



School Curriculum and Standards Authority

Science

Aims

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

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

Rationale

Science provides an empirical way of answering interesting and important questions about the biological, physical

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

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

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

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

Content Structure

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

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

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. The Science Understanding strand comprises four sub-strands. The content is described by year level.

BIOLOGICAL SCIENCES

The biological sciences sub-strand is concerned with understanding living things. The key concepts developed within this sub-strand are that: a diverse range of living things have evolved on Earth over hundreds of millions of years; living things are interdependent and interact with each other and their environment; and the form and features of living things are related to the functions that their body systems perform. Through this sub-strand, students investigate living things, including animals, plants, and micro-organisms, 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. Students are introduced to the cell as the basic unit of life and the processes that are central to its function.

CHEMICAL SCIENCES

The chemical sciences sub-strand is concerned with understanding the composition and behaviour of substances. The key concepts developed within this sub-strand are that: the chemical and physical properties of substances are determined by their structure at an atomic scale; and that substances change and new substances are produced by rearranging atoms through atomic interactions and energy transfer. In this sub-strand, 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 which can combine to form molecules, and chemical reactions involve atoms being rearranged and recombined to form new substances. They explore the relationship between the way in which atoms are arranged and the properties of substances, and the effect of energy transfers on these arrangements.

EARTH AND SPACE SCIENCES

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

The physical sciences sub-strand is concerned with understanding the nature of forces and motion, and matter and energy. The two key concepts developed within this sub-strand are that: forces affect the behaviour of objects; and that energy can be transferred and transformed from one form to another. Through this sub-strand students gain an understanding of how an object's motion (direction, speed and acceleration) is influenced by a range of contact and non-contact forces such as friction, magnetism, gravity 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.

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 science 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. This strand also recognises that science advances through the contributions of many different people from different cultures and that there are many rewarding science-based career paths.

The content in the *Science as a Human Endeavour* strand is described in two-year bands. There are two substrands of *Science as a Human Endeavour*. These are:

Nature and development of science: This sub-strand develops an appreciation of the unique nature of science and scientific knowledge, including how current knowledge has developed over time through the actions of many people.

Use and influence of science: This sub-strand explores how science knowledge and applications affect peoples' lives, including their work, and how science is influenced by society and can be used to inform decisions and actions.

Science Inquiry Skills

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.

In science investigations, collection and analysis of data and evidence play a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, prose, keys, spreadsheets and databases.

The content in the *Science Inquiry Skills* strand is described in two-year bands. There are five sub-strands of *Science Inquiry Skills*. These are:

Questioning and predicting: Identifying and constructing questions, proposing hypotheses and suggesting possible outcomes.

Planning and conducting: Making decisions regarding how to investigate or solve a problem and carrying out an investigation, including the collection of data.

Processing and analysing data and information: Representing data in meaningful and useful ways; identifying trends, patterns and relationships in data, and using this evidence to justify conclusions.

Evaluating: Considering the quality of available evidence and the merit or significance of a claim, proposition or conclusion with reference to that evidence.

Communicating: Conveying information or ideas to others through appropriate representations, text types and modes.

Relationship between the strands

In the practice of science, the three strands of *Science Understanding*, *Science as a Human Endeavour* and *Science Inquiry Skills* 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 school science 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 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 investigate how science understanding has developed, including considering some of the people and the stories behind these advances in science.

They will also recognise how this 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, medical interventions, biodiversity and the origins of the universe. 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 Skills* strand, for example by analysing, evaluating and communicating.

Year level descriptions

Year level descriptions have three functions. Firstly, they emphasise the interrelated nature of the three strands, and the expectation that planning a science program will involve integration of content from across the strands. Secondly, they re-emphasise the overarching ideas as appropriate for that stage of schooling. Thirdly, they provide an overview of the content for the year level.

Content descriptions

The Australian Curriculum: Science includes content descriptions at each year level. These describe the knowledge, concepts, skills and processes that teachers are expected to teach and students are expected to learn. However, they do not prescribe approaches to teaching. While *Science Understanding* content is presented in year levels, when units of work are devised, attention should be given to the coverage of content from *Science Inquiry Skills* and *Science as a Human Endeavour* over the two-year band. The content descriptions ensure that learning is appropriately ordered and that unnecessary repetition is avoided. However, a concept or skill introduced at one year level may be revisited, strengthened and extended at later year levels as needed.

Content elaborations

Content elaborations are provided for Foundation to Year 10 to illustrate and exemplify content and assist teachers to develop a common understanding of the content descriptions. They are not intended to be comprehensive content points that all students need to be taught.

The overarching ideas

There are a number of overarching ideas that represent key aspects of a scientific view of the world and bridge knowledge and understanding across the disciplines of science.

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

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

Patterns, order and organisation

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

Form and function

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

Stability and change

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

Scale and measurement

Quantification of time and spatial scale is critical to the development of science understanding as it enables the

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

Matter and energy

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

Systems

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

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

Science across Foundation to Year 12

Although the curriculum is described year by year, this document provides advice across four year groupings on the nature of learners and the relevant curriculum:

- Foundation Year 2: typically students from 5 to 8 years of age
- Years 3-6: typically students from 8 to 12 years of age
- Years 7-10: typically students from 12 to 15 years of age
- Senior secondary years: typically students from 15 to 18 years of age.

Foundation - Year 2

Curriculum focus: awareness of self and the local world

Young children have an intrinsic curiosity about their immediate world. Asking questions leads to speculation and the testing of ideas. Exploratory, purposeful play is a central feature of their investigations.

In this stage of schooling students' explorations are precursors to more structured inquiry in later years. They use the senses to observe and gather information, describing, making comparisons, sorting and classifying to create an order that is meaningful. They observe and explore changes that vary in their rate and magnitude and begin to describe relationships in the world around them. Students' questions and ideas about the world become increasingly purposeful. They are encouraged to develop explanatory ideas and test them through further exploration.

Years 3-6

Curriculum focus: recognising questions that can be investigated scientifically and investigating them

During these years students can develop ideas about science that relate to their lives, answer questions, and solve mysteries of particular interest to their age group. In this stage of schooling students tend to use a trial-and-error approach to their science investigations. As they progress, they begin to work in a more systematic way. The notion of a 'fair test' and the idea of variables are developed, as well as other forms of science inquiry. Understanding the importance of measurement in quantifying changes in systems is also fostered.

Through observation, students can detect similarities among objects, living things and events and these similarities can form patterns. By identifying these patterns, students develop explanations about the reasons for them. Students' understanding of the complex natural or built world can be enhanced by considering aspects of the world as systems, and how components, or parts, within systems relate to each other. From evidence derived from observation, explanations about phenomena can be developed and tested. With new evidence, explanations may be refined or changed.

By examining living structures, Earth, changes of solids to liquids and features of light, students begin to recognise patterns in the world. The observation of aspects of astronomy, living things, heat, light and electrical circuits helps students develop the concept of a system and its interacting components, and understand the relationships, including the notion of cause and effect, between variables.

Years 7-10

Curriculum focus: explaining phenomena involving science and its applications

During these years, students continue to develop their understanding of important science concepts across the major science disciplines. It is important to include contemporary contexts in which a richer understanding of science can be enhanced. Current science research and its human application motivates and engages students.

Within the outlined curriculum, students should undertake some open investigations that will help them refine their science inquiry skills. The quantitative aspects of students' inquiry skills are further developed to incorporate consideration of uncertainty in measurement. In teaching the outlined curriculum, it is important to provide time to build the more abstract science ideas that underpin understanding.

Students further develop their understanding of systems and how the idea of equilibrium is important in dynamic systems. They consider how a change in one of the components can affect all components of the system because of the interrelationships between the parts. They consider the idea of form and function at a range of scales in both living and non-living systems. Students move from an experiential appreciation of the effects of energy to a more abstract understanding of the nature of energy.

As students investigate the science phenomena outlined in these years, they begin to learn about major theories that underpin science, including the particle theory, atomic theory, the theory of evolution, plate tectonic theory and the Big Bang theory.

Senior secondary years

Curriculum focus: disciplines of science

The senior secondary courses for physics, chemistry, biology, and Earth and environmental science build on prior learning across these areas in Foundation to Year 10.

Achievement standards

Across Foundation to Year 10, achievement standards indicate the quality of learning that students should typically demonstrate by a particular point in their schooling. Achievement standards comprise a written description and student work samples.

An achievement standard describes the quality of learning (the extent of knowledge, the depth of understanding and the sophistication of skills) that would indicate the student is well placed to commence the learning required at the next level of achievement.

The sequence of achievement standards across Foundation to Year 10 describes progress in the learning area. This sequence provides teachers with a framework of growth and development in the learning area.

Student work samples play a key role in communicating expectations described in the achievement standards. Each work sample includes the relevant assessment task, the student's response, and annotations identifying the quality of learning evident in the student's response in relation to relevant parts of the achievement standard.

Together, the description of the achievement standard and the accompanying set of annotated work samples help teachers to make judgments about whether students have achieved the standard.

Student diversity

ACARA is committed to the development of a high-quality curriculum for all Australian students that promotes excellence and equity in education.

All students are entitled to rigorous, relevant and engaging learning programs drawn from the Australian Curriculum: Science. Teachers take account of the range of their students' current levels of learning, strengths, goals and interests and make adjustments where necessary. The three-dimensional design of the Australian Curriculum, comprising learning areas, general capabilities and cross-curriculum priorities, provides teachers with flexibility to cater for the diverse needs of students across Australia and to personalise their learning.

More detailed advice has been developed for schools and teachers on using the Australian Curriculum to meet diverse learning needs and is available under <u>Student Diversity</u> on the Australian Curriculum website.

Students with disability

The <u>Disability Discrimination Act 1992</u> and the <u>Disability Standards for Education 2009</u> require education and training service providers to support the rights of students with disability to access the curriculum on the same basis as students without disability.

Many students with disability are able to achieve educational standards commensurate with their peers, as long as the necessary adjustments are made to the way in which they are taught and to the means through which they demonstrate their learning.

In some cases curriculum adjustments are necessary to provide equitable opportunities for students to access ageequivalent content in the Australian Curriculum: Science. Teachers can draw from content at different levels along the Foundation to Year 10 sequence. Teachers can also use the extended general capabilities learning continua in Literacy, Numeracy and Personal and social capability to adjust the focus of learning according to individual student need.

Gifted and talented students

Teachers can use the Australian Curriculum: Science flexibly to meet the individual learning needs of gifted and talented students.

Teachers can enrich student learning by providing students with opportunities to work with learning area content in more depth or breadth; emphasising specific aspects of the general capabilities learning continua (for example, the

higher order cognitive skills of the Critical and creative thinking capability); and/or focusing on cross-curriculum priorities. Teachers can also accelerate student learning by drawing on content from later levels in the Australian Curriculum: Science and/or from local state and territory teaching and learning materials.

Teachers can also develop depth and breadth using the Australian Curriculum: Science <u>overarching ideas</u> as a frame. Learning in science emphasises the ability to make connections between diverse concepts and across contexts. The overarching ideas provide a valuable frame to support students to make these connections and to develop a scientific view of the world.

English as an additional language or dialect

Students for whom English is an additional language or dialect (EAL/D) enter Australian schools at different ages and at different stages of English language learning and have various educational backgrounds in their first languages. Whilst many EAL/D students bring already highly developed literacy (and numeracy) skills in their own language to their learning of Standard Australian English, there is a significant number of students who are not literate in their first language, and have had little or no formal schooling.

While the aims of the Australian Curriculum: Science are the same for all students, EAL/D students must achieve these aims while simultaneously learning a new language and learning content and skills through that new language. These students may require additional time and support, along with teaching that explicitly addresses their language needs. Students who have had no formal schooling will need additional time and support in order to acquire skills for effective learning in formal settings

General capabilities

In the Australian Curriculum, the general capabilities encompass the knowledge, skills, behaviours and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century.

There are seven general capabilities:

- Literacy
- Numeracy
- Information and communication technology (ICT) capability
- Critical and creative thinking
- Personal and social capability
- Ethical understanding
- Intercultural understanding.

In the Australian Curriculum: Science, general capabilities are identified wherever they are developed or applied in

content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning through content elaborations. Icons indicate where general capabilities have been identified in Science content. Teachers may find further opportunities to incorporate explicit teaching of the capabilities depending on their choice of activities.

Literacy

Students become literate as they develop the knowledge, skills and dispositions to interpret and use language confidently for learning and communicating in and out of school and for participating effectively in society. Literacy involves students in listening to, reading, viewing, speaking, writing and creating oral, print, visual and digital texts, and using and modifying language for different purposes in a range of contexts.

Students develop literacy capability as they learn how to construct an understanding of how scientific knowledge is produced; to explore, analyse and communicate scientific information, concepts and ideas; and to plan, conduct and communicate investigations. Scientific texts that students are required to comprehend and compose include those that provide information, describe events and phenomena, recount experiments, present and evaluate data, give explanations and present opinions or claims. Language structures are used to link information and ideas, give explanations, formulate hypotheses and construct evidence-based arguments.

By learning the literacy of science students understand that language varies according to context and they increase their ability to use language flexibly. Scientific vocabulary is often technical and includes specific terms for concepts and features of the world, as well as terms that encapsulate an entire process in a single word, such as 'photosynthesis'. Students learn to understand that much scientific information is presented in the form of diagrams, flow charts, tables and graphs.

Numeracy

Students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.

Many elements of numeracy are evident in the Science Curriculum, particularly in *Science Inquiry Skills*. These include practical measurement and the collection, representation and interpretation of data from investigations.

Students are introduced to measurement, first using informal units then formal units. Later they consider issues of uncertainty and reliability in measurement. As students progress, they collect both qualitative and quantitative data, which is analysed and represented in graphical forms. Students learn data analysis skills, including identifying trends and patterns from numerical data and graphs. In later years, numeracy demands include the statistical analysis of data, including issues relating to accuracy, and linear mathematical relationships to calculate and predict values.

Information and Communication Technology (ICT) capability

Students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. ICT capability involves students in learning to make the most of the technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment.

Students develop ICT capability when they research science concepts and applications, investigate scientific phenomena, and communicate their scientific understandings. In particular, they employ their ICT capability to access information; collect, analyse and represent data; model and interpret concepts and relationships; and communicate science ideas, processes and information.

Digital technology can be used to represent scientific phenomena in ways that improve students' understanding of concepts, ideas and information. Digital aids such as animations and simulations provide opportunities to view phenomena and test predictions that cannot be investigated through practical experiments in the classroom and may enhance students' understanding and engagement with science.

Critical and creative thinking

Students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are integral to activities that require students to think broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation in all learning areas at school and in their lives beyond school.

Students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use them when seeking new pathways or solutions. In the Science learning area, critical and creative thinking are embedded in the skills of posing questions, making predictions, speculating, solving problems through investigation, making evidence-based decisions, and analysing and evaluating evidence. Students develop understandings of concepts through active inquiry that involves planning and selecting appropriate information, and evaluating sources of information to formulate conclusions.

Creative thinking enables the development of ideas that are new to the individual, and this is intrinsic to the development of scientific understanding. Scientific inquiry promotes critical and creative thinking by encouraging flexibility and open-mindedness as students speculate about their observations of the world. Students' conceptual understanding becomes more sophisticated as they actively acquire an increasingly scientific view of their world.

Personal and social capability

Students develop personal and social capability as they learn to understand themselves and others, and manage

their relationships, lives, work and learning more effectively. The personal and social capability involves students in a range of practices including recognising and regulating emotions, developing empathy for and understanding of others, establishing positive relationships, making responsible decisions, working effectively in teams and handling challenging situations constructively.

Students develop personal and social capability as they engage in science inquiry, learn how scientific knowledge informs and is applied in their daily lives, and explore how scientific debate provides a means of contributing to their communities. This includes developing skills in communication, initiative taking, goal setting, interacting with others and decision making, and the capacity to work independently and collaboratively.

The Science learning area enhances personal and social capability by expanding students' capacity to question, solve problems, explore and display curiosity. Students use their scientific knowledge to make informed choices about issues that impact their lives such as health and nutrition and environmental change, and consider the application of science to meet a range of personal and social needs.

Ethical understanding

Students develop ethical understanding as they identify and investigate the nature of ethical concepts, values, character traits and principles, and understand how reasoning can assist ethical judgment. Ethical understanding involves students in building a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others.

Students develop the capacity to form and make ethical judgments in relation to experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and explore and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms.

They use scientific information to evaluate claims and to inform ethical decisions about a range of social, environmental and personal issues, for example, land use or the treatment of animals.

Intercultural understanding

Students develop intercultural understanding as they learn to value their own cultures, languages and beliefs, and those of others. They come to understand how personal, group and national identities are shaped, and the variable and changing nature of culture. The capability involves students in learning about and engaging with diverse cultures in ways that recognise commonalities and differences, create connections with others and cultivate mutual respect.

There are opportunities in the Science learning area to develop intercultural understanding. Students learn to appreciate the contribution that diverse cultural perspectives have made to the development, breadth and diversity of science knowledge and applications. Students become aware that the raising of some debates within culturally diverse groups requires cultural sensitivity. They recognise that increasingly scientists work in culturally diverse

teams and engage with culturally diverse communities to address issues of international importance.

Cross-curriculum priorities

The Australian Curriculum is designed to meet the needs of students by delivering a relevant, contemporary and engaging curriculum that builds on the educational goals of the Melbourne Declaration. The Melbourne Declaration identified three key areas that need to be addressed for the benefit of both individuals and Australia as a whole. In the Australian Curriculum these have become priorities that provide students with the tools and language to engage with and better understand their world at a range of levels. The priorities provide dimensions which will enrich the curriculum through development of considered and focused content that fits naturally within learning areas. They enable the delivery of learning area content at the same time as developing knowledge, understanding and skills relating to:

- · Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- sustainability.

Cross-curriculum priorities are addressed through learning areas and are identified wherever they are developed or applied in content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning in content elaborations. They will have a strong but varying presence depending on their relevance to the learning area.

Aboriginal and Torres Strait Islander histories and cultures

Across the Australian Curriculum, the Aboriginal and Torres Strait Islander histories and cultures priority provides opportunities for all learners to deepen their knowledge of Australia by engaging with the world's oldest continuous living cultures. Students will understand that contemporary Aboriginal and Torres Strait Islander Communities are strong, resilient, rich and diverse. The knowledge and understanding gained through this priority will enhance the ability of all young people to participate positively in the ongoing development of Australia.

The Australian Curriculum: Science values Aboriginal and Torres Strait Islander histories and cultures. It acknowledges that Aboriginal and Torres Strait Islander Peoples have longstanding scientific knowledge traditions.

Students will have opportunities to learn that Aboriginal and Torres Strait Islander Peoples have developed knowledge about the world through observation, using all the senses; through prediction and hypothesis; through testing (trial and error); and through making generalisations within specific contexts. These scientific methods have been practised and transmitted from one generation to the next. Students will develop an understanding that Aboriginal and Torres Strait Islander Peoples have particular ways of knowing the world and continue to be innovative in providing significant contributions to development in science. They will investigate examples of

Aboriginal and Torres Strait Islander science and the ways traditional knowledge and western scientific knowledge can be complementary.

Asia and Australia's engagement with Asia

Across the Australian curriculum, this priority will ensure that students learn about and recognise the diversity within and between the countries of the Asia region. They will develop knowledge and understanding of Asian societies, cultures, beliefs and environments, and the connections between the peoples of Asia, Australia, and the rest of the world. Asia literacy provides students with the skills to communicate and engage with the peoples of Asia so they can effectively live, work and learn in the region.

In the Australian Curriculum: Science, the priority of Asia and Australia's engagement with Asia provides rich and engaging contexts for developing students' science knowledge, understanding and skills.

The Australian Curriculum: Science provides opportunities for students to recognise that people from the Asia region have made and continue to make significant contributions to the development of science understandings and their applications. It enables students to recognise that the Asia region includes diverse environments and to appreciate that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world.

In this learning area, students appreciate that the Asia region plays an important role in scientific research and development. These can include research and development in areas such as medicine, natural resource management, nanotechnologies, communication technologies and natural disaster prediction and management.

Sustainability

Across the Australian Curriculum, sustainability will allow all young Australians to develop the knowledge, skills, values and world views necessary for them to act in ways that contribute to more sustainable patterns of living. It will enable individuals and communities to reflect on ways of interpreting and engaging with the world. The Sustainability priority is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and their interdependence.

In the Australian Curriculum: Science the priority of sustainability provides authentic contexts for exploring, investigating and understanding chemical, biological, physical and Earth and space systems.

The Australian Curriculum: Science explores a wide range of systems that operate at different time and spatial scales. By investigating the relationships between systems and system components and how systems respond to change, students develop an appreciation for the interconnectedness of Earth's biosphere, geosphere, hydrosphere and atmosphere. Relationships including cycles and cause and effect are explored, and students develop observation and analysis skills to examine these relationships in the world around them.

In this learning area, students appreciate that science provides the basis for decision making in many areas of society and that these decisions can impact on the Earth system. They understand the importance of using science to predict possible effects of human and other activity and to develop management plans or alternative technologies that minimise these effects.

Links to other learning areas

Learning in science involves the use of knowledge and skills learnt in other areas, particularly in English, mathematics and history.

English

There is strong support in schools across Australia for linking learning in science with learning literacy skills. The science tradition places a high priority on accurate communication. The Australian Curriculum: Science is supported by and in turn reinforces the learning of literacy skills. Students need to describe objects and events, interpret descriptions, read and give instructions, explain ideas to others, write reports and procedural accounts, participate in group discussions and provide expositions.

Mathematics

The science curriculum closely complements that of mathematics. In science, students process data using simple tables, lists, picture graphs, simple column graphs and line graphs. In the mathematics curriculum they will be developing these skills at similar year levels. In mathematics, students' data analysis skills will develop to include scatter plots, linear graphs and the gradient of graphs. This will enhance their ability to analyse patterns and trends in data as part of scientific investigations.

Students develop their use of metric units in both the mathematics and science curriculums. The ability to convert between common metric units of length and mass and their use of decimal notation in mathematics will enable them to represent and compare data in meaningful ways in science. In mathematics, students learn simple statistical methods and these skills will enable students to apply quantitative analysis of data as required in science. The concept of outliers, learnt in mathematics, will help them to identify inconsistencies in quantitative data in science.

When considering phenomena and systems at a vast range of scales in science, students use their mathematical knowledge of timescales and intervals. They use scientific notation in the representation of these values as required. Students' mathematical ability to solve problems involving linear equations can be utilised in science when investigating quantitative relationships.

History

History provides another avenue to the understanding of how science works. Science and its discoveries are a

source of historical facts and artefacts. The strand *Science as a Human Endeavour* is an important link to historical developments. It is important that students learn that science and technology have grown through the gradual accumulation of knowledge over many centuries; that all sorts of people, including people like themselves, use and contribute to science. Historical studies of science and technology in the early Egyptian, Greek, Chinese, Arabic and Aboriginal and Torres Strait Islander cultures extending to modern times will help students understand the contributions of people from around the world.

The Australian Curriculum: Science takes account of what students have learnt in these areas so that their science learning is supported and their learning in other areas enhanced.

Implications for teaching, assessment and reporting

The science curriculum emphasises inquiry-based teaching and learning. A balanced and engaging approach to teaching will typically involve context, exploration, explanation and application. This requires a context or point of relevance through which students can make sense of the ideas they are learning. Opportunities for student-led open inquiry should also be provided within each phase of schooling.

Assessment encourages longer-term understanding and provides detailed diagnostic information. It shows what students know, understand and can demonstrate. It also shows what they need to do to improve. In particular, *Science Inquiry Skills* and *Science as a Human Endeavour* require a variety of assessment approaches.

Teachers use the Australian Curriculum content and achievement standards first to identify current levels of learning and achievement and then to select the most appropriate content (possibly from across several year levels) to teach individual students and/or groups of students. This takes into account that in each class there may be students with a range of prior achievement (below, at and above the year level expectations) and that teachers plan to build on current learning.

Teachers also use the achievement standards, at the end of a period of teaching, to make on-balance judgments about the quality of learning demonstrated by the students – that is, whether they have achieved below, at or above the standard. To make these judgments, teachers draw on assessment data that they have collected as evidence during the course of the teaching period. These judgments about the quality of learning are one source of feedback to students and their parents and inform formal reporting processes.

If a teacher judges that a student's achievement is below the expected standard, this suggests that the teaching programs and practice should be reviewed to better assist individual students in their learning in the future. It also suggests that additional support and targeted teaching will be needed to ensure that the student does not fall behind.

Assessment of the Australian Curriculum takes place in different levels and for different purposes, including:

- ongoing formative assessment within classrooms for the purposes of monitoring learning and providing feedback, to teachers to inform their teaching and for students to inform their learning
- summative assessment for the purposes of twice-yearly reporting by schools to parents and carers on the progress and achievement of students
- annual testing of Years 3, 5, 7 and 9 students' levels of achievement in aspects of literacy and numeracy, conducted as part of the National Assessment Program – Literacy and Numeracy (NAPLAN)
- periodic sample testing of specific learning areas within the Australian Curriculum as part of the National Assessment Program (NAP).

Glossary

Science v8.1

Year 8 Syllabus

Year Level Description

The science inquiry skills and science as a human endeavour strands are described across a two-year band. In their planning, schools and teachers refer to the expectations outlined in the achievement standard and also to the content of the science understanding strand for the relevant year level to ensure that these two strands are addressed over the two-year period. The three strands of the curriculum are interrelated and their content is taught in an integrated way. The order and detail in which the content descriptions are organised into teaching and learning programs are decisions to be made by the teacher.

Incorporating the key ideas of science

Over Years 7 to 10, students develop their understanding of microscopic and atomic structures; how systems at a range of scales are shaped by flows of energy and matter and interactions due to forces, and develop the ability to quantify changes and relative amounts.

In Year 8, students are introduced to cells as microscopic structures that explain macroscopic properties of living systems. They link form and function at a cellular level and explore the organisation of body systems in terms of flows of matter between interdependent organs. Similarly, they explore changes in matter at a particle level, and distinguish between chemical and physical change. They begin to classify different forms of energy, and describe the role of energy in causing change in systems, including the role of heat and kinetic energy in the rock cycle. Students use experimentation to isolate relationships between components in systems and explain these relationships through increasingly complex representations. They make predictions and propose explanations, drawing on evidence to support their views while considering other points of view.

Science Understanding

BIOLOGICAL SCIENCES

Cells are the basic units of living things; they have specialised structures and functions (ACSSU149)

Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce

(ACSSU150)

CHEMICAL SCIENCES

Properties of the different states of matter can be explained in terms of the motion and arrangement of particles

(ACSSU151)

Differences between elements, compounds and mixtures can be described at a particle level (ACSSU152)

Chemical change involves substances reacting to form new substances (ACSSU225)

EARTH AND SPACE SCIENCES

Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth

Science as a Human Endeavour

NATURE AND DEVELOPMENT OF SCIENCE

Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available

(ACSHE134)

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)

USE AND INFLUENCE OF SCIENCE

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations

(ACSHE135)

Ethical understanding

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)

Ethical understanding

Science Inquiry Skills

QUESTIONING AND PREDICTING

Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

Literacy

Critical and creative thinking

PLANNING AND CONDUCTING

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed

(ACSIS140)

Literacy

Critical and creative thinking Personal and social capability Ethical understanding

Measure and control variables, select equipment appropriate to the task and collect data with accuracy (ACSIS141)

Numeracy

PROCESSING AND ANALYSING DATA AND INFORMATION

Construct and use a range of representations, including graphs,

over a variety of timescales

(ACSSU153)

PHYSICAL SCIENCES

Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems (ACSSU155) keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS144)

Literacy Numeracy Information and Communication Technology (ICT) capability Critical and creative thinking

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS145)

Literacy Numeracy Critical and creative thinking

EVALUATING

Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements (ACSIS146)

Literacy Numeracy Critical and creative thinking

Use scientific knowledge and findings from investigations to evaluate claims based on evidence (ACSIS234)

Literacy

Critical and creative thinking

COMMUNICATING

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate <u>(ACSIS148)</u>

Literacy

Information and Communication Technology (ICT) capability

Year 8 Achievement Standard

By the end of Year 8, students compare physical and chemical changes and use the particle model to explain and predict the properties and behaviours of substances. They identify different forms of energy and describe how energy transfers and transformations cause change in simple systems. They compare processes of rock formation, including the timescales involved. They analyse the relationship between structure and function at cell, organ and body system levels. Students examine the different science knowledge used in occupations. They explain how evidence has led to an improved understanding of a scientific idea and describe situations in which scientists collaborated to generate solutions to contemporary problems. They reflect on implications of these solutions for different groups in society.

Students identify and construct questions and problems that they can investigate scientifically. They consider safety and ethics when planning investigations, including designing field or experimental methods. They identify variables to be changed, measured and controlled. Students construct representations of their data to reveal and analyse patterns and trends, and use these when justifying their conclusions. They explain how modifications to methods could improve the quality of their data and apply their own scientific knowledge and investigation findings to evaluate claims made by others. They use appropriate language and representations to communicate science ideas, methods and findings in a range of text types.