Australian CURRICULUM Review

SCIENCE

CONSULTATION CURRICULUM

All elements 7–10

AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

acara

TABLE OF CONTENTS

F–10 AUSTRALIAN CURRICULUM: SCIENCE

ABOUT THE LEARNING AREA

Introduction

The Australian Curriculum: Science has been developed on the basis that all students will study Science from Foundation to Year 10.

Rationale

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 provides an empirical way of answering interesting and important questions about the changing world in which we live. The knowledge it produces has proved to be a reliable basis for action in our personal, social and economic lives. Science knowledge is contestable and is revised, refined and extended as new evidence arises.

The Australian Curriculum: Science gives students opportunities to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, 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 needed to make informed decisions about local, national and global issues and to participate 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 practices. 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.

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
- a solid foundation of knowledge of the biological, Earth and space, physical and chemical sciences, including being able to select and integrate the scientific knowledge and practices needed to explain and predict phenomena, to apply that understanding to new situations and events, and to appreciate the dynamic nature of scientific knowledge

- an understanding of the nature of scientific inquiry and the ability to use a range of scientific inquiry practices, 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 relationship between science and society.

Organisation of the learning area

Content structure

The Australian Curriculum: Science is presented in year levels from Foundation to Year 10.

Year level descriptions

Year level descriptions give an overview of the learning that students should experience at each year level. Year level overviews include example inquiry questions that could be used to prompt discussion; they are optional only.

Achievement standards

Achievement standards describe the expected quality of learning that students should typically demonstrate by the end of each year.

Content descriptions

Content descriptions specify the essential knowledge, understanding and skills that students are expected to learn, and teachers are expected to teach, in each year. The content descriptions are organised into strands and sub-strands.

Content elaborations

Content elaborations give teachers suggestions and illustrations of ways to teach the content descriptions. They are optional material only; they are not a set of complete or comprehensive content points that all students need to be taught. They illustrate and exemplify content descriptions with a diverse range of examples.

Strands and sub-strands

The Australian Curriculum: Science has three interrelated strands:

- Science understanding
- Science as a human endeavour
- Science inquiry.

Together, the three strands 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.

Content under each strand is further organised into sub-strands as shown in Figure 1 and Table 1.

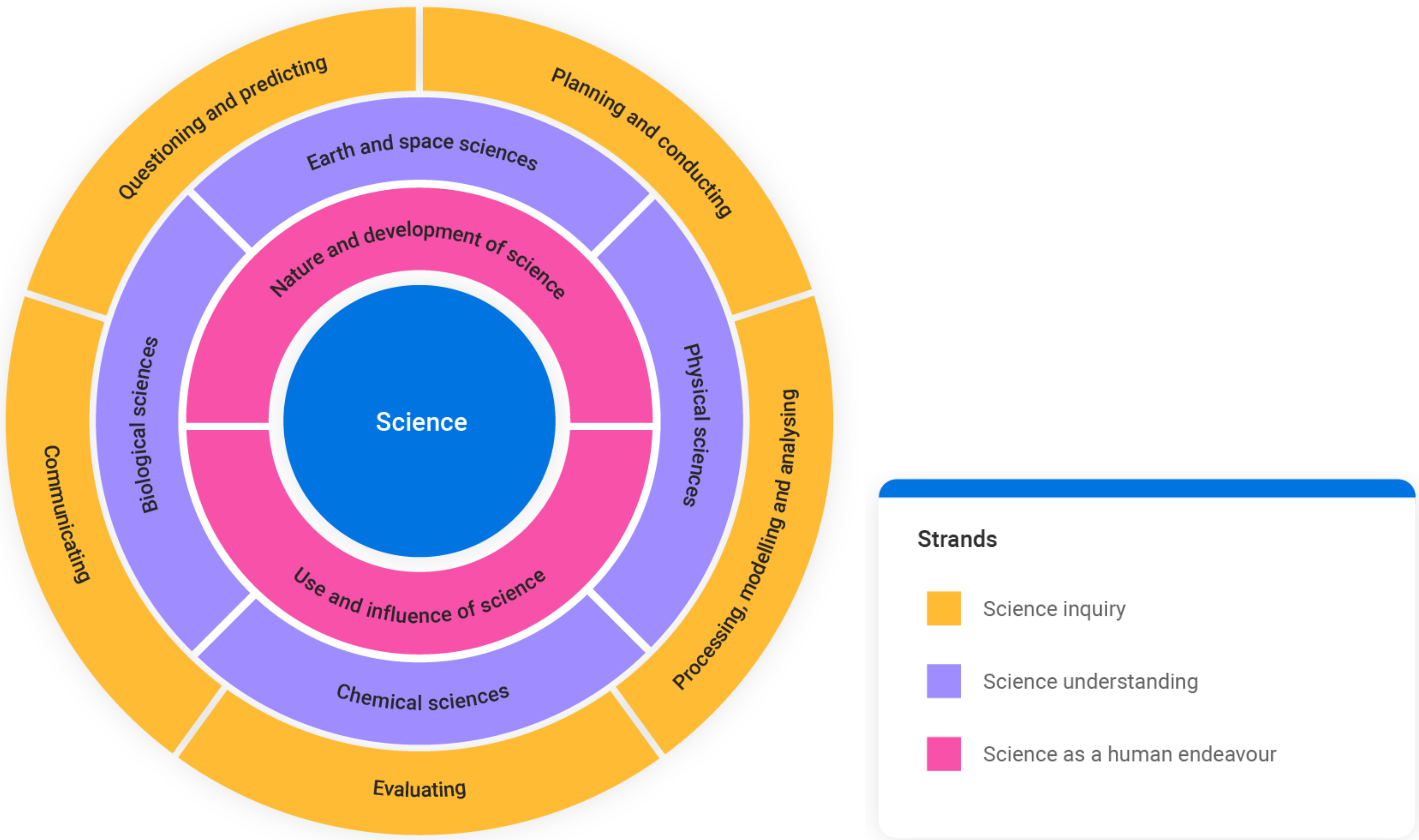

Figure 1: Science strands and sub-strands

Table 1: Relationship between strands and sub-strands

Strands	Science understanding	Science as a human endeavour	Science inquiry
Sub-strands	Biological sciences	Nature and development of science	Questioning and predicting
	Earth and space sciences	Use and influence of science	Planning and conducting
	Physical sciences		Processing, modelling and analysing
	Chemical sciences		Evaluating
			Communicating

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Science understanding

Science understanding is evident when a person selects and integrates appropriate science knowledge to explain and predict phenomena and applies that knowledge to new situations. Science knowledge refers to facts, concepts, principles, laws, theories and models that have been established by scientists over time.

Content for science understanding is described by year level. The science understanding strand comprises four sub-strands:

- **Biological sciences –** The biological sciences sub-strand is concerned with understanding living things. Students investigate living things, including animals, plants and microorganisms, and their interdependence and interactions within ecosystems. They explore their life cycles, body systems, structural adaptations and behaviours; how these features aid survival; and how their characteristics are inherited from one generation to the next.
- **Earth and space sciences** – The Earth and space sciences sub-strand is concerned with Earth's dynamic structure and its place in the cosmos. Through this sub-strand, students view Earth as part of a larger celestial system. They explore how changes on Earth such as day and night and the seasons relate to Earth's rotation and its orbit around the sun. Students investigate the processes that result in change to Earth's surface, recognising that Earth has evolved over 4.5 billion years and that the effect of some of these processes is only evident when

viewed over extremely long timescales. They explore the interactions and interdependencies of the biosphere, geosphere, atmosphere and hydrosphere and appreciate the influence of human activity on the Earth system.

- **Physical sciences** – The physical sciences sub-strand is concerned with understanding the nature of forces and motion, and matter and energy. Students gain an understanding of how an object's motion is influenced by a range of forces such as frictional, magnetic, gravitational and electrostatic forces. They develop an understanding of the concept of energy and how energy transfer is associated with phenomena involving motion, heat, sound, light and electricity. They appreciate that concepts of force, motion, matter and energy apply to systems ranging in scale from atoms to the universe itself.
- **Chemical sciences –** The chemical sciences sub-strand is concerned with understanding the composition and behaviour of substances. Students classify substances based on their properties, such as solids, liquids and gases; or their composition, such as elements, compounds and mixtures. They explore physical changes such as changes of state and dissolving and investigate how chemical reactions result in the production of new substances. Students recognise that all substances consist of atoms, and that chemical reactions involve atoms in substances being rearranged and recombined to form new substances. They explore relationships between rearrangements of atoms, properties of substances and energy.

Science as a human endeavour

Through science, humans seek to improve their understanding and explanations of the natural world. Science involves the construction of explanations based on evidence, and scientific knowledge can be changed as new evidence becomes available. Science influences society by posing and responding to social and ethical questions, and scientific research is itself influenced by the needs and priorities of society. This strand highlights the development of science as a unique way of knowing and doing, and the role of science in contemporary decision-making and problem-solving. It acknowledges that in making decisions about science practices and applications, ethical and social implications must be taken into account.

The content in the science as a human endeavour strand is described in two-year bands. The science as a human endeavour strand comprises two sub-strands:

- **Nature and development of science** – Through this sub-strand students develop an appreciation of the unique nature of science and scientific knowledge, including how science is based on empirical evidence that can be changed in light of new or reinterpreted evidence. Students learn how scientific knowledge has been revised, refined and extended over time through the individual and collaborative efforts of scientists from diverse cultures.

- **Use and influence of science –** Through this sub-strand students explore how scientific knowledge and applications affect individuals and communities, including informing their decisions and identifying responses to contemporary issues. Students learn that scientific knowledge and applications are also influenced by social, cultural and economic factors.

Science inquiry

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting evidence; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, drawing valid conclusions and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The choice of the approach taken will depend on the context and subject of the investigation.

The content in the science inquiry strand is described in two-year bands. There are five sub-strands. These are:

- **Questioning and predicting –** Students identify and construct questions, propose hypotheses and predict possible outcomes.
- **Planning and conducting –** Students make decisions regarding how to investigate or solve a problem and carry out an investigation, including the generation of data.
- **Processing, modelling and analysing –** Students represent data in meaningful and useful ways and identify trends, patterns and relationships in data.
- **Evaluating –** Students consider the quality of available evidence, and the merit or significance of a claim, proposition or conclusion with reference to that evidence.
- **Communicating –** Students convey information or ideas to others in ways appropriate to the purpose and audience.

Relationship between the strands

In the practice of science, the three strands of science understanding, science inquiry and science as a human endeavour are closely integrated; the work of scientists reflects the nature and development of science, is built around scientific inquiry and seeks to respond to and influence society's needs. Students' experiences of science at school should mirror and connect to this multifaceted view of science.

To achieve this, the three strands of the Australian Curriculum: Science should be taught in an integrated way. The content descriptions of the three strands have been written so that at each year this integration is possible. In the earlier years, the nature and development of science sub-strand within the science as a human endeavour strand focuses on how scientists engage in scientific inquiry. This enables students to make clear connections between the inquiry skills that they are learning and the work of scientists. As students progress through the curriculum they will be able to investigate how science understanding has developed, including considering some of the people and stories behind advances in science.

Students will also recognise how science understanding can be applied to their lives and the lives of others. As students develop a more sophisticated understanding of the knowledge and skills of science, they are increasingly able to appreciate the role of science in society. The content of the science understanding strand will inform students' understanding of contemporary issues such as climate change, use of resources, emerging technologies and protection of biodiversity. The importance of these areas of science can be emphasised through the content of the science as a human endeavour strand, and students can be encouraged to view contemporary science critically through aspects of the science inquiry strand; for example, by analysing, evaluating and communicating.

Core concepts

Core concepts are the big ideas, understandings, skills or processes that are central to the Science curriculum. They give clarity and direction about what content matters most in the learning area. In the curriculum development process, core concepts help identify the essential content students should learn to develop a deep and increasingly sophisticated understanding of Science across the years of schooling. They ensure content is connected within and across the strands, building in sophistication across the year levels.

In Science, the core concepts are complemented by a set of key ideas. Figure 2 gives an overview of the design of the Australian Curriculum: Science.

Figure 2: Overview of the design of the Australian Curriculum: Science

In Science, core concepts are identified for each strand, as shown in Table 2.

Table 2: Science core concepts by strand

Science core concepts		
Science understanding	**Science as a human endeavour**	**Science inquiry**
• Earth is part of an astronomical system; interactions between Earth and celestial bodies influence Earth's systems • Earth's systems are dynamic and interdependent; interactions between the systems cause continuous change over a range of scales • A diverse range of living things have evolved on Earth over hundreds of millions of years • Biological systems are interdependent and interact with each other and their environment • The form and features of living things are related to the functions that their body systems perform • The chemical and physical properties of substances are determined by their structure at a range of scales • Substances change and new substances are produced by rearranging atoms; these changes involve energy transfer and transformation • Forces affect the motion and behaviour of objects • Energy can be transferred and transformed from one form to another and is conserved within systems	• Science inquiry values curiosity, creativity, accuracy, objectivity, perseverance and scepticism • Science knowledge is a result of individual and collaborative efforts, and advances reflect historical and cultural contributions • Science knowledge is built on empirical evidence; however, all science knowledge can be changed in light of new or reinterpreted evidence • Scientific knowledge, practices and products are influenced by social, ethical and economic factors • Science, technology and engineering are interconnected; advances in one field can lead to advances in other fields • Science knowledge, balanced with ethical and social considerations, contributes to understanding complex contemporary issues and identifying responses	• Science inquiry involves making observations and predictions, asking questions, and constructing evidence-based explanations for natural and physical phenomena • Science inquiry may be undertaken to describe a phenomenon, explore relationships, test a theory or model, or design solutions • Science inquiries should be designed to systematically collect valid and reliable primary and secondary data in a safe, ethical and interculturally aware manner • Mathematical thinking underpins science practices of representing objects and events, analysing data and modelling relationships • Evaluating evidence enables development of explanations, decision-making and designed solutions • Critiquing and communicating science ideas effectively is critical to advancing science and influencing environmental, social and economic futures

Key ideas

Science core concepts are further underpinned by a set of key ideas. The key ideas support the coherence and development of science knowledge within and across year levels. They frame the development of core concepts in the science understanding strand, support key aspects of the science inquiry strand and contribute to developing students' appreciation of the nature of science in the science as a human endeavour strand.

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The key ideas are:

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 or gas, or living or 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 timescale of an hour.

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 living and non-living objects rely on their forms. Students' 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 often 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.

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. Students begin to appreciate that stability can be the result of competing but balanced forces. They become increasingly adept at quantifying change through measurement and looking for patterns of change by representing and analysing data in tables or graphs.

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 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.

Matter and energy

Many aspects of science involve identifying, describing and measuring transfers of energy and matter. As students progress through the year levels, they become increasingly able to explain phenomena in terms of the flow of matter and energy. In the early years, students focus on direct experience and observation of phenomena and materials. As they progress, they begin to connect observable phenomena with 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.

Systems

Science often involves thinking, modelling and analysing in terms of systems to understand, explain and predict events and phenomena. As students progress from 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. Across 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.

Key connections

General capabilities

In the Australian Curriculum, general capabilities equip young Australians with the knowledge, skills, behaviours and dispositions to live and work successfully. General capabilities are developed through learning area content; they are not separate learning areas, subjects or isolated skills.

Opportunities to develop general capabilities in learning area content vary. The general capabilities of most relevance and application to Science are Literacy, Numeracy, Critical and Creative Thinking, Digital literacy, Ethical Understanding and Personal and Social capability.

Literacy and numeracy are fundamental to all learning. While literacy and numeracy development is core to the curriculum in English and Mathematics, literacy and numeracy skills are required and applied in all learning areas, including Science.

General capabilities are identified in content descriptions when they are developed or applied through learning area content. They are also identified in content elaborations when they offer opportunities to add depth and richness to student learning.

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Literacy

In Science, students develop literacy capability as they explore and investigate their world. They comprehend and compose texts including those that give information; describe events and phenomena; recount experiments; present and evaluate data; give explanations; and present ideas, opinions and claims. They comprehend and compose multimodal texts such as charts, graphs, diagrams, pictures, maps, animations, models and visual media. Language structures and text structures are used to link information and ideas, give descriptions and explanations, formulate hypotheses and construct evidence-based arguments capable of expressing an informed position.

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 a ‘photosynthesis’. Language is therefore essential in providing the link between the concept itself and student understanding and assessing whether the student has understood the concept.

Numeracy

Students use and develop numeracy through investigation of science understanding concepts and application of science inquiry practices. The key ideas of science which underpin science understanding and science as a human endeavour are closely linked to numeracy through their focus on scale and measurement, and patterns, order and organisation.

Through inquiry practices, students develop numeracy through a focus on measurement and data collection. They identify patterns in data and use mathematical relationships to represent those patterns. They represent observed and secondary data using tables, displays and visualisations and interpret data to construct evidence-based conclusions and arguments. In later years, they engage in statistical analysis of data and consider issues of validity and reliability of data.

Critical and Creative Thinking

Students develop critical and creative thinking as they learn to generate and evaluate ideas and possibilities when seeking new pathways or solutions. In the Science learning area, critical and creative thinking are embedded in the skills of questioning and predicting, solving problems through planning and conducting investigations, and analysing and evaluating evidence to make decisions and draw conclusions. Students develop an understanding of science concepts through active inquiry that involves selecting appropriate information, evaluating sources of information to formulate hypotheses and reflecting on the processes used to reach evidence-based 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 and the ability to use and design new processes to solve problems and create solutions. Students' conceptual understanding becomes more sophisticated as they actively acquire an increasingly scientific view of their world and the ability to examine it from new perspectives.

Digital Literacy

Students develop digital literacy as they operate and manage digital systems and practise digital safety and wellbeing while investigating, creating and communicating. In particular, they use digital literacy to access information; collect, analyse and represent data and information; model and interpret concepts and relationships; and communicate science ideas, processes and information.

Digital tools such as animations and simulation software can support student understanding of abstract phenomena, as they give opportunities to view phenomena and test predictions that cannot be investigated through practical investigations in the classroom.

Ethical Understanding

Students develop their understanding of ethical concepts and ethical decision-making processes in relation to science investigations, codes of practice, and the use of scientific information and science applications. They learn about ethical procedures for investigating and working with people, animals, data and materials. Students use scientific information to evaluate claims and to inform ethical decisions about a range of social, environmental and personal issues. They consider their own roles as discerning citizens and learn to analyse biases and assumptions as they apply ethical concepts when making decisions in complex situations.

Personal and Social capability

Students develop self-awareness and self-management skills as they direct their own learning, plan and carry out investigations, and become independent learners who can apply science understanding and practices to make decisions. They build skills in social awareness and social management as they engage in collaborative investigations that require them to work cooperatively in teams, share resources and processes, make group decisions and show leadership. Empathy and respect are developed as students identify and learn about the diverse world views and perspectives that have informed the development of science, and the ways in which different individuals and groups may perceive scientific knowledge, advances or solutions.

Cross-curriculum priorities

Cross-curriculum priorities support the Australian Curriculum to be a relevant, contemporary and engaging curriculum that reflects regional, national and global contexts. Cross-curriculum priorities are incorporated through learning area content; they are not separate learning areas or subjects. They give opportunities to enrich the content of the learning areas where most appropriate and authentic, allowing students to engage with and better understand their world.

Opportunities to apply cross-curriculum priorities to learning area content vary. The cross-curriculum priorities of most relevance and meaning to the Science curriculum are Sustainability and Aboriginal and Torres Strait Islander Histories and Cultures.

Read more

Sustainability

In Science, the sustainability priority provides contexts for investigating and understanding biological, Earth and space, physical and chemical systems. Students explore a range of systems that operate at different time and spatial scales. By investigating the relationship 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. Students also explore how science is used to predict possible effects of human and other activity and to develop management plans or alternative technologies that minimise or mitigate these effects.

Through the lens of science as a human endeavour, students explore the relationship between science and society and the importance of understanding and considering competing viewpoints, values and interests. Students appreciate that science provides the basis for decision-making in many areas of society and that these decisions can impact the sustainability of environmental, social and economic systems.

Aboriginal and Torres Strait Islander Histories and Cultures

In Science, students will have opportunities to learn that First Nations Peoples of Australia have longstanding scientific knowledge traditions and developed knowledge about the world by making observations, using all the senses, engaging in prediction, hypothesising and testing (trial and error), and making generalisations within specific contexts such as the use of food, natural materials, navigation and sustainability of the environment.

Science provides opportunities for students to become aware that First Nations Australians have worked scientifically for millennia and continue to provide significant contributions to developments in science. Content elaborations in each strand include examples of particular First Nations Australians' science knowledges and suggestions for how students can explore cultural techniques and processes employed by First Nations Australians such as stone knapping, skin tanning, cooking methods, production of pigments and dyes, and fire lighting methods that relate to Australian Curriculum: Science. Through the exploration of the contributions of First Nations Peoples of Australia to areas such as medicine, mining, ecology, fire management, habitat restoration and water management, students can investigate the ways First Nations Australians knowledges and Western knowledges can be used in combination to advance scientific understanding and to care for Country and Place.

Science inquiry provides an opportunity for students to engage in reconciliation, respect and recognition of First Nations Peoples of Australia and their cultures through respectful approaches to field work, consultation and collaboration. Students consider ethical considerations regarding access to Country and Place, the treatment of cultural heritage sites and respect for intellectual property rights.

Learning Areas

The Australian Curriculum: Science gives opportunities to integrate and connect content to other learning areas; in particular, Mathematics, Technologies, Humanities and Social Sciences and Health and Physical Education.

Read more

Science and Mathematics

Science and Mathematics share a focus on measurement, empirical reasoning, inquiry, experimentation and investigation. In both learning areas students are introduced to measurement, first using informal units, then using formal units. Later, they consider issues of uncertainty and reliability in measurement. As students progress, they collect qualitative and quantitative data, which are analysed and represented in graphical forms. Students learn data analysis skills, including identifying trends and patterns from numerical data and graphs. In later years, students explore the use of mathematical relationships to model interactions between system components and make predictions.

Science and Technologies

Science and Technologies share a focus through the Design and Technologies sub-strand: technologies contexts, which gives students an opportunity to apply the core concepts and explanatory models they learn in Science to designed solutions. Physical sciences inform engineering principles and systems; chemical sciences inform materials and technologies specialisations, and food specialisations; and biological sciences share concepts and models with food and fibre production.

Science and Humanities and Social Sciences

Science and Humanities and Social Sciences share a focus on understanding patterns of continuity and change in the world. Humanities and Social Science subjects draw on students' scientific understandings of biological and Earth and space sciences and give students an opportunity to explore socio-scientific issues through the lens of science as a human endeavour. Science and Humanities and Social Sciences also share a focus on developing students' inquiry practices, with an emphasis on questioning and data collection and analysis to form evidence-based conclusions and arguments.

Science and Health and Physical Education

Science and Health and Physical Education share a focus on the human body and movement. In Health and Physical Education, students investigate human anatomy, movement performance in a practical context, and body responses to exercise and activity. Science approaches these topics through the lenses of biological systems and interactions of force and energy. Health and Physical Education also gives students an opportunity to explore applications of scientific concepts in ways that directly relate to their sense of self and wellbeing within their community.

Key considerations

Safety

Identifying and managing risk in Science addresses the safe use of equipment and materials as well as safe behaviours in field, classroom or laboratory contexts. It covers all necessary aspects of health, safety and injury prevention and the use of potentially dangerous materials and equipment.

Science learning experiences may involve the use of potentially hazardous substances and hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2017, in addition to relevant state or territory health and safety guidelines.

In implementing investigations involving food, care must also be taken with regard to food safety and specific food allergies that may result in anaphylactic reactions. The Australasian Society of Clinical Immunology and Allergy has published guidelines for the prevention of anaphylaxis in schools. Some states and territories have their own specific guidelines that should be followed.

When state and territory curriculum authorities integrate the Australian Curriculum into local courses, they will include more specific advice on safety. For more information about relevant guidelines, contact your state or territory curriculum authority.

Animal ethics and biosecurity

Any teaching activities that involve caring for, using or interacting with animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes 2013*, in addition to relevant state or territory guidelines. The Australian Government and state and territory governments may have extra legislation for animal ethics, protection of native animals and biosecurity that could affect how schools use animals.

When state and territory curriculum authorities integrate the Australian Curriculum into local courses, they will include specific advice on the care and use of, or interaction with, animals. Schools must ensure they are aware of and comply with all state, territory and Commonwealth legislation or regulation about the use of animals in schools. For more information about relevant guidelines or to access your animal ethics committee, contact your state or territory curriculum authority.

Australian code of practice for the care and use of animals for scientific purposes, 2013

https://www.nhmrc.gov.au/about-us/publications/australian-code-care-and-use-animals-scientific-purposes

Information correct as at 1 April 2021

Protocols for engaging with First Nations Australians

When planning teaching activities involving engagement with First Nations Australians, teachers should follow protocols that describe principles, procedures and behaviours for recognising and respecting First Nations' Australians people and their intellectual property. Teachers should use approved resources such as those provided by their state or territory school system, First Nations Australians education consultative groups or other protocols accredited by First Nations Australians.

CURRICULUM ELEMENTS

Year 7

Year level description
In Year 7 students explore the diversity of life on Earth and continue to develop their understanding of the role of classification in ordering and organising information. They use and develop models to represent and analyse the flow of energy and matter through ecosystems and explore the impact of changing components within these systems. They investigate relationships in the Earth-sun-moon system and use models to predict and explain events. They extend their understanding of the particulate nature of matter and explore how interactions of matter and energy at the sub-microscopic scale determine macroscopic properties. They consider the effects of multiple forces when explaining changes in an object’s motion. Students make accurate measurements and analyse relationships between system components. They construct and use models to test hypotheses about phenomena at scales that are difficult to study directly and use these observations and other evidence to draw conclusions. They begin to understand the relationship between science and society and appreciate the need for ethical and cultural considerations when acquiring data. Inquiry questions can help excite students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: • Which is the best system for classifying living things? • Mosquitoes are so annoying! What would the impact be if we got rid of them? • How do simple machines make our lives easier? • Why do we mix substances to create new materials? • How are the calendars we use influenced by our culture and world view?
Achievement standard
By the end of Year 7 students explain how biological diversity is ordered and organised. They represent flows of matter and energy in ecosystems and predict the effect of environmental changes. They model cycles in the Earth-sun-moon system and explain the effects of these cycles on Earth phenomena. They represent and explain the effects of forces acting on objects. They use particle theory to explain the physical properties of substances and design and explain processes to separate substances. Students describe the factors that result in scientific knowledge changing over time. They examine scientific responses to contemporary issues and describe the role of science communication. Students plan and conduct safe, reproducible investigations to test relationships or aspects of scientific models. They recognise ethical issues and identify key intercultural considerations for specific field locations or use of secondary data. They use equipment to generate and record data with precision. They construct

representations to organise and process data and information. They analyse data and information to identify patterns, trends and relationships. They identify possible sources of error in methods and identify conflicting evidence and unanswered questions when analysing conclusions and claims. They identify evidence to support their conclusions and construct arguments to support or dispute claims. They select and use text features to achieve their purpose when communicating their ideas, findings and arguments to specific audiences.

Strand / Sub-strand		Content description *Students learn to:*	Elaboration *This may involve students:*
Science understanding	Biological sciences	investigate the role of classification in ordering and organising the diversity of life on Earth and use and develop classification tools including dichotomous keys (AC9S7U01)	investigating classification systems used by First Nations Australians and how they differ with respect to approach and purpose from those used by contemporary science (AC9S7U01_E1)
			observing and identifying the similarities and differences of particular features within and between groups of organisms (AC9S7U01_E2)
			creating and modifying a dichotomous key to classify organisms into groups and groups within groups (AC9S7U01_E3)
			naming and classifying species using scientific conventions from the Linnaean hierarchical classification system, such as kingdom, phylum, class, order, family, genus, species (AC9S7U01_E4)
			considering the reasons for classifying living things, such as identification and communication (AC9S7U01_E5)
			examining how biological classification has changed over time through improvements in microscopy (AC9S7U01_E6)
			using provided dichotomous keys to identify organisms surveyed on a field trip (AC9S7U01_E7)
		investigate how models, including food webs and biomass pyramids, represent matter and energy flow in ecosystems and predict the impact of changing abiotic and biotic factors	investigating First Nations Australians’ responses to invasive species and their effect on food webs that many communities are a part of, and depend on, for produce and medicine (AC9S7U02_E1)
			investigating how First Nations Australians’ use fire-mediated chemical reactions to facilitate energy and nutrient transfer in ecosystems through the practice of firestick farming (AC9S7U02_E2)
			analysing food webs to show feeding relationships between organisms in an ecosystem and the role of microorganisms (AC9S7U02_E3)
			modelling how energy flows into and out of an ecosystem via the pathways of food webs (AC9S7U02_E4)

		on populations (AC9S7U02)	comparing and contrasting biomass pyramids from different ecosystems and exploring why some biomass pyramids are inverted (AC9S7U02_E5)
			examining how events such as seasonal changes, destruction of habitat or introduction of a species impact abiotic and biotic factors and cause changes to populations (AC9S7U02_E6)
	Earth and space sciences	investigate how cyclic changes in the relative positions of the Earth, sun and moon can be modelled and explain how these cycles cause eclipses and influence predictable phenomena on Earth, including seasons and tides (AC9S7U03)	researching First Nations Australians' oral traditions and cultural recordings of solar and lunar eclipses and investigating similarities and differences with contemporary understandings of such phenomena (AC9S7U03_E1)
			investigating First Nations Australians' calendars and how they are used to predict seasonal changes (AC9S7U03_E2)
			researching knowledges held by First Nations Australians regarding the phases of the moon and the connection between the lunar cycle and ocean tides (AC9S7U03_E3)
			using physical models or simulations to explain how Earth's tilt and position relative to the sun causes differences in light intensity on Earth's surface, resulting in seasons (AC9S7U03_E4)
			examining the effect of the gravitational attraction of the moon and the sun on Earth's oceans and describing how the relative positions of the moon and sun with respect to Earth result in tidal variations (AC9S7U03_E5)
			using physical models or simulations to describe the cyclic patterns of lunar phases and eclipses of the sun and moon (AC9S7U03_E6)
	Physical sciences	investigate and represent balanced and unbalanced forces, including gravitational force, acting on objects, and relate changes in an object's motion to its mass and the magnitude and direction of forces acting on it (AC9S7U04)	analysing the forces acting on boomerangs and how early First Peoples of Australia designed an air foil profile which allowed for multiple variations and applications (AC9S7U04_E1)
			investigating the effects of applying different forces to familiar objects (AC9S7U04_E2)
			investigating the effect of balanced and unbalanced forces on an object's motion, such as starting, stopping and changing direction (AC9S7U04_E3)
			measuring the magnitude of a force using a force meter and representing the magnitude and direction of forces acting on an object using force arrow diagrams (AC9S7U04_E4)
			investigating how gravitational force is the attractive force which pulls objects to the centre of Earth and its magnitude is related to the mass of an object (AC9S7U04_E5)
			investigating how simple machines such as levers and pulleys are used to change the magnitude of force needed to perform a task (AC9S7U04_E6)

			examining how gravity affects objects in space, including moons, planets, stars, galaxies and black holes (AC9S7U04_E7)
	Chemical sciences	investigate how particle theory describes the arrangement of particles in a substance, including the motion of and attraction between particles, and relate this to the properties of the substance (AC9S7U05)	using and constructing models, diagrams or simulations to represent changes in particle arrangement as substances change state (AC9S7U05_E1)
			relating strength of attractive forces between particles to distances between particles of the same substance in different states (AC9S7U05_E2)
			examining how the changing motion and energy of particles is affected by the amount of heat energy absorbed or released (AC9S7U05_E3)
			investigating properties of materials such as density, melting point and compressibility and explaining these in terms of particle arrangement (AC9S7U05_E4)
		investigate how particles in pure substances and mixtures can be modelled and how differences in the properties of substances can be used to separate mixtures (AC9S7U06)	investigating separation techniques used by First Nations Australians, such as hand picking, sieving, winnowing, yandying, filtering, cold-pressing and steam distilling (AC9S7U06_E1)
			using representations of particles to show the difference between samples of pure substances and mixtures and identifying examples of each (AC9S7U06_E2)
			examining different solutions and identifying the solvent and solute (AC9S7U06_E3)
			investigating and using a range of physical separation techniques such as filtration, decantation, evaporation, crystallisation, chromatography and distillation (AC9S7U06_E4)
			exploring and comparing separation methods used in a variety of situations such as in the home, recycling industries and purifying water (AC9S7U06_E5)
			examining how the physical properties of substances in mixtures, such as particle size, density or volatility, determine the separation technique used (AC9S7U06_E6)

Science as a human endeavour	Nature and development of science	investigate how new evidence or different perspectives can lead to changes in scientific knowledge (AC9S8H01)	investigating how First Nations Australians developed specific fire-based agricultural practices using observations, evidence and understandings of complex ecological relationships (AC9S8H01_E1)
			investigating how people's understanding of the nature of matter has changed over time as developments in technology have led to new evidence (AC9S8H01_E2)
			exploring how scientists are re-examining the relationships between organisms to refine the classification of species as they discover new information or interpret evidence in new ways (AC9S8H01_E3)
			researching developments in the understanding of astronomy, such as the predictions of eclipses and the calculation of the length of the solar year by Abu Abdallah Mohammad ibn Jabir ibn Sinan al-Raqqi al-Harrani al-Sabi al-Battani in the 10th century (AC9S8H01_E4)
		investigate how cultural perspectives and world views influence the development of scientific knowledge (AC9S8H02)	investigating how the land management practices of First Nations Australians inform contemporary management of the environment to protect biodiversity (AC9S8H02_E1)
			investigating how First Nations Australians' knowledges of the identification and use of medicinal and endemic plants has led to the development of new pharmaceuticals and treatments (AC9S8H02_E2)
			exploring how David Unaipon, a Ngarrindjeri man, used his knowledge of forces and motion of boomerangs to conceptualise the principle of the helicopter, the final development of which used exactly the principle he had developed (AC9S8H02_E3)
			exploring how the personal beliefs of a scientist may influence the questions they choose to pursue and how they investigate those questions, such as Richard Levins, whose political views led him to focus on population ecology, or Joseph Rotblat, a physicist who refused to work on science that might lead to development of an atomic bomb (AC9S8H02_E4)
			considering why it is important to recognise that different people in society have different perspectives on the introduction of biological controls to eradicate an invasive species (AC9S8H02_E5)
			exploring the work of Wang Zhenyi, an acclaimed female scholar of 18th-century China, including her experiments in studying lunar eclipses (AC9S8H02_E6)

	Use and Influence of science	investigate how proposed scientific responses to contemporary issues may impact on society and explore environmental, social and economic considerations (AC9S8H03)	investigating how scientific knowledge that larger reserves are better for maintaining ecosystem function might interact with competing viewpoints, values and interests for land use when planning ecological reserves (AC9S8H03_E1)
			examining how laboratory-grown meat might reduce impact on ecosystems and considering any social, ethical and economic implications of developing laboratory-grown meat for wider consumption (AC9S8H03_E2)
			examining how the use of desalination plants to produce fresh water has impacted marine ecosystems where the desalination plants are located (AC9S8H03_E3)
			discussing how scientific knowledge of the forces involved in flight has led to changes in aircraft design and any social, environmental and economic considerations of these changes (AC9S8H03_E4)
		investigate the role of science communication in informing individual viewpoints and community policies and regulations (AC9S8H04)	investigating how, through two-way approaches, First Nations Australians are communicating their knowledge and viewpoints, such as caring for Country and Place initiatives to influence related policies (AC9S8H04_E1)
			reflecting on the role of contemporary First Nations Australians astronomers and astrophysicists, such as Kirsten Banks, in promoting First Nations astronomy knowledges and understandings (AC9S8H04_E2)
			examining how science communication of endangered species has led to policies and regulations related to fishing catch and hunting limits (AC9S8H04_E3)
			exploring how Dame Jane Goodall's communication of her research resulted in changed individual viewpoints and conservation policies (AC9S8H04_E4)
			examining how global reporting on high-impact weather events such as cyclones, tidal surges and heatwaves has led to the development of warning systems and evacuation policies (AC9S8H04_E5)
			investigating how science communication of the impact of waste materials on the environment has led to the adoption of community policies for separating household waste and encouraged other recycling initiatives (AC9S8H04_E6)
Science inquiry	Questioning and predicting	develop investigable questions, observation-based predictions and hypotheses to explore scientific models, identify	consulting with First Nations Australians to clarify investigable questions based on their traditional ecological knowledge, such as predictions regarding the impact of invasive species (AC9S8I01_E1)
			discussing the features of investigable and non-investigable questions, including consideration of school and web-based resources available, and examining their own and others' questions (AC9S8I01_E2)
			discussing the relationship between a prediction and a hypothesis, identifying essential elements of a hypothesis and using a provided scaffold to develop hypotheses (AC9S8I01_E3)

		patterns or test relationships (AC9S8I01)	developing questions to test relationships, such as: 'Why does the volume of a balloon change as it is heated and cooled? What happens to the height of the tide at different points of the lunar cycle?' (AC9S8I01_E4)
			developing questions to explore scientific models, such as: 'How does particle theory explain the properties of substances? How does the shape of a biomass pyramid change in response to ecosystem disruption?' (AC9S8I01_E5)
			formulating hypotheses such as: 'If the surface area of the parachute is decreased, it will descend more quickly because there will be less air resistance' (AC9S8I01_E6)
	Planning and conducting	plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country or Place (AC9S8I02)	recognising state and territory laws as they relate to First Nations Australians' heritage sites and artefacts (AC9S8I02_E1)
			learning to recognise First Nations Australians' artefacts and heritage sites, such as human stonework and scatter sites in comparison with rocks changed by natural processes, and understanding not to harm or disturb sites (AC9S8I02_E2)
			collaborating with First Nations Australians communities and organisations to conduct investigations about ecosystems, ensuring mutually beneficial outcomes (AC9S8I02_E3)
			discussing the features of reproducible investigations, constructing methods and reviewing other students' methods (AC9S8I02_E4)
			comparing the method with the hypothesis and examining the reasonableness of the method for testing that hypothesis (AC9S8I02_E5)
			identifying assumptions relating to variables that are assumed to be constant, such as ambient temperature, properties of materials used or purity of substances (AC9S8I02_E6)
			identifying risks to themselves and others in investigations and considering actions that can be taken to avoid or manage those risks (AC9S8I02_E7)
			considering ethical issues relating to interactions with living things (AC9S8I02_E8)
		select and use equipment to generate and record data with	selecting and using equipment appropriate to the investigation, such as ensuring a selected thermometer can measure within the range of temperatures expected, or selecting an appropriate-capacity measuring cylinder for the volume of liquid needed (AC9S8I03_E1)

		precision, using digital technologies as appropriate (AC9S8I03)	considering an appropriate sample size for the investigation, and how the use of digital technologies might enable more-efficient data collection for larger sample sizes (AC9S8I03_E2)
			using digital technologies such as apps for field identification (AC9S8I03_E3)
			using appropriate standard units and performing simple unit conversions when recording data (AC9S8I03_E4)
			constructing tables, spreadsheets and graphic organisers to collect data and information (AC9S8I03_E5)
	Processing, modelling and analysing	select, construct and use appropriate representations, including tables, graphs, mathematical relationships, and models, to organise and process data and information (AC9S8I04)	acknowledging, analysing and interpreting data and information from First Nations Australians' understandings of Earth systems (AC9S8I04_E1)
			constructing food webs to represent feeding relationships and flows of energy and matter in an ecosystem (AC9S8I04_E2)
			constructing representations of dichotomous keys, such as a creating a visual key or an interactive presentation, or coding a simple program (AC9S8I04_E3)
			analysing data, including secondary data, to determine mathematical relationships, such as tidal variations over the course of a lunar cycle (AC9S8I04_E4)
			distinguishing between discrete and continuous data and selecting appropriate data representations (AC9S8I04_E5)
			using spreadsheets to aid the presentation and analysis of data (AC9S8I04_E6)
		analyse data and information to identify patterns, trends, relationships and anomalies (AC9S8I05)	collaborating with First Nations Australians communities to create a calendar as a representation of seasonal patterns and relationships using digital technology (AC9S8I05_E1)
			using spreadsheets to analyse second-hand data such as biomass at different trophic levels in an ecosystem (AC9S8I05_E2)
			identifying patterns and relationships such as identifying qualitative relationships between the mass of a planet and its gravity (AC9S8I05_E3)
			identifying patterns in the proportions of a day spent in sunlight and in darkness and relating these patterns to the seasons (AC9S8I05_E4)
			analysing change in predator and prey numbers over time to identify predator-prey cycles (AC9S8I05_E5)

	Evaluating	analyse methods, conclusions and claims for assumptions, possible sources of error, conflicting evidence and unanswered questions (AC9S8I06)	identifying and considering indicators of the quality of the data when analysing results to identify unanswered questions (AC9S8I06_E1)
			evaluating the method used in an investigation, identifying assumptions made about variables that should be controlled, suggesting ways it could be improved and giving reasons for the suggested changes (AC9S8I06_E2)
			analysing conclusions and claims to identify facts or premises that are taken for granted to be true, and considering their relevance to conclusions (AC9S8I06_E3)
			considering the spread of repeated measurements and observations (AC9S8I06_E4)
			identifying the evidence being cited to support a claim and evaluating conflicting evidence (AC9S8I06_E5)
		construct evidence-based arguments to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with using or citing secondary data or information (AC9S8I07)	researching the development of commercial products that are founded on the traditional knowledges and practices of First Nations Australians and discussing related ethical considerations associated with biopiracy and intellectual property rights (AC9S8I07_E1)
			constructing an argument supported by evidence and reasoning in support of or to reject a hypothesis (AC9S8I07_E2)
			drawing a logical conclusion in consideration of the method of data collection, quality of evidence and limitations or significance of a claim (AC9S8I07_E3)
			exploring how to determine credibility of a source (AC9S8I07_E4)
	Communicating	create multimodal texts to communicate ideas, findings and arguments for specific purposes and audiences, including selection of appropriate language and text features, using digital technologies as appropriate (AC9S8I08)	reporting on a scientific investigation, incorporating diagrams, graphical representations and data as appropriate, and including examination of the accuracy and reproducibility of the data (AC9S8I08_E1)
			creating an informative explanation for a younger audience to show how the tilt of Earth's axis, rotation of Earth on that axis, and the revolution of Earth around the sun cause the seasons (AC9S8I08_E2)
			creating an animation that explains particle theory to a peer audience (AC9S8I08_E3)
			writing a letter to the editor to express a view about an environmental issue affecting local ecosystems (AC9S8I08_E4)
			designing a conference poster to report on a scientific investigation (AC9S8I08_E5)

Year 8

Year level description
In Year 8 students are introduced to cells as microscopic structures that explain macroscopic properties of living systems. They link form and function at an organ level and explore the organisation of a body system in terms of flows of matter between interdependent organs. They begin to classify different types of energy and describe the role of energy in causing change in systems, including the role of energy and forces in the geosphere. They learn to classify matter at the atomic level and distinguish between chemical and physical change. They understand that chemical reactions also involve energy. Students use experimentation to isolate relationships between components in systems and explain these relationships through increasingly complex representations. They consider the magnitude of properties and use appropriate units to describe proportional relationships. Inquiry questions can help excite students' curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: • Could artificial organs make transplants obsolete? • What can earthquakes and volcanoes tell us about Earth? • How should we power Australia's future? • How do we know a substance has changed? • Are women under-represented in the history of science?
Achievement standard
By the end of Year 8 students explain the role of specialised cell structures and organelles in cellular function and analyse the relationship between structure and function at organ and body system levels. They apply an understanding of forces, energy and the theory of plate tectonics to explain patterns of change in the geosphere. They compare processes of electricity generation and represent transfer and transformation of energy in simple systems. They represent and classify different types of matter and distinguish between physical and chemical change. Students explain how social, cultural and technological factors can influence development and application of scientific knowledge. They analyse scientific responses to contemporary issues and examine the importance of science communication. Students plan and conduct safe, reproducible investigations to test relationships or explore models. They consider ethical issues and describe any intercultural considerations for specific field locations or use of secondary data. They select and use appropriate equipment to generate and record data with precision. They select and construct appropriate representations to organise and process data and information. They analyse data and information to identify patterns, trends, relationships and anomalies. They identify assumptions and sources of error when analysing methods and identify conflicting evidence or unanswered questions

when analysing conclusions and claims. They construct evidence-based arguments to support conclusions or evaluate claims. They select and use language and text features to achieve their purpose when communicating their ideas, findings and arguments to specific audiences.

Strand / Sub-strand		Content description *Students learn to:*	Elaboration *This may involve students:*
Science understanding	Biological sciences	investigate how cells are the basic units of living things, the differences between plant and animal cells, and the function of specialised cell structures and organelles (AC9S8U01)	exploring an augmented or virtual reality tour of a plant or animal to 'zoom in' and understand the scale of cells (AC9S8U01_E1)
			identifying the structure and function of organelles in cells including the nucleus, cell membrane, cell wall, cytoplasm, chloroplasts and vacuoles (AC9S8U01_E2)
			examining a variety of cells, including single-celled organisms, using a light microscope, digital technologies, simulations and photomicrographs (AC9S8U01_E3)
			comparing the similarities and differences of plant cells and animal cells visible with a light microscope and represented in a digital or physical model (AC9S8U01_E4)
			designing a physical or digital model of a cell and explaining how the representation models the cell (AC9S8U01_E5)
			considering how the invention of the microscope has contributed to understanding of cell structure (AC9S8U01_E6)
		investigate the relationship between structure and function of cells, tissues and organs in a plant and an animal organ system and explain how these systems enable survival of the individual (AC9S8U02)	comparing 2-dimensional and 3-dimensional representations of organ systems to understand how organs are positioned within the body (AC9S8U02_E1)
			comparing the structure and function of analogous systems in a plant and an animal (AC9S8U02_E2)
			examining the specialised cells and tissues involved in structure and function of particular organs in an organ system (AC9S8U02_E3)
			describing the structure of each organ in a system and relating its function to the overall function of the system (AC9S8U02_E4)
			researching how a disorder in cells or tissues can affect how an organ functions, such as how hardening of the arteries can lead to poor circulation or heart disease (AC9S8U02_E5)
			investigating how an artificial organ mimics or augments the function or functions of a real organ (AC9S8U02_E6)

	Earth and space sciences	investigate the role of energy and forces in tectonic activity, including formation of geological features at divergent, convergent and transform plate boundaries, and describe the scientific evidence for the theory of plate tectonics (AC9S8U03)	researching First Nations Australians' cultural narratives that provide evidence of earthquakes and volcanoes (AC9S8U03_E1)
			observing patterns of earthquake and volcanic activity over time and proposing explanations (AC9S8U03_E2)
			modelling interactions at plate boundaries (AC9S8U03_E3)
			investigating convection currents and identifying the source of the heat energy driving tectonic activity (AC9S8U03_E4)
			relating the extreme age and stability of a large part of the Australian continent to its plate tectonic history (AC9S8U03_E5)
			constructing a timeline of evidence to show the development of the theory of plate tectonics (AC9S8U03_E6)
			evaluating the impact of tectonic events on human populations and examining engineering solutions designed to reduce the impact (AC9S8U03_E7)
	Physical sciences	investigate how different types of energy are classified as kinetic or potential energy and represent energy transfer and transformations in simple systems (AC9S8U04)	investigating traditional fire-starting methods used by First Nations Australians and their understandings of the transformation of energy (AC9S8U04_E1)
			identifying types of energy as either kinetic energy such as movement, heat and electricity or potential energy such as chemical, elastic and gravitational (AC9S8U04_E2)
			using representations such as flow diagrams to illustrate changes between different forms of energy in a system (AC9S8U04_E3)
			identifying where heat energy is produced as a by-product of energy transfer, such as filament light globes, exercise, and battery charging and use (AC9S8U04_E4)
			observing a Rube Goldberg machine and identifying the energy transfers and transformations involved (AC9S8U04_E5)
			investigating relationships between kinetic and potential energy in a simple system such as a rollercoaster or Newton's cradle (AC9S8U04_E6)
		investigate processes of electricity generation	examining the differences between renewable and non-renewable energy resources including referring to the timescales involved (AC9S8U05_E1)

		from a non-renewable and a renewable source, including examining energy transfers and transformations (AC9S8U05)	investigating the change in the relative contribution of renewables and non-renewable energy sources to Australian electricity generation over the past 20 years and proposing reasons for this change (AC9S8U05_E2)
			using representations such as a flowchart to show the sequence of steps and energy changes involved in producing electricity from a non-renewable source and from a renewable source (AC9S8U05_E3)
			discussing the advantages and disadvantages of using different energy sources considering economic and environmental factors (AC9S8U05_E4)
	Chemical sciences	investigate how matter can be classified as elements, compounds and mixtures, and compare different representations of these, including 2-dimensional and 3-dimensional models, symbols and formulas (AC9S8U06)	using simulated and physical models to distinguish between elements and compounds in terms of types of atoms (AC9S8U06_E1)
			examining how Dmitri Mendeleev arranged the elements in the first version of the periodic table and comparing his arrangement with the current version of the modern periodic table (AC9S8U06_E2)
			explaining why elements are represented by a symbol, compounds by a formula and mixtures by percentages (AC9S8U06_E3)
			using a representation to show the classification of matter as element, compound and different types of mixtures such as solutions, suspensions and colloids (AC9S8U06_E4)
			examining the information conveyed by different types of representations of elements and compounds and identifying where and why these different representations are used (AC9S8U06_E5)
			creating a timeline or models to show how the concept of an element has changed over time from Democritus to John Dalton (AC9S8U06_E6)
		investigate the differences between physical and chemical changes and identify indicators of energy change in chemical reactions (AC9S8U07)	investigating chemical reactions employed by First Nations Australians in the production of substances such as quicklime, plaster, pigments, acids, salts and ethanol (AC9S8U07_E1)
			performing simple chemical reactions to identify the indicators of chemical change such as gas production, solid production, colour change and temperature change (AC9S8U07_E2)
			analysing and interpreting data on the properties of substances before and after the substances interact to determine if a chemical or physical change has occurred (AC9S8U07_E3)
			investigating and identifying energy changes in different chemical reactions such as differences in temperature (AC9S8U07_E4)
			examining how the physical and chemical properties of a substance will affect its production or use (AC9S8U07_E5)

			discussing where indicators of chemical change are used for identifying the presence of particular substances, such as pool water testing kits, bore water test kits, lead testing kits, diabetes test strips or drug testing strips (AC9S8U07_E6)
Science as a human endeavour	Nature and development of science	investigate how new evidence or different perspectives can lead to changes in scientific knowledge (AC9S8H01)	identifying how the development of technologies has led to improved understanding of cells and organs (AC9S8H01_E5)
			considering how advances in technologies have enabled medical science to repair and replace organs using synthetic materials (AC9S8H01_E6)
			describing how evidence led to the acceptance of the theory of plate tectonics over the idea of continental drift (AC9S8H01_E7)
			researching why Dmitri Mendeleev developed a different representation of the periodic table (AC9S8H01_E8)
			discussing the story of Sir Isaac Newton’s discovery of gravity or the questions that Albert Einstein asked which led him to developing a new theory (AC9S8H01_E9)
		investigate how cultural perspectives and world views influence the development of scientific knowledge (AC9S8H02)	investigating how First Nations Australians develop material culture through a holistic world view that employs multidisciplinary knowledge and skills (AC9S8H02_E7)
			exploring how geologist and oceanographic cartographer Marie Tharp’s topological maps of the Atlantic Ocean floor provided support for the acceptance of the theory of plate tectonics (AC9S8H02_E8)
			researching how cultural building techniques such as houses built of bamboo led to the development of structures and materials better able to withstand the effects of earthquakes (AC9S8H02_E9)
			discussing how world views on fairness in sport have led to the development of rapid chemical tests to identify performance-enhancing drugs (AC9S8H02_E10)
			investigating how world views about the role of women lead to women scientists being placed in subordinate roles and ‘written out’ of history, a phenomenon known as the Matilda effect (AC9S8H02_E11)

	Use and Influence of science	investigate how proposed scientific responses to contemporary issues may impact on society and explore environmental, social and economic considerations (AC9S8H03)	exploring how remote First Nations Australians communities are embracing renewable energy systems that meet environmental, social and economic considerations (AC9S8H03_E5)
			examining the environmental impact, reliability and affordability of different forms of electricity generation and proposing an energy profile for a particular community (AC9S8H03_E6)
			investigating how the development of hybrid and solar-, electric- and hydrogen-powered vehicles are applications of contemporary science responses to the depletion of fossil fuels and exploring environmental considerations (AC9S8H03_E7)
			discussing how scientists' development of organoids has impacted on the social, ethical and economic issues that arise from using live animals in a laboratory to research diseases and treatments (AC9S8H03_E8)
			discussing ethical issues that arise from organ transplantation (AC9S8H03_E9)
		investigate the role of science communication in informing individual viewpoints and community policies and regulations (SHEUI7/8.2) (AC9S8H04)	investigating campaigns designed to increase rates of organ donation (AC9S8H04_E7)
			exploring how seismic data is collected and shared between governments across Asia and how governments use this data to issue alerts (AC9S8H04_E8)
			investigating how the development and promotion of using biodegradable materials has informed individual viewpoints (AC9S8H04_E9)
			research how high-profile science communicators such as Professor Lisa Harvey-Smith or Dr Karl Kruszelnicki influence people's attitudes to science (AC9S8H04_E10)
Science inquiry	Questioning and predicting	develop investigable questions, observation-based predictions and hypotheses to explore scientific models, identify patterns or test relationships (AC9S8I01)	discussing what is meant by a causal relationship and examining how causation is different from correlation (AC9S8I01_E7)
			developing questions to test causal relationships, such as: 'How does the concentration of a salt solution affect plant cells? How does the amount of sunlight affect the amount of electricity produced by a solar cell?' (AC9S8I01_E8)
			developing questions to explore scientific models, such as: 'How do the shapes of the continents support the theory of plate tectonics?' (AC9S8I01_E9)
			formulating hypotheses such as: 'An earthquake of greater magnitude will cause more damage because there is more energy transferred (AC9S8I01_E10)

			predicting what will happen when conditions change in a given scenario or phenomenon, such as: 'When materials of less resistance are used to transfer electricity there will be less heat energy produced' (AC9S8I01_E11)
	Planning and conducting	plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country or Place (AC9S8I02)	learning to recognise First Nations Australians' artefacts and heritage sites of significance such as ceremonial grounds and traditional quarries, and ensuring they cause no harm to heritage sites and artefacts (AC9S8I02_E9)
			designing investigations that specifically test variables of the causal relationship and control the remaining variables (AC9S8I02_E10)
			identifying assumptions related to testing a hypothesis using analogous models such as using dialysis tubing to model the properties of plant cell walls, and using a shake table to model the effects of an earthquake on buildings (AC9S8I02_E11)
			explaining why safety procedures address identified risks (AC9S8I02_E12)
			considering ethical issues relating to the access to and use of biological material and secondary data (AC9S8I02_E13)
		select and use equipment to generate and record data with precision, using digital technologies as appropriate (AC9S8I03)	selecting and using equipment with required precision such as adjusting magnification to observe specific cell structures and recording this magnification, reading the bottom of the meniscus (AC9S8I03_E6)
			recording data with precision appropriate to the instrument such as rounding up or down with finer graduations or estimating an intermediate value with coarser graduations (AC9S8I03_E7)
			using digital technologies such as digital microscopes, simulations and video-recording devices when appropriate to observe, measure and record qualitative and quantitative data (AC9S8I03_E8)
			using conventions related to dependent and independent variables with relevant units when constructing tables and spreadsheets (AC9S8I03_E9)
			using appropriate positive and negative signs for standard units, number of decimal points and exponential notation where relevant when recording data (AC9S8I03_E10)

	Processing, modelling and analysing	select, construct and use appropriate representations, including tables, graphs, mathematical relationships, and models, to organise and process data and information (AC9S8I04)	using simple formulas in spreadsheets to organise and process collected data (AC9S8I04_E7)
			using visual displays of large datasets such as maps showing the location of volcanoes and earthquakes, charts showing the structure of body systems and graphs showing variable current in electricity production to identify temporal and spatial relationships (AC9S8I04_E8)
			constructing graphs using correct conventions such as independent variable on the horizontal axis and dependent variable of the vertical axis, axis labelling and graph naming (AC9S8I04_E9)
			constructing energy flow diagrams to represent energy changes in a system such as a roller-coaster or rocket launch (AC9S8I04_E10)
			constructing representations of chemical and physical changes, such as creating a visual model or symbolic representation (AC9S8I04_E11)
			collating data from a number of sources such as different groups in the class who performed the same investigation to create a summary (AC9S8I04_E12)
			examining the strengths and limitations of representations such as physical models, diagrams and simulations and selecting the most appropriate representation to use (AC9S8I04_E13)
		analyse data and information to identify patterns, trends, relationships and anomalies (AC9S8I05)	identifying correlational relationships in data such as: 'Dropping a mass from a greater height produces a larger indentation' and analysing this relationship for causality (AC9S8I05_E6)
			describing measures of central tendency such as mean, mode and median and identifying outliers for quantitative data (AC9S8I05_E7)
			using spreadsheets to analyse second-hand data such as daily power output of solar panels and examining anomalies such as periods of reduced output (AC9S8I05_E8)
			analysing changes in battery energy output following recharging over many cycles and relating to available chemical potential energy (AC9S8I05_E9)
	Evaluating	analyse methods, conclusions and claims for assumptions, possible sources of error, conflicting evidence and	identifying assumptions then examining if extra variable controls are required and how these might affect the data and conclusion (AC9S8I06_E6)
			identifying sources of error in methods such as inconsistent variable control and inaccuracies in procedures or measurements, and explaining how the method could be improved (AC9S8I06_E7)

		unanswered questions (AC9S8I06)	considering the limitations to the accuracy of the data such as number of trials, cost, risk and time, and adjusting the investigation method accordingly (AC9S8I06_E8)
			comparing results with other groups or secondary sources to examine consistency and describing where there may be conflicting results or conclusions (AC9S8I06_E9)
			analysing conclusions or claims to determine if there are further questions which should be explored to verify the conclusion or claim (AC9S8I06_E10)
			analysing conclusions to identify facts or premises that are taken for granted to be true, and discussing the reasonableness of those assumptions with others (AC9S8I06_E11)
		construct evidence-based arguments to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with using or citing secondary data or information (AC9S8I07)	evaluating the quality of evidence of primary and secondary sources used when constructing an argument to support a conclusion or claim (AC9S8I07_E5)
			examining competing ideas, differences in methods and sources of error when constructing an argument (AC9S8I07_E6)
			considering the ethical issues or cultural protocols when using or citing secondary data, such as acknowledging sources and respecting cultural protocols around sharing of particular information (AC9S8I07_E7)
	Communicating	create multimodal texts to communicate ideas, findings and arguments for specific purposes and audiences, including selection of appropriate language and text features, and using digital technologies as appropriate (AC9S8I08)	writing a report on a scientific investigation using correct conventions including passive voice and past tense, and including a discussion of how assumptions and possible sources of error may have affected the results (AC9S8I08_E6)
			modifying the method for an investigation and explaining where and why the original was changed with reference to any assumptions and sources of error (AC9S8I08_E7)
			constructing a persuasive text on the use of renewable energy sources, including scientific explanations and principles, to influence a specified audience (AC9S8I08_E8)
			creating an infographic to compare and contrast different forms of energy, highlighting examples of energy transfer and transformations within each (AC9S8I08_E9)
			filming a documentary on the dynamic nature of the geosphere and selecting appropriate language, models and analogies to engage a specific audience (AC9S8I08_E10)

Year 9

Year level description

In Year 9 students consider the operation of systems at a range of scales and how those systems respond to external changes in order to maintain stability. They explore ways in which the human body system responds to changes in the external environment through physiological feedback mechanisms and the reproductive processes that enable a species to respond to a changing environment over time. They are introduced to the notion of the atom as a system of protons, electrons and neutrons, and how this system can change through nuclear decay. They learn that matter can be rearranged through chemical change and that these changes play an important role in many systems. They are introduced to the concepts of conservation of matter and energy and begin to develop a more sophisticated view of energy transfer. They explore these concepts as they relate to the global carbon cycle. Students begin to consider how well a sample or model represents the phenomena under study and use a range of evidence to support their conclusions.

Inquiry questions can help excite students' curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration:

- How is the human body like an ecosystem?
- What are the biological advantages and disadvantages of sexual reproduction?
- Whose responsibility is it to reduce carbon emissions?
- How do different technologies help humans to communicate?
- What happens if scientists cannot establish consensus?

Achievement standard

By the end of Year 9 students explain how body systems provide a coordinated response to stimuli. They examine how the processes of sexual and asexual reproduction enable survival of the species. They examine how interactions within and between Earth's spheres affect the carbon cycle. They explain energy conservation in simple systems and apply wave and particle models to describe energy transfer. They explain observable chemical processes in terms of changes in atomic structure, atomic rearrangement, mass and energy. Students explain the role of publication in validating scientific knowledge and describe the relationship between science, technologies and engineering. They examine key factors that influence interactions between science and society.

Students plan and conduct safe, reproducible investigations to test or identify relationships or explore models. They examine ethical and intercultural considerations when acquiring or using primary and secondary data. They select and use equipment to generate and record repeatable data. They select and construct appropriate representations to organise, process and summarise data and information. They analyse and connect data and information to identify and explain patterns, trends, relationships and anomalies. They analyse methods for assumptions and sources of error and evaluate the validity of conclusions and claims. They construct logical, evidence-based arguments to support conclusions or evaluate claims. They select and use content, language and text features to achieve their purpose when communicating their ideas, findings and arguments to specific audiences.

Strand / Sub-strand		**Content description** *Students learn to:*	**Elaboration** *This may involve students:*
Science understanding	Biological sciences	investigate how a body system regulates and coordinates the body's response to stimuli and the role of positive and negative feedback mechanisms (AC9S9U01)	examining how feedback mechanisms serve to maintain balance in internal systems, including body temperature, blood sugar, iron levels, or extracellular pH (AC9S9U01_E1)
			contrasting the role of positive feedback mechanisms to negative feedback mechanisms, focusing on the ability to maintain the direction of a stimulus and accelerate its effect (AC9S9U01_E2)
			exploring the relationships between body systems that are necessary to maintain a functioning body using models, flow diagrams or simulations (AC9S9U01_E3)
			modelling how the process of regulation is monitored and adjusted by connections between the receptor, command centre and effector (AC9S9U01_E4)
			exploring the response of an organism to changes as a result of the presence of a pathogen, such as high temperatures, inflammation, or changes in skin colour (AC9S9U01_E5)
			examining the effects of a disorder in a feedback system, such as diabetes-induced blindness or hypothermia (AC9S9U01_E6)
			considering how understanding of feedback mechanisms has enabled the development of pharmaceuticals and other products to address issues or enhance performance, such as insulin or electrolytes in sports drinks (AC9S9U01_E7)
		investigate how the processes of sexual and asexual reproduction in animals and plants enable survival of the species (AC9S9U02)	examining how the male and female reproductive structures work collectively as a system to produce and release gametes (AC9S9U02_E1)
			identifying and comparing sexual and asexual reproductive strategies in plants (AC9S9U02_E2)
			exploring how mutations arising during asexual reproduction can produce offspring different from their parents, while sexual reproduction creates a greater rate of variation among offspring (AC9S9U02_E3)

			examining how the reproductive strategies of multicellular animals are related to their environment and the complexity of the organism (AC9S9U02_E4)
			examining how the number of offspring produced by animals is related to the amount of parental care (AC9S9U02_E5)
	Earth and space sciences	investigate how key processes in the carbon cycle, including combustion, photosynthesis and respiration, rely on interactions between the biosphere, geosphere, hydrosphere and atmosphere (AC9S9U03)	identifying Earth as a system, describing Earth's spheres and discussing examples of interactions between different spheres (AC9S9U03_E1)
			examining the carbon cycle using diagrams, animations or simulations, explaining the role of photosynthesis and cellular respiration and identifying the impact of combustion reactions as a result of human activity (AC9S9U03_E2)
			investigating the greenhouse effect and relating it to the role carbon dioxide plays in maintaining temperatures that support life on Earth (AC9S9U03_E3)
			conducting a field investigation to evaluate carbon sequestration in an ecosystem, such as measuring tree biomass, deadwood, leaf litter and soil depth and using formulas to calculate approximate carbon storage (AC9S9U03_E4)
			identifying how carbon dioxide is captured and stored naturally or through the use of technologies (AC9S9U03_E5)
			calculating an individual's carbon fingerprint, examining the impact of human activities and suggesting strategies to reduce carbon dioxide emissions (AC9S9U03_E6)
	Physical sciences	investigate how wave and particle models describe energy transfer through different mediums and examine the usefulness of each model for explaining phenomena (AC9S9U04)	investigating the impact of material selection on the transfer of sound energy in First Nations Australians' traditional musical, hunting and communication instruments (AC9S9U04_E1)
			investigating aspects of heat transfer and conservation in the design of First Nations Australians' bedding and clothing in the various climatic regions of Australia (AC9S9U04_E2)
			describing the processes underlying convection and conduction of heat in terms of the particle model (AC9S9U04_E3)
			modelling the transfer of sound energy as waves using slinky springs and relating to the medium through which the sound is transferred (AC9S9U04_E4)
			discussing the wave and particle models of energy transfer and how they are useful for understanding aspects of light and other forms of electromagnetic radiation (AC9S9U04_E5)

			examining the forms of electromagnetic radiation that are used in different modern communication technologies and identifying any limitations (AC9S9U04_E6)
		investigate how energy transfers and transformations in physical systems demonstrate the law of conservation of energy and analyse system efficiency in terms of energy inputs and outputs (AC9S9U05)	explaining that the law of conservation of energy explains that total energy is maintained in energy transfer and transformation in a system (AC9S9U05_E1)
			recognising that in energy transfer and transformation a variety of processes can occur, so that the amount of usable energy is reduced and the system is not 100 per cent efficient (AC9S9U05_E2)
			using representations such as Sankey diagrams to show energy inputs, changes and outputs in a system (AC9S9U05_E3)
			examining the meaning of energy star ratings given to appliances such as refrigerators and washing machines and criteria used to determine these ratings (AC9S9U05_E4)
			examining how improving efficiency in energy transfer and transformations in sporting activities such as pole vaulting or archery improves athletic performance (AC9S9U05_E5)
			comparing the efficiency of electricity generation from coal and solar sources (AC9S9U05_E6)
	Chemical sciences	investigate how the discovery of protons, neutrons and electrons influenced the model of the atom and how natural radioactive decay results in stable atoms (AC9S9U06)	investigating how radiocarbon and other dating methods have been used to establish that First Peoples of Australia have been present on the Australian continent for more than 60,000 years (AC9S9U06_E1)
			comparing the mass and charge of protons, neutrons and electrons (AC9S9U06_E2)
			examining and representing how the discovery of electrons, protons and neutrons resulted from experimental evidence and answered questions related to properties and behaviours of atoms (AC9S9U06_E3)
			explaining that differences in the number of neutrons in atoms of the same element results in isotopes and that naturally occurring isotopes of some elements are unstable (AC9S9U06_E4)
			describing in simple terms how different unstable isotopes decay such as radon-222 releasing an alpha particle, iodine-131 releasing a beta particle and cobalt-60 releasing gamma radiation to form stable atoms (AC9S9U06_E5)
			defining half-life, examining the timescales of decay of different elements such as carbon-14 and uranium-238 and simulating or using simulations to examine radioactive decay including half-life (AC9S9U06_E6)

			identifying where applications of radioactivity are used in medicine and industry such as diagnosing and treating cancer and checking for faults in materials used in spacecraft (AC9S9U06_E7)
			discussing how mass and energy are connected at all scales and energy conversion processes within atomic nuclei (AC9S9U06_E8)
		investigate how the rearrangement of atoms in chemical reactions can be modelled using a range of representations, including word and simple balanced chemical equations, and use these to demonstrate the law of conservation of mass (AC9S9U07)	investigating how First Nations Australians develop pigments and dyes through understanding of chemical reactions, and knowledge of plant-based dyes and mineral sources and their properties (AC9S9U07_E1)
			identifying reactants and products in chemical reactions (AC9S9U07_E2)
			using models and representations to show the rearrangement of atoms in chemical reactions (AC9S9U07_E3)
			investigating chemical reactions in closed and open systems and relating data obtained to the law of conservation of mass (AC9S9U07_E4)
			writing symbolic equations that are easy to balance and explaining, using the law of conservation of mass, and atoms, the rationale for balancing chemical equations (AC9S9U07_E5)
			investigating why most elements are not found in their elemental state and processes which are used to obtain the element (AC9S9U07_E6)
			predicting how ideas of green chemistry such as minimising the amount of unusable waste products, energy use and using more environmentally friendly chemical processes will affect the environment (AC9S9U07_E7)
Science as a human endeavour	Nature and development of science	investigate how scientific knowledge is validated, including the role of publication and peer review (AC9S10H01)	investigating how the publication of data and findings related to the reintroduction of First Nations Australians' traditional fire regimes has informed more effective fire-reduction strategies and policies (AC9S10H01_E1)
			investigating how First Nations Australians understood the causative nature of infection and developed effective wound treatments such as the use of tea tree, and how the effectiveness of these treatments was subsequently evaluated then published in peer-reviewed journals (AC9S10H01_E2)
			investigating the process of publishing a paper in a scientific journal such as *Science*, which receives about 12,000 submissions per year, and consider how editors evaluate submitted papers (AC9S10H01_E3)
			examining how Marie and Pierre Curie's discovery of new elements was validated (AC9S10H01_E4)
			exploring why the work of Professor Barry Marshall and Dr Robin Warren related to the cause of peptic ulcers was first rejected for publication then later validated (AC9S10H01_E5)

		examining the scientific consensus supporting global warming (AC9S10H01_E6)
	investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering (AC9S10H02)	considering how the development of imaging technologies has improved our understanding of the functions and interactions of body systems (AC9S10H02_E1)
		considering the impact of technological advances developed in Australia such as the cochlear implant pioneered by Professor Graeme Clark, the Monash Vison Group's work on a bionic eye and Professor Fiona Woods' development of spray-on skin (AC9S10H02_E2)
		researching how technological advances in monitoring greenhouse gas emissions and other environmental factors have contributed to the reinstatement of traditional fire management practices as a strategy to reduce atmospheric pollution (AC9S10H02_E3)
		considering how common properties of electromagnetic radiation relate to its uses, such as radar, medicine, mobile phone communications and microwave cooking (AC9S10H02_E4)
		exploring how scientists and engineers make machines more energy efficient (AC9S10H02_E5)
		exploring how understanding of the nature of matter and energy has changed over time, and how modern technology has enabled exploration of energy conversion processes at all scales, from black holes to atoms to sub-atomic particles (AC9S10H02_E6)
		examining how advances in understanding of radioactivity and radioisotopes have led to new applications and technologies (AC9S10H02_E7)
Use and Influence of science	investigate key factors that contribute to science knowledge and practices being adopted more broadly by society (AC9S10H03)	considering how the traditional ecological knowledges of First Nations Australians are being reaffirmed by modern science and how these practices are being adopted more broadly in the field of restorative ecology (AC9S10H03_E1)
		investigating how an understanding of materials and concern for the environment have led to the adoption of widespread recycling practices (AC9S10H03_E2)
		examining reasons for the adoption of solar panels and battery storage by individuals, industry and communities (AC9S10H03_E3)
		investigating how the practices adopted by society based on research by Australian Dr Helen Mayo led to a reduction in infant mortality (AC9S10H03_E4)

			examining how assisted reproductive technologies have become widely used since their initial development (AC9S10H03_E5)
		investigate how the values and needs of society influence the focus of scientific research (AC9S10H04)	researching how First Nations Peoples of the Torres Strait are at the forefront of the development of scientific measures to prevent the transfer of certain infectious diseases and pests to the Australian continent (AC9S10H04_E1)
			exploring how governments determine which scientific research projects should be funded (AC9S10H04_E2)
			exploring how Australia has developed an artificial intelligence system which is used to predict the likelihood of a viable pregnancy from transfer of a single embryo to a woman undergoing IVF (AC9S10H04_E3)
			investigating how the need to minimise greenhouse gas production has led to scientific and technological advances (AC9S10H04_E4)
			considering how the development of new materials and procedures has contributed to safe sound levels for humans in the workplace and leisure activities (AC9S10H04_E5)
			examining why many manufacturers are adopting green chemistry processes (AC9S10H04_E6)
			considering innovative energy transfer devices, including those used in transport and communication (AC9S10H04_E7)
Science inquiry	Questioning and predicting	develop investigable questions, predictions and hypotheses to test relationships or develop explanatory models (AC9S10I01)	acknowledging and using the knowledges of science held by First Nations Australians to hypothesise about fauna or flora distributions (AC9S10I01_E1)
			collaborating with First Nations Australians to formulate questions and hypotheses that can be investigated to test casual relationships regarding disrupted ecosystems (AC9S10I01_E2)
			generating questions about the relationships between human body systems and everyday events, such as: ‘How does the intensity of exercise affect heart rate and breathing rate?’ (AC9S10I01_E3)
			developing investigable questions to explore an explanatory model such as: ‘How is sound wave transfer affected by the density of the medium through which it travels? What causes our body temperature to rise when we are ill?’ (AC9S10I01_E4)
			discussing why a scientific hypothesis has to be able to be supported or refuted through evidence (AC9S10I01_E5)

			proposing a hypothesis to test an identified relationship such as: 'If objects of different temperature are placed in contact, heat energy will transfer from an object of higher temperature to an object of lower temperature until both objects reach the same temperature' (AC9S10I01_E6)
	Planning and conducting	plan and conduct valid, reproducible investigations to answer questions and test hypotheses, including, as appropriate, developing risk assessments, considering ethical issues, and addressing key considerations regarding heritage sites and artefacts on Country or Place (AC9S10I02)	recognising First Nations Australians' heritage laws and public responsibilities to report new sites or artefacts, and developing awareness of the consequences for disturbing heritage sites on, above or below the land surface, or in waters (AC9S10I02_E1)
			identifying the potential hazards of chemicals or biological materials and processes used in experimental investigations and identifying how these should be addressed (AC9S10I02_E2)
			discussing the ethical and social issues involved in the care and use of animals for scientific purposes before starting an investigation involving animals (AC9S10I02_E3)
			discussing what is meant by validity and reproducibility and how they relate to the method used in an investigation (AC9S10I02_E4)
			identifying assumptions in methods then examining if further testing or extra variable control is needed (AC9S10I02_E5)
			determining the reproducibility of a field investigation using survey techniques that seeks to answer a question such as: 'How much traffic passes the school during a designated period of time?' (AC9S10I02_E6)
			using modelling and simulations to investigate phenomena such as the body's response to cancerous cells (AC9S10I02_E7)
		select and use data generation equipment with precision to obtain useful sample sizes and repeatable data, using digital technologies as appropriate (AC9S10I03)	using an electronic balance that measures within the parameters of the required mass, and recording data to the correct number of significant figures using correct units (AC9S10I03_E1)
			using data loggers and choosing correct scale and appropriate output representation (AC9S10I03_E2)
			examining the degree of accuracy that different instruments provide, such as a measuring cylinder compared with a pipette, and recording data values to the correct degree of accuracy using appropriate scientific notation (AC9S10I03_E3)
			considering the reproducibility of data collected using different instruments, including the inaccuracies that may be introduced when taking measurements (AC9S10I03_E4)

			minimising wastage of resources by checking the quantities of substances used in an investigation are only what is required (AC9S10I03_E5)
			examining and selecting credible data sources (AC9S10I03_E6)
	Processing, modelling and analysing	select and construct appropriate representations including tables, graphs, descriptive statistics, models and mathematical relationships to organise and process data and information (AC9S10I04)	using spreadsheet software to present data in tabular and graphical forms (AC9S10I04_E1)
			identifying which sample properties such as mean, median and range, are the most appropriate to use to make generalisations (AC9S10I04_E2)
			comparing the information provided by molecular models and word and balanced symbolic chemical equations when examining the law of conservation of mass (AC9S10I04_E3)
			applying algorithms to measure carbon storage of different vegetation types (AC9S10I04_E4)
			applying ratios to accurately represent usable and waste energy in transfer and transformation diagrams such as Sankey diagrams (AC9S10I04_E5)
		analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies (AC9S10I05)	recognising First Nations Australians' histories and cultural expressions as a data source that can reveal trends, relationships and anomalies from the past (AC9S10I05_E1)
			analysing representations of data from atmospheric monitoring and ice cores to identify patterns and trends in the amount of carbon dioxide in the atmosphere, highlighting inconsistencies (AC9S10I05_E2)
			comparing published data with experimental data such as the sound-insulating levels of different materials and identifying any trends or patterns in differences such as: 'The published sound levels are usually higher than the experimentally determined levels' (AC9S10I05_E3)
			analysing data on heat transfer through multiple layers of an insulating material and identifying patterns and proportional relationships such as: 'When the thickness of the material is doubled the amount of heat transferred is halved' (AC9S10I05_E4)
			examining tables, graphs and simulations of radioactive decay half-life to predict changes in mass over time (AC9S10I05_E5)
			discussing the validity of the data when extrapolating from a graph (AC9S10I05_E6)

	Evaluating	assess the validity and reproducibility of methods and evaluate the validity of conclusions and claims, including by identifying conflicting evidence and areas of uncertainty (AC9S10I06)	identifying gaps or weaknesses in conclusions and relating these to the validity and reproducibility of the method (AC9S10I06_E1)
			considering how general practitioners manage conflicting evidence to diagnose illness (AC9S10I06_E2)
			discussing what is meant by 'validity' and how the validity of information in secondary sources can be evaluated (AC9S10I06_E3)
			identifying assumptions in methods and determining the impact these could have on the validity of the conclusion (AC9S10I06_E4)
			analysing methods and conclusions to identify facts or premises that are taken for granted to be true, and evaluating the reasonableness of those assumptions (AC9S10I06_E5)
			considering if areas of uncertainty could lead to a viable alternative conclusion (AC9S10I06_E6)
		construct arguments based on a variety of evidence to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information (AC9S10I07)	constructing an argument for acknowledging the contributions to medicine of First Nations Australians' knowledges of physiological pathways and contemporary medicinal delivery systems (AC9S10I07_E1)
			identifying multiple sources of evidence that are consistent with a claim such as the effectiveness of a vaccine (AC9S10I07_E2)
			interrogating the evidence and reasoning used to justify claims regarding the age of ancient artefacts (AC9S10I07_E3)
			researching the methods used by scientists in studies reported in the media to evaluate the validity of the headlines (AC9S10I07_E4)
			examining secondary data to ensure it does not contain personal information which could potentially harm individuals, is correctly cited and is relevant to the investigation question or claim (AC9S10I07_E5)
			examining secondary data to determine the credibility of the source and the validity and reproducibility of the data (AC9S10I07_E6)

	Communicating	create multimodal texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital technologies as appropriate (AC9S10I08)	selecting appropriate content and language which is culturally responsive and maintains cultural protocols, considering sensitivities in communicating First Nations Australians' knowledges and managing risks of offensive narratives, language, images and attributions (AC9S10I08_E1)
			writing a report on a scientific investigation including: an introductory paragraph that explains or references scientific theories, processes or other related knowledge that gives background information to the investigation; an explanation of the results obtained using scientific knowledge; and a discussion that considers validity and reproducibility (AC9S10I08_E2)
			planning a Twitter campaign to encourage young people to reduce their carbon fingerprint (AC9S10I08_E3)
			collaborating to prepare a written report for local government on estimated carbon storage across different local ecosystems and proposals to increase carbon storage across the area (AC9S10I08_E4)
			developing an interactive presentation that shows feedback loops in human body systems (AC9S10I08_E5)

Year 10

Year level description

In Year 10 students explore the biological, chemical and geological evidence for different theories, such as the theories of natural selection and the Big Bang. Through investigating natural selection and processes of heredity they come to understand the evolutionary feedback mechanisms that ensure the continuity of life. They appreciate how energy drives the Earth system and how climate models simulate the flow of energy and matter within and between Earth's spheres. Students develop a more sophisticated understanding of atomic theory to understand patterns and relationships within the periodic table. They understand that motion and forces are related by applying physical laws and can be modelled mathematically. Students analyse and synthesise data from systems at multiple scales to develop evidence-based explanations for phenomena. They learn that all models involve assumptions and approximations, and that this can limit the reliability of predictions based on those models.

Inquiry questions can help excite students' curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration:

- What is the future of our species?
- Are Newton's laws all we need to explain and predict motion in our universe?
- How do we know what an atom is?
- Is seeing believing?
- Just because we have the technology, should we use it?
- How should Australia's research priorities be determined?

Achievement standard

By the end of Year 10 students explain the processes that underpin heredity and genetic diversity and describe the evidence supporting the theory of evolution by natural selection. They sequence key events in the origin and evolution of the universe and describe the supporting evidence for the big bang theory. They examine patterns of global climate change and identify causal factors. They explain how Newton's laws describe and predict motion of objects in a system. They explain patterns and trends in the periodic table and predict the products of reactions and the effect of changing reactant and reaction conditions. Students explain the processes through which scientific knowledge is validated and examine the relationship between science, technology and engineering. They analyse key factors that influence interactions between science and society.

Students plan and conduct safe, valid and reproducible investigations to test relationships or develop explanatory models. They explain ethical and intercultural considerations when acquiring or using primary and secondary data. They select and use equipment efficiently to generate and record repeatable data. They select and use effective representations to organise, process and summarise data and information. They analyse and connect a variety of data and information to identify patterns, trends, relationships and anomalies. They assess the validity and reproducibility of methods, and the validity of conclusions and claims. They construct logical arguments based on a variety of evidence to support conclusions and evaluate claims. They select and use content, language and text features effectively to achieve their purpose when communicating their ideas, findings and arguments to diverse audiences.

Strand / Sub-strand		**Content description** *Students learn to:*	**Elaboration** *This may involve students:*
Science understanding	Biological sciences	investigate the role of meiosis and mitosis and the function of chromosomes, DNA and genes in heredity and explain and predict patterns of Mendelian inheritance (AC9S10U01)	investigating First Nations Australians' knowledges of heredity as evidenced by the strict adherence to kinship and family structures, especially marriage laws (AC9S10U01_E1)
			using models and diagrams to represent the relationship between genes, chromosomes, and DNA of an organism's genome (AC9S10U01_E2)
			explaining how genetic information passed on to offspring from both parents by meiosis and fertilisation increases the variation of a species (AC9S10U01_E3)
			using Mendelian inheritance to predict the ratio of offspring genotypes and phenotypes in monohybrid crosses involving dominant and recessive alleles or in genes that are sex-linked (AC9S10U01_E4)
			using pedigree diagrams to show patterns of inheritance of simple dominant and recessive characteristics through multigenerational families (AC9S10U01_E5)
			examining karyotypes and applications of gene technologies, such as gene therapy and genetic engineering and biotechnologies used to produce therapeutic proteins (AC9S10U01_E6)
			exploring environmental and other factors that cause mutations and identifying changes in DNA or chromosomes (AC9S10U01_E7)
			exploring the role of DNA in cancer or genetic disorders such as haemochromatosis, sickle cell anaemia and cystic fibrosis (AC9S10U01_E8)
		investigate how the theory of evolution by natural selection explains past and present diversity and	investigating some of the structural and physiological adaptations of First Nations Australians to the Australian environment (AC9S10U02_E1)
			outlining processes involved in natural selection including variation, isolation and selection (AC9S10U02_E2)
			examining biodiversity as a function of evolution (AC9S10U02_E3)

		analyse the scientific evidence supporting the theory (AC9S10U02)	investigating changes caused by natural selection in a particular population as a result of a specified selection pressure such as artificial selection in breeding for desired characteristics (AC9S10U02_E4)
			relating genetic characteristics to survival and reproductive rates (AC9S10U02_E5)
			examining evidence for the theory of evolution by natural selection including the fossil record, chemical and anatomical similarities, and geographical distribution of species (AC9S10U02_E6)
	Earth and space sciences	investigate how the big bang theory models the origin and evolution of the universe, including the formation of stars and galaxies, and analyse the supporting evidence for the theory (AC9S10U03)	researching First Nations Australians' knowledge of celestial bodies and explanations of the origin of the universe (AC9S10U03_E1)
			describing the major components of the universe using appropriate scientific terminology and units including astronomical units, scientific notation and light-years (AC9S10U03_E2)
			examining how stars' light spectra and brightness is used to identify compositional elements of stars, their movements and their distances from Earth (AC9S10U03_E3)
			constructing a timeline to show major changes in the universe which occurred from the Big Bang until the formation of the major components such as stars and galaxies (AC9S10U03_E4)
			explaining how each different type of evidence such as cosmic microwave background information, red or blue shift of galaxies, Edwin Hubble's observations and proportion of matter in the universe provides support for the acceptance of the big bang theory (AC9S10U03_E5)
			identifying the different technologies used to collect astronomical data and the type of data collected (AC9S10U03_E6)
			exploring recent advances in astronomy and astrophysics such as the discovery of gravity waves, dark matter and dark energy, and identifying new knowledge which has emerged (AC9S10U03_E7)
		investigate how models of energy flow between the biosphere, geosphere, hydrosphere and atmosphere describe patterns of	investigating how First Nations Australians are reducing Australia's greenhouse gas emissions through the reinstatement of traditional fire management regimes (AC9S10U04_E1)
			examining the role of radiation from the sun and how its interactions with the atmosphere, ocean and land are the foundation for the global climate system (AC9S10U04_E2)
			investigating indicators of climate change such as changes in ocean and atmospheric temperatures, sea levels, biodiversity, permafrost and sea ice (AC9S10U04_E3)

		global climate change and predict future changes (AC9S10U04)	identifying changes in global climate over time and using simulations to explore why energy balances have changed (AC9S10U04_E4)
			examining the factors, including energy, that drive deep ocean currents, their role in regulating global climate and their effects on marine life (AC9S10U04_E5)
			examining patterns of climate change using models, simulations and data (AC9S10U04_E6)
			predicting changes to the Earth system and identifying strategies which attempt to reduce climate change (AC9S10U04_E7)
	Physical sciences	investigate Newton's laws of motion and quantitatively analyse the relationship between force, mass and acceleration of objects (AC9S10U05)	investigating how First Nations Australians achieve an increase in speed and subsequent impact force through the use of spearthrowers and bows (AC9S10U05_E1)
			investigating a moving object to analyse and propose relationships between distance and time, speed, force and acceleration (AC9S10U05_E2)
			using mathematical representations including graphs and algebraic formula to quantitatively relate force, speed, acceleration and mass (AC9S10U05_E3)
			modelling how a change in net force acting on an object affects its motion and relating to the purpose of safety features such as seatbelts, airbags and crumple zones in vehicles (AC9S10U05_E4)
			investigating the application of Newton's laws in sport and how these are applied to improve an athlete's performance or safety (AC9S10U05_E5)
			discussing how Einstein's theory of relativity arose from limitations of Newton's laws (AC9S10U05_E6)
			constructing an argument, supported by data, to support lower speed limits near schools or for trucks in urban environments (AC9S10U05_E7)

	Chemical sciences	investigate how the Bohr model of the atom explains the structure and properties of atoms and relates to their organisation in the periodic table (AC9S10U06)	examining how elements are organised in the periodic table and recognising that elements in the same group of the periodic table have similar properties (AC9S10U06_E1)
			investigating the physical properties of some metals and non-metals (AC9S10U06_E2)
			describing the structure of atoms in terms of electron shells and relating this to their properties and position in the periodic table (AC9S10U06_E3)
			deducing that repeating patterns of the periodic table reflect patterns of outer electron states (AC9S10U06_E4)
			conducting flame tests for a selection of elements and examining emission spectra (AC9S10U06_E5)
			examining how the development of the spectroscope led to further development of the model of the atom (AC9S10U06_E6)
		investigate synthesis, decomposition and displacement reactions, predict their products, and examine the factors that affect reaction rates (AC9S10U07)	investigating some of the chemical reactions and methods employed by First Nations Australians to convert toxic plants into edible food products (AC9S10U07_E1)
			investigating chemical reactions employed by First Nations Australians in the production of substances such as acids and ethanol (AC9S10U07_E2)
			defining and representing synthesis, decomposition and displacement reactions using a variety of formats such as molecular models, diagrams and word and balanced symbolic equations (AC9S10U07_E3)
			identifying reaction type and predicting the products (AC9S10U07_E4)
			investigating synthesis reactions such as reaction of metals with oxygen, formation of water and sodium chloride; decomposition reactions such as those used to extract metals; and displacement reactions such as metal and acid, neutralisation and precipitation (AC9S10U07_E5)
			investigating the effect of a range of factors, such as temperature, concentration, surface area and catalysts, on the rate of chemical reactions (AC9S10U07_E6)
			examining reactions that are used to produce a range of useful products (AC9S10U07_E7)

Science as a human endeavour	Nature and development of science	investigate how scientific knowledge is validated, including the role of publication and peer review (AC9S10H01)	examining how the work of Rosalind Franklin was critical to the discovery of the double helix structure of DNA and her publications validated the findings of James Watson and Francis Crick (AC9S10H01_E7)
			investigating how the development of the periodic table has been disputed, altered and improved as science has progressed and new elements have been discovered (AC9S10H01_E8)
			exploring the role of large datasets and statistical analysis in validating scientific findings, such as Gregor Mendel's experiments with pea plants (AC9S10H01_E9)
			examining why there are different climate change models used by scientists when there is a climate change consensus among scientists (AC9S10H01_E10)
			exploring how astronomer Vera Rubin's discovery of the existence of dark matter was validated (AC9S10H01_E11)
			examining how the discovery of gravity waves validated Einstein's theory of general relativity and why this discovery did not occur until 100 years after the theory was proposed (AC9S10H01_E12)
		investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering (AC9S10H02)	researching how technological advances in dating methods of First Peoples of Australia's material culture are contributing to our understanding of the changing climatic conditions and human interaction with the Australian megafauna (AC9S10H02_E8)
			recognising that the development of fast computers has made possible the analysis of DNA sequencing, radio astronomy signals and other data (AC9S10H02_E9)
			considering how computer modelling has improved knowledge and predictability of phenomena such as climate change and atmospheric pollution (AC9S10H02_E10)
			researching examples of major international scientific projects, for example the Large Hadron Collider and the International Space Station (AC9S10H02_E11)
			considering how information technology can be applied to different areas of science such as bioinformatics and the Square Kilometre Array (AC9S10H02_E12)
			examining how the recent use of female crash test dummies has shown women are at greater risk of injury in a car accident and considering implications for changing car safety features (AC9S10H02_E13)

	Use and Influence of science	investigate key factors that contribute to scientific knowledge and practices being adopted more broadly by society (AC9S10H03)	considering how the traditional ecological knowledges of First Nations Australians are being reaffirmed by modern science and how these practices are being used by traditional owners in carbon farming initiatives (AC9S10H03_E6)
			examining statistics to compare bicycle or electric scooter injuries sustained by riders with and without helmets and relating these to helmet wearing requirements (AC9S10H03_E7)
			discussing examples of the application of genetic screening and reasons for the adoption of the practice by groups within society (AC9S10H03_E8)
			examining why climate change models used by scientists are contested by some people in society (AC9S10H03_E9)
			discussing citizen science projects such as the GLOBE Project and examining why people would choose to be involved (AC9S10H03_E10)
			investigating why agricultural practices have changed to include widespread use of genetically engineered crops (AC9S10H03_E11)
		investigate how the values and needs of society influence the focus of scientific research (AC9S10H04)	researching how the values of 19th and early 20th century Australian society, combined with scientific misconceptions about heredity and evolution, influenced policies and attitudes towards First Nations Australians (AC9S10H04_E8)
			investigating how disease outbreaks and the emergence of drug-resistant infections have focused scientific research into First Nations Australians' traditional medicines to identify effective therapeutic compounds for the use in pharmaceuticals (AC9S10H04_E9)
			examining the link between scientific research and real-world applications such as space research and new material development (AC9S10H04_E10)
			investigating the use and control of chlorofluorocarbons (CFCs) based on scientific studies of atmospheric ozone (AC9S10H04_E11)
			recognising that financial backing from governments or commercial organisations is needed for scientific developments and that this can determine what research is carried out (AC9S10H04_E12)
			considering the use of genetic testing for decisions such as genetic counselling, embryo selection, identification of carriers of genetic mutations and the use of this information for personal use or by organisations such as insurance companies or medical facilities (AC9S10H04_E13)

Science inquiry	Questioning and predicting	develop investigable questions, predictions and hypotheses to test relationships or develop explanatory models (AC9S10I01)	discussing how a tested hypothesis may lead to further predictions and testing to determine if the prediction is supported (AC9S10I01_E7)
			observing a change in the frequency of extreme weather events and hypothesising causes from scientific models such as: 'If the El Niño weather pattern occurs more frequently then there will be more droughts due to decreased rainfall' (AC9S10I01_E8)
			observing how changing the surface area, concentration and temperature affects the rate of a chemical reaction and developing predictions (AC9S10I01_E9)
			developing hypotheses about the role of human activity in changes to climate and investigating these using secondary data (AC9S10I01_E10)
			asking questions about the relationship between crash impact force and speed and developing a hypothesis which can then be tested (AC9S10I01_E11)
	Planning and conducting	plan and conduct valid, reproducible investigations to answer questions and test hypotheses, including, as appropriate, developing risk assessments, considering ethical issues, and addressing key considerations regarding heritage sites and artefacts on Country or Place (AC9S10I02)	addressing ethical issues when collaborating with First Nations Australians to explore the development of a commercial product based on traditional ecological knowledges (AC9S10I02_E8)
			modelling how to report the discovery of unregistered First Nations Australians artefacts and heritage or any unauthorised disturbance (AC9S10I02_E9)
			considering possible confounding variables or effects and ensuring these are controlled or accounted for in planned methods for data collection and analysis (AC9S10I02_E10)
			identifying the potential hazards of chemicals or biological materials and processes used in experimental investigations and how these should be addressed (AC9S10I02_E11)
			considering the ethical and social issues, and legal responsibilities, involved in the care and use of animals for scientific purposes before starting an investigation involving animals (AC9S10I02_E12)
			identifying safety risks and impacts on animal welfare and ensuring these are effectively managed within an investigation (AC9S10I02_E13)
			addressing assumptions through choice of equipment, variable control or further testing (AC9S10I02_E14)
		select and use data generation equipment	ensuring instruments are correctly calibrated before use and planning for recalibration as necessary between uses to improve reliability of results (AC9S10I03_E7)

		with precision to obtain useful sample sizes and repeatable data, using digital technologies as appropriate (AC9S10I03)	explaining how estimation affects precision and examining the inaccuracy introduced when reading between scale markings (AC9S10I03_E8)
			identifying how human error can affect repeatability and reproducibility (AC9S10I03_E9)
			deciding how much data is needed to produce reproducible conclusions (AC9S10I03_E10)
	Processing, modelling and analysing	select and construct appropriate representations including tables, graphs, descriptive statistics, models and mathematical relationships to organise and process data and information (AC9S10I04)	using spreadsheet software to carry out mathematical analyses of data (AC9S10I04_E6)
			evaluating the merits and limitations of time-lapse visual representations of changes in polar ice coverage with a mathematical representation (AC9S10I04_E7)
			comparing merits and limitations of patterns as represented by the periodic table with graphical representations of patterns such as melting point or boiling point, and with consideration of anomalies (AC9S10I04_E8)
			describing sample properties such as mean, median, range and large gaps visible on a graph to make generalisations, acknowledging uncertainties and the effects of outliers (AC9S10I04_E9)
			considering how data or information can be organised and represented to effectively communicate support for conclusions, including through visual or interactive models (AC9S10I04_E10)
			considering how the scales used for representing data affect interpretation of the data (AC9S10I04_E11)
		analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies (AC9S10I05)	representing speed and acceleration data from investigations or simulations in tables and graphs and comparing how these facilitate the identification of relationships (AC9S10I05_E7)
			exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics to make predictions about global climate change (AC9S10I05_E8)
			identifying similar trends and patterns in data from different sources such as homologous structures and fossil evidence (AC9S10I05_E9)
			exploring how different interpretations can be made from data that is organised or processed in different ways, and the implications of this for data analysis (AC9S10I05_E10)
			analysing data regarding the distribution of species in time and space to identify patterns and relationships between organisms (AC9S10I05_E11)

	Evaluating	assess the validity and reproducibility of methods and evaluate the validity of conclusions and claims, including by identifying conflicting evidence and areas of uncertainty (AC9S10I06)	evaluating the strength of a conclusion that can be inferred from a particular dataset (AC9S10I06_E7)
			distinguishing between random and systematic errors and how these can affect investigation results (AC9S10I06_E8)
			judging the validity of science-related media reports and how these reports might be interpreted by the public (AC9S10I06_E9)
			identifying assumptions in methods then examining if further testing or extra variable control is needed (AC9S10I06_E10)
			considering how data variation can indicate uncertainty and might affect confidence in conclusions reached and claims made (AC9S10I06_E11)
			analysing conclusions and claims to identify facts or premises that are taken for granted to be true, and evaluating the reasonableness of those assumptions (AC9S10I06_E12)
		construct arguments based on a variety of evidence to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information (AC9S10I07)	acknowledging the need to critically analyse scientific literature for potential cultural bias towards First Nations Australians (AC9S10I07_E7)
			constructing a scientific argument showing how a range of evidence supports a claim relating to the age of the universe (AC9S10I07_E8)
			engaging in evidence-based debates about the role of human activity in global climate change (AC9S10I07_E9)
			reasoning from a range of evidence to support or rebut claims made in news reports on scientific research (AC9S10I07_E10)
			examining secondary data to determine the credibility of the source and the validity and reproducibility of the data, and identifying the extent to which the data is consistent with data from other sources (AC9S10I07_E11)
			considering the ethical issues of non-therapeutic genetic testing performed by commercial companies (AC9S10I07_E12)
			using primary or secondary scientific evidence to support or oppose a local action that may impact on global climate change (AC9S10I07_E13)
			preparing an argument for increased funding for a particular scientific research focus (AC9S10I07_E14)

	Communicating	create multimodal texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital technologies as appropriate (AC9S10I08)	writing a report on a scientific investigation ensuring only relevant data and observations are reported in the results and including a discussion that presents: an argument based on the results with comparisons related to accepted values; an explanation of outliers; and the effect of possible sources of error (AC9S10I08_E6)
			creating a campaign to lower speed limits in specific areas of the local community (AC9S10I08_E7)
			creating an infographic to highlight the multiple lines of evidence from polar ice caps, ocean temperatures and extreme weather to explain how climate change is impacting Earth (AC9S10I08_E8)
			explaining the Big Bang to an audience of their peers through a comic (AC9S10I08_E9)
			designing a public performance about climate change collaboratively to encourage people to take specific action (AC9S10I08_E10)
			writing a letter to a member of parliament in support of or against a proposed action or climate change mitigation strategy, such as a carbon capture and storage technology or the building of a new solar farm (AC9S10I08_E11)