307.html

English as an Additional Language or Dialect

Further information and resources about English as an Additional Language or Dialect, see:

- Overview and EAL/D Learning Progression
  www.acara.edu.au/verve/_resources/English_as_an_Additional_Language_or_Dialect_Teacher_Resource_05_06_12.pdf
- Annotated content descriptions: English Foundation to Year 10
  www.acara.edu.au/verve/_resources/EALD_Learning_Area_Annotations_English_Revised_06_05_12.pdf

3. Assessment

Assessment is an integral part of teaching and learning. It is the purposeful collection of evidence about students' achievements. An awareness of what learning is assessed and how it is assessed helps both students and parents/carers develop an understanding of what is valued and where to focus attention.

Assessment is used for a variety of purposes, but its most important use is in supporting student learning.

Sufficient and suitable evidence is collected to enable fair judgments to be made about student learning. Once the evidence is collected and analysed, it is summarised and presented in ways that are meaningful and useful to:

- help students achieve the highest standards they can
- promote, assist and improve teaching and learning
- build a shared understanding of the qualities of student work and communicate meaningful information about students' progress and achievements to students, teachers, parents/carers and the system.

See Appendix 2: Principles of assessment.

3.1 Standards-based assessment

The Australian Curriculum is standards-based (see section 2.2).

Teacher judgment is guided by achievement standards that are fixed reference points used to describe what is valued as important for young people to know, understand and do. The standards describe the expected qualities of student work and give a common frame of reference and a shared language to describe student achievement.

Standards-based assessment is an integral part of the teaching and learning process that is planned and ongoing.

3.2 School-based assessment

School-based assessment involves individual teachers or groups of teachers making informed decisions about what evidence of learning will be collected at suitable intervals as part of the teaching and learning program.

School-based assessment puts teachers' professional knowledge and practice at the centre of aligning what is taught, how it is taught, how student learning is assessed and how learning is reported.

3.3 Developing an assessment program

An assessment program is planned at the same time as the teaching and learning program and is developed using the achievement standard and the content descriptions.

A planned assessment program will:

- guide and support targeted teaching and learning
- ensure students have opportunities to demonstrate the depth and breadth of their learning in all aspects of the achievement standard
- provide regular feedback to students about how they can improve their learning
- clarify future teaching and learning needs
- ensure teachers have sufficient evidence of learning to make defensible on-balance judgments about the quality of students' work against the standard.

Table 5: Types and purposes of assessment that may be included in an assessment program

Diagnostic assessment	Assessment *for* learning
Provides opportunities to use assessment to determine the nature of students' learning as a basis for providing feedback or intervention, e.g. literacy and numeracy indicators	Enables teachers to use information about student progress to inform their teaching, e.g. using feedback from a previous unit to inform learning in the current unit
Formative assessment	**Assessment *as* learning**
Focuses on monitoring to improve student learning, e.g. practising an assessment technique	Enables students to reflect on and monitor their own progress to inform their future learning goals, e.g. opportunities to reflect on an inquiry process
Summative assessment	**Assessment *of* learning**
Indicates standards achieved at particular points for reporting purposes, e.g. an assessment that contributes to a reported result	Assists teachers to use evidence of student learning to assess student achievement against standards, e.g. the assessments contained in the targeted folio for reporting

The assessment program includes:

- a range and balance of assessment categories, techniques and conditions appropriate for the learning area, the year level, the school context and the student cohort
- opportunities for students to become familiar with the assessment techniques and for teachers to monitor student achievement and provide feedback to students.

For fact sheets about assessment for learning, see:

- Assessment for learning — A new perspective
  www.qsa.qld.edu.au/downloads/p_10/as_afl_new_perspective.doc
- Assessment for learning — Improving assessment pedagogy
  www.qsa.qld.edu.au/downloads/p_10/as_afl_improv_pedagogy.doc
- Assessment for learning — School improvement
  www.qsa.qld.edu.au/downloads/p_10/as_afl_school_improve.doc
- Assessment for learning — Student achievement
  www.qsa.qld.edu.au/downloads/p_10/as_afl_student_achieve.doc

- Assessment for learning — Inclusive practice
  www.qsa.qld.edu.au/downloads/p_10/as_afl_inclusive_practice.doc
- Assessment for learning — Developing student understanding
  www.qsa.qld.edu.au/downloads/p_10/as_afl_dev_stud_understand.doc

3.4 Year 10 Science assessment folio

The planned assessment program specifies the evidence of learning that is summative assessment or assessment *of* learning and when it will be collected. This collection of student responses to assessments makes up a targeted assessment folio.

The targeted assessment folio contains sufficient evidence of learning on which to make a defensible on-balance judgment A to E (or equivalent five-point scale) about how well the evidence of student learning matches the standard for the reporting period. (See section 4.2 for advice and information about making an on-balance judgment on a folio of work).

A Year 10 Science assessment folio includes student responses that demonstrate achievement in a range and balance of assessments designed to assess the identified knowledge, understandings and skills in the content and achievement standard.

Table 6: Range and balance

Range Range is informed by:	**and**	**Balance** Balance is achieved by including:
· content descriptions		· all aspects of the curriculum content across the three strands — Science Understanding, Science as a Human Endeavour and Science Inquiry Skills
· assessment categories: – written – spoken/signed – multimodal		· all aspects of the Australian Curriculum achievement standard: Understanding and Skills
· assessment techniques (section 3.4.1): – experimental investigation – research – collection of work – supervised assessment – observation record		· a variety of assessment categories, techniques and conditions.
· assessment conditions (section 3.4.2): – supervised – open.		

An example of an assessment program for Year 10 Science is in the Year 10 exemplar year plan: www.qsa.qld.edu.au/downloads/p_10/ac_science_yr10_plan.doc.

The Year 10 standard elaborations (section 2.2.1) identify the valued features in the content descriptions and the achievement standard for Australian Curriculum: Science. Teachers can use the standard elaborations to ensure their assessment program includes opportunities for students to demonstrate their achievement in *all* aspects of the curriculum content and achievement standard for the full A to E range by the end of the year.

3.4.1 Assessment techniques, formats and categories

The following table provides information and examples about assessment techniques, formats and categories for developing a range and balance within an assessment program.

Table 7: Assessment techniques, formats and categories

Technique: **Experimental investigation**	**Technique:** **Research**	**Technique:** **Collection of work**	**Technique:** **Supervised assessment**
Purpose			
This technique is used to assess students' abilities to: · experiment · generate and analyse primary data.	This technique is used to assess students' abilities to research, collect, analyse and draw conclusions about secondary data and information.	This technique is used to assess student responses to a series of focused tasks relating to a single cohesive investigative context.	This technique is used to assess student responses that are produced independently, under supervision and in a set time frame. A supervised assessment ensures there is no question about student authorship.
Description			
· Assessments are developed to investigate a hypothesis or answer practical research questions. The focus is on planning an experimental investigation and problem solving using primary data generated by the student. · Teachers can provide the research question, or it may be developed by the student. · Experiments may be conducted in the classroom, laboratory or field. · Students can develop a planned course of action and maintain a journal.	· Research includes locating and using information that goes beyond the data and information students have been given and the knowledge they currently have. · Research conventions (e.g. referencing) must be followed regardless of the presentation format. · Research responses follow an inquiry approach that aligns to the Science Inquiry Skills strand for a year level. Figure 5 outlines a model for sequencing scientific inquiry. · An observation record could be used to support the gathering of evidence in the research technique.	· A collection of work is made up of student responses to a small number of short assessments.	· Supervised assessment items are usually questions or statements that are typically unseen. · If seen, teachers must ensure the purpose of this technique is not compromised. · Stimulus materials may be used. They may be seen or unseen. · Unseen questions, statements or stimulus materials should not be copied from information or texts that students have previously been exposed to or have directly used in class.

· Experimental investigations are based on research practices. These practices include locating and using information that goes beyond the data that students have been given and the knowledge they currently have. The research process is iterative and is based on the exploration of a research question, issue or hypothesis. · Experimental investigations follow an inquiry approach that aligns to the Science Inquiry Skills strand for a year level. Figure 5 outlines a model for sequencing scientific inquiry. · All practical work must be organised with student safety in mind. Information on creating safe and healthy school environments, along with current work health and safety laws, is available at the Queensland Department of Education, Training and Employment website: http://education.qld.gov.au/health/safety/index.html Schools must ensure that their practices meet current guidelines. · An observation record could be used to support the gathering of evidence in the research technique.			

Format			
Examples of experimental investigation presentation formats include: · scientific reports · science journals · demonstrations · model building · scientific phenomena modelling · computer-generated simulations · records of investigations involving setting up, making observations and gathering and analysing data to maintain systems, e.g. aquariums, ecosystems or habitats.	Examples of research presentation formats include: · reports · multimodal presentations · interviews · debates · webcasts and podcasts · seminars and conferences · webpages.	Examples of presentation formats for a collection of work include: · labelled diagrams · written explanations · graphs and tables · flowcharts and diagrams · science journal entries · reports on short practical activities · scientific analyses of real-world scenarios · records of research data or data gathered on a field trip or industry site visit · summaries and analyses of newspaper or magazine articles from a scientific perspective · annotated bibliographies · oral, electronic or multimodal presentations.	Examples of supervised assessment presentation formats include: · questions – Items may include multiple-choice, single-word, true/false, or sentence answers. These types of questions are useful for assessing content knowledge. They are difficult to construct if trying to elicit meaningful high-order cognitive responses. · prose – Items may include response to stimulus activities that require ▪ explanations longer than one sentence ▪ ideas that are maintained, developed and justified ▪ full sentence responses and responses that may have one or several paragraphs. ▪ practical exercises and calculations ▪ construction, use, interpretation or analysis of primary or secondary data, graphs, tables or diagrams ▪ application of algorithms or demonstration of mathematical calculations and problem solving · extended written response – Items require sustained analysis and evaluation to fully answer a problem, question or hypothesis.

			– Students provide a response to a seen or unseen question or statement, or a seen or unseen sources/stimuli. – The response could be written in an analytical exposition format/genre.
Categories			
Responses can be written, spoken/signed or multimodal (integrate visual, print and/or audio features).			
Technique: Observation record			
Observation records can be used as an independent assessment technique or across all assessment techniques. They are used to record evidence of the learner's ability to use science skills and communicate scientific understanding in a task. An observation record is a collection of evidence gathered by teachers in digital and or written formats about learning in a range of contexts. Examples include: annotated work samples, anecdotes, observations, questioning, interviewing and checklists.			

3.4.2 Assessment conditions

The following table provides information and examples about assessment conditions including suggested lengths for developing a range and balance within an assessment program.

Table 8: Assessment conditions

Open conditions	Supervised conditions
Experimental investigations, research and collections of evidence can be: · undertaken individually and/or in groups · prepared in class time and/or in students' own time. **Suggested lengths:** · written responses 200–800 words* · spoken/signed or multimodal responses 3–5 minutes* **Ensuring authenticity** When using open conditions, teachers should ensure that students' work is their own, particularly where students have access to electronic resources or when they are preparing collaborative assessments. Methods teachers can use to monitor that students' work is their own include requesting that students: · submit plans and drafts of their work · produce and maintain documentation that charts the development of responses · acknowledge resources used.	Supervised assessment items will typically: · be undertaken individually · be held under test/exam conditions · allow perusal time, if required · use stimulus materials that are succinct enough to allow students to engage with them in the time provided. (If stimulus materials are lengthy, they may need to be given to students prior to the administration of the supervised assessment) · be completed in one uninterrupted supervised session or a number of supervised sessions. **Suggested lengths:** · 45–90 mins · up to 400 words*
*The length of student responses should be considered in the context of the assessment. Longer responses do not necessarily provide better quality evidence of achievement.	

3.4.3 Developing assessments

When developing assessment, teachers construct assessments that show the alignment between what has been taught (curriculum), how it is taught (pedagogy), how students are assessed and how the learning is reported. Figure 6 below shows the process of alignment.

Figure 6: Aligning assessment

What is taught — targeted curriculum (content and achievement standard)

Teachers:

- provide opportunities for students to learn the targeted content, and review and consolidate content that students may not have engaged with recently
- provide learning experiences that support the format of the assessment, modelling the assessment technique where possible. This preparation should not involve rehearsal of the actual assessment.

What is assessed

Teachers:

- identify the content and aspects of the achievement standard that will be the focus of the assessment
- identify the targeted valued features of the learning area to be assessed (See the standard elaborations that identify the valued features in the learning area).

What students are required to do in order to demonstrate what they know and can do

Teachers:

- construct the assessment and consider:
  - face validity
  - content validity
  - authenticity
  - language and layout
  - equity
- determine the conditions for the task, e.g. time and resources

What will be reported

Teachers:

- identify the task-specific standards on which judgments about evidence in student work will be made (see standard elaborations).

"Working the assessment" to confirm the alignment

The following checklist assists and supports schools with reviewing and evaluating their assessments.

Figure 7: Assessment evaluation checklist

Check the assessment for:	
Face validity The extent to which an assessment appears to assess (on face value) what it intends to assess.	· Identify the specific content descriptions and aspects of the achievement standard being assessed to determine what is being assessed. · Consider whether student responses to the assessment will provide evidence of learning for the intended curriculum.
Content validity The extent to which the assessment measures what it claims to measure (either the subject-matter content or behaviour).	· Review the assessment to determine what is valued in the assessment. · Check that it is clear what students are expected to know and be able to do to complete this assessment. · Ensure students will be able to demonstrate the full range of standards A to E in their responses to the assessment. For example, does the assessment require sufficient depth and breadth of the targeted knowledge, understanding and skills; does it encourage students to demonstrate a range of thinking skills? · Use the standard elaborations to confirm that the assessment provides opportunities for students to demonstrate their achievement in particular targeted aspects of the curriculum content and achievement standard.
Authenticity The extent to which students will find the assessment engaging.	· Use an appropriate and meaningful context to engage students. · Ensure the assessment is pitched appropriately for the year level.
Language and layout The extent to which the assessment clearly communicates to students what is needed for producing their best performance.	· Identify specific terms students are required to know and consider whether students are likely to understand the terms or not. · Check the level of language required to interpret the assessment and consider how well students will be able to understand what the assessment requires them to do. · Consider the clarity of the instructions, cues, format, diagrams, illustrations and graphics and how well they assist students to understand what they are required to do.
Equity The extent to which the assessment provides opportunities for all students to demonstrate what they know and can do.	· Check for any cultural, gender or social references and stereotypes. · List aspects of the task that might need adjusting for verified students. (See section 2.3.7.) Note that adjustments to the task should not impact on judgments made about student achievement.

Note: When students undertake assessment in a group or team, the assessment must be designed so that teachers can validly assess the work of individual students and not apply a judgment of the group processes and outcome to all individuals.

See the following:

- Designing good assessment (video)
  www.qsa.qld.edu.au/19788.html
- Assessment instrument — multiple-choice responses
  www.qsa.qld.edu.au/downloads/p_10/as_ai_multiple_choice.doc
- Scaffolding — supporting student performance
  www.qsa.qld.edu.au/downloads/p_10/as_scaffolding.doc
- Thinking like an assessor vs activity designer
  www.qsa.qld.edu.au/downloads/p_10/as_assessor_vs_designer.doc
- Sample assessments:
  www.qsa.qld.edu.au/yr10-science-resources.html

3.5 Making judgments

When making judgments about the evidence in student work, teachers are advised to use task-specific standards. Task-specific standards give teachers:

- a tool for directly matching the evidence of learning in the student response to the standards
- a focal point for discussing student responses
- a tool to help provide feedback to students.

Task-specific standards are not a checklist; rather they are a guide that:

- highlights the valued features that are being targeted in the assessment and the qualities that will inform the overall judgment
- specifies particular *targeted aspects* of the curriculum content and achievement standard — the alignment between the valued feature, the task-specific descriptor and the assessment must be obvious and strong
- clarifies the curriculum expectations for learning at each of the five grades (A–E) and shows the connections between what students are expected to know and do, and how their responses will be judged
- allows teachers to make consistent and comparable on-balance judgments about student work by matching the qualities of student responses with the descriptors
- supports evidence-based discussions to help students gain a better understanding of how they can critique their own responses and achievements and identify the qualities needed to improve
- increases the likelihood of students communicating confidently about their achievement with teachers and parents/carers and asking relevant questions about their own progress
- encourages and provides the basis for conversations among teachers, students and parents/carers about the quality of student work and curriculum expectations and related standards.

The standard elaborations (section 2.2.1) are a resource that can be used to inform the development of task-specific standards.

Task-specific standards can be prepared as a matrix or continua.

See templates with features shown for:

- Continua
  www.qsa.qld.edu.au/downloads/p_10/ac_science_tss_continua.dot
- Matrix
  www.qsa.qld.edu.au/downloads/p_10/ac_science_tss_matrix.dot

3.6 Using feedback

Feedback is defined as the process of seeking and interpreting evidence for use by students and their teachers to decide where the students are in their learning, where they need to go and how best to get there.

Feedback gathered throughout the teaching and learning cycle informs future teaching learning and assessment. Its purpose is to recognise, encourage and improve student learning.

Assessment feedback is most helpful if the specific elements of the content (knowledge, understanding and skills) are identified and specific suggestions are provided. The standard elaborations provide a resource for developing specific feedback to students about the valued features in the content and achievement standards.

Assessment alone will not contribute to improved learning. It is what teachers and students do with assessment and other available information that makes a difference.

See:

- Seeking and providing feedback
  www.qsa.qld.edu.au/downloads/p_10/as_feedback_about.doc
- About feedback
  www.qsa.qld.edu.au/downloads/p_10/as_feedback_provide.doc

4. Reporting

Schools are required to provide parents/carers with plain-language reports twice a year. In most schools, this takes place at the end of each semester. The report must:

- be readily understandable and give an accurate and objective assessment of the student's progress and achievement
- include a judgment of the student's achievement reported as A, B, C, D or E (or equivalent five-point scale), clearly defined against the Australian Curriculum achievement standards.

4.1 Reporting standards

The reporting standards are summary statements that succinctly describe typical performance at each of the five levels (A–E) for the two dimensions of the Australian Curriculum achievement standards — understanding (including knowledge) and application of skills for the purpose of reporting twice-yearly.

Table 9: Reporting standards

A	B	C	D	E
Evidence in a student's work typically demonstrates a **very high level** of knowledge and understanding of the content (facts, concepts, and procedures), and application of skills.	Evidence in a student's work typically demonstrates a **high level** of knowledge and understanding of the content (facts, concepts, and procedures), and application of skills.	Evidence in a student's work typically demonstrates a **sound level** of knowledge and understanding of the content (facts, concepts, and procedures), and application of skills.	Evidence in a student's work typically demonstrates a **limited level** of knowledge and understanding of the content (facts, concepts and procedures), and application of skills.	Evidence in a student's work typically demonstrates a **very limited level** of knowledge and understanding of the content (facts, concepts and procedures), and application of skills.

The key purpose of reporting student achievement and progress is to improve student learning. The following principles underpin reporting school-based, standards-based assessment:

- Alignment of teaching, learning, assessment and reporting: what is taught (curriculum) must inform how it is taught (pedagogy), how students are assessed (assessment) and how the learning is reported. (See section 2)
- A collection of evidence or folio of student work: summative judgments for reporting purposes are based on a planned and targeted selection of evidence of student learning collected over the reporting period. (See section 3)
- On-balance judgments: professional decisions made by teachers about the overall quality of a student's work in a range of assessments that best matches the valued features of a learning area described in the achievement standards *at the time of reporting*.

- Moderation: Making consistent judgments about students' achievements within and between schools occurs when teachers develop shared understandings of the curriculum content and achievement standards. Moderation provides students and their parents/carers with confidence that the awarded grades are an accurate judgment of achievement and that the report is meaningful, professional and consistent.

Student achievement is reported against the Australian Curriculum achievement standard for the year level they are taught.

Teachers make reasonable adjustments during the cycle of teaching, learning and assessment to support the learning of students with disabilities, for example adjustments to presentation, response, timing, scheduling and location. In most instances, the required curriculum content, achievement and reporting standards will be used for these students. (See section 2.3.7 for inclusivity materials.)

School sectors and schools make decisions following negotiation with parents/carers about the provision of modified or accelerated learning and assessment programs to meet the learning needs of some students. Reporting achievement for these students should clearly indicate the year level of the curriculum content and the achievement standards against which judgments about student achievement have been made.

Achievement in a learning area is only one source of information on student achievement and progress. Schools may report on other important aspects of student engagement at school separate from achievement in a learning area such as:

- student participation and skills in school-based extracurricular activities
- student attributes such as effort, punctuality, and social and behavioural skills
- student attendance
- other school or system priorities.

4.2 Making an on-balance judgment on a folio

By the end of the year, a planned and targeted assessment program will result in an assessment folio of evidence of students' learning (summative assessment) on which the overall standard is awarded.

The range and balance of assessment in the folio ensures there is sufficient evidence of achievement in both dimensions of the Australian Curriculum achievement standard — Understanding and Skills — to make an on-balance judgment for reporting.

An on-balance judgment involves a teacher, or a group of teachers, making a professional decision about how the pattern of evidence in the folio best matches the standards.

Figure 8: On-balance judgments

A folio of evidence of students' learning (summative assessment) on which the achievement standard is awarded.

Consider all the evidence of achievement in the folio with reference to the expected standard described in the Australian Curriculum achievement standard.

Is the pattern of evidence at the expected standard?

The pattern of evidence is at the expected standard.

The pattern of evidence is below the expected standard.

Are the characteristics in the evidence of learning best described as C or B or A?

Are the characteristics in the evidence of learning best described as D or E?

Is there an "easy-fit" or match to one of the A–E standards for all the valued features? In this case, the on-balance judgment will be obvious.

If there is uneven performance across the valued features, weigh up the contribution of each valued feature across the range and balance of the assessments and decide whether the pattern of evidence of learning is more like an A or B or C etc.

Standard elaborations assist in making an on-balance judgment by describing the characteristics of student work in a folio, A to E.

When looking at the pattern of evidence of achievement, consider:

- How well does the evidence of student learning demonstrate understanding and skills?
- What is the pattern of achievement in the valued features:
  - Science Understanding
  - Science as a Human Endeavour
  - Questioning and predicting
  - Planning and conducting
  - Processing and analysing data and information
  - Evaluating
  - Communicating?
- How well does recent evidence of student learning in understanding and skills demonstrate student progress?

An on-balance judgment does not involve averaging grades across different assessments or “ticking” every box. Rather it is a professional judgment that considers all the evidence of achievement in the folio.

The standard elaborations assist in making the on-balance decision. The elaborations describes *how well* on a five-point scale students have demonstrated what they know, understand and can do using the Australian Curriculum achievement standard. The standard elaborations assist teachers to make consistent and comparable evidence-based A to E judgments about the patterns of evidence in a folio of work. They provide transparency about how decisions about grades are made, and for conversations among teachers, students and parents/carers about the qualities in student work matched to the valued features in the curriculum expectations and the standards.

4.2.1 Making an on-balance judgment for mid-year reporting

For mid-year reporting, the on-balance judgment is based on the pattern of evidence of student achievement and progress *at the time of reporting* and in relation to what has been taught and assessed during the reporting period.

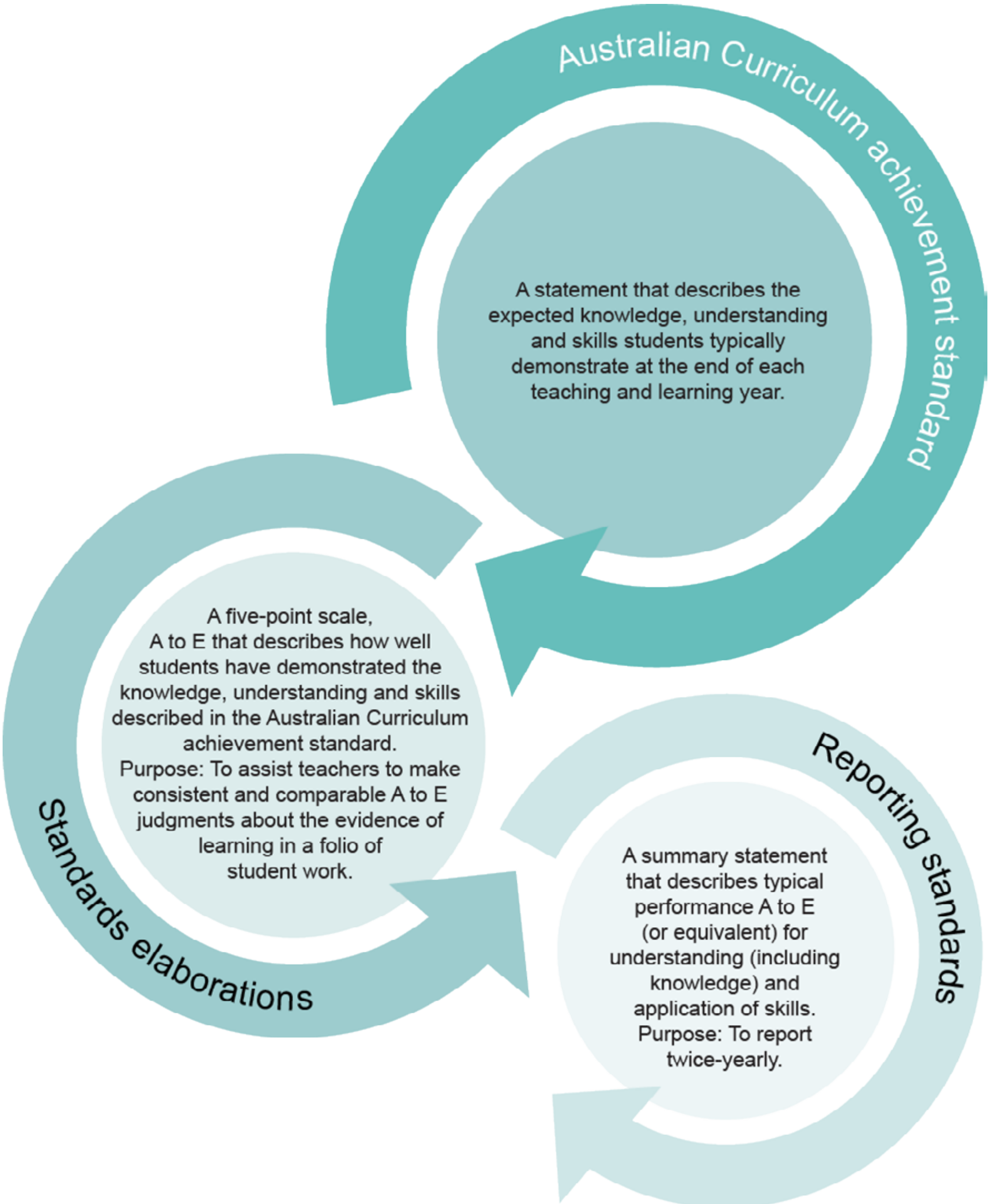
The application of the Australian Curriculum achievement standard during the year requires a judgment based on matching qualities in student work rather than checking coverage.

The standard elaborations assist in making an on-balance judgment for mid-year reporting.

The process for assessing and making judgments about student achievement may be assisted by progressively recording student achievement for each assessment on a student profile or similar.

4.2.2 Applying the Australian Curriculum achievement standards

Figure 9: The relationship between the Australian Curriculum achievement standard, standards elaborations and the reporting standards.



4.3 Moderation

The achievement standards guide teacher judgment about how well students have achieved. The most effective way to build consistent and comparable on-balance teacher judgment is through planned activities when teachers — in a partnership or team situation — engage in focused professional dialogue to discuss and analyse the quality of student work, compare their judgments about student achievement and determine the match between the evidence in student work and standards. This process is known as moderation.

Professional dialogue increases teachers' awareness about the variety of ways in which students may respond to the assessment and the types of evidence that may be available to support teacher judgments. In this way, teachers gain valuable insights about how the standards can be demonstrated in student work. They build a shared understanding about the match of evidence to standards, enhancing classroom practice and supporting the alignment of curriculum and assessment.

Moderation provides students and their parents/carers with confidence that the standards awarded are defensible judgments of achievement and that the report is meaningful, professional and consistent.

See the following fact sheets for more information:

- Consistency of judgments — Calibration model
  www.qsa.qld.edu.au/downloads/p_10/as_coj_calibration.doc
- Consistency of judgments — Conferencing model
  www.qsa.qld.edu.au/downloads/p_10/as_coj_conferencing.doc
- Consistency of judgments — Expert model
  www.qsa.qld.edu.au/downloads/p_10/as_coj_expert.doc

See also the suggested approaches to moderation in the Year level plan:
www.qsa.qld.edu.au/downloads/p_10/ac_science_yr10_plan.doc

Appendix 1: Glossary

Curriculum

For definitions of terms used by ACARA in the development of the Australian Curriculum: Science, see: www.australiancurriculum.edu.au/Science/Glossary.

Term	Description
Curriculum	The Australian Curriculum sets out what all young people should be taught through the specification of curriculum content and achievement standards. Curriculum content has three components: disciplinary learning, general capabilities and cross-curriculum priorities.
Content strand	The three strands in Science are: Science Understanding, Science as a Human Endeavour and Science Inquiry Skills. They describe what is to be taught and learnt.
Sub-strand	Each strand is organised by sub-strands to illustrate the clarity and sequence of development of concepts through and across the year levels. They support the ability to see the connections across strands and the sequential development of concepts from Foundation to Year 10.
Content elaboration	An example provided to illustrate and exemplify content. Elaborations are not a requirement for the teaching of the Australian Curriculum.

Assessment

Term	Description
Assessment	The purposeful and systematic collection of evidence about students' achievements.
Assessment task	A tool or instrument to gather evidence of students' achievement.

Appendix 2: Principles of assessment

The following principles were developed to inform the policy context of the national curriculum and provide a basis on which local decisions about specific approaches to assessment can be built.

1. The main purposes of assessment are to inform teaching, improve learning and report on the achievement of standards.
2. Assessment is underpinned by principles of equity and excellence. It takes account of the diverse needs of students and contexts of education, and the goal of promoting equity and excellence in Australian schooling.
3. Assessment is aligned with curriculum, pedagogy and reporting. Quality assessment has curricular and instructional validity — what is taught informs what is assessed, and what is assessed informs what is reported.
4. Assessment aligned with curriculum, pedagogy and reporting includes assessment of deep knowledge of core concepts within and across the disciplines, problem solving, collaboration, analysis, synthesis and critical thinking.
5. Assessment involves collecting evidence about expected learning as the basis for judgments about the achieved quality of that learning. Quality is judged with reference to published standards and is based on evidence.
6. Assessment evidence should come from a range of assessment activities. The assessment activity is selected because of its relevance to the knowledge, skills and understanding to be assessed, and the purpose of the assessment.
7. Information collected through assessment activities is sufficient and suitable to enable defensible judgments to be made. To show the depth and breadth of the student learning, evidence of student learning is compiled over time. Standards are reviewed periodically and adjusted according to evidence to facilitate continuous improvement.
8. Approaches to assessment are consistent with and responsive to local and jurisdictional policies, priorities and contexts. It is important that schools have the freedom and support to develop quality assessment practices and programs that suit their particular circumstances and those of the students they are assessing.
9. Assessment practices and reporting are transparent. It is important that there is professional and public confidence in the processes used, the information obtained and the decisions made.

Queensland Studies Authority
154 Melbourne Street, South Brisbane
PO Box 307 Spring Hill QLD 4004 Australia
T +61 7 3864 0299
F +61 7 3221 2553
www.qsa.qld.edu.au