Science

Victorian Curriculum F–10 Version 2.0

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# Introduction

## Rationale

Science is a dynamic, collaborative and creative human endeavour arising from our curiosity and desire to make sense of our world. Through science, we explore the unknown, investigate universal phenomena, make predictions and solve problems. Science is an empirical way of asking and answering questions about the changing world we live in, which is undergoing both natural and human-induced changes. Scientific knowledge is revised, refined and extended as new evidence arises and in response to peer review.

The Victorian Curriculum F–10 Science provides opportunities for students to experience the wonder of understanding the world scientifically. It enables students to develop an understanding of key science concepts and processes, the inquiry practices used to acquire and develop scientific knowledge, science’s contribution to our cultures and society, and applications of science in our lives.

The curriculum supports students to investigate their own questions of interest. Students apply critical and creative thinking skills to evaluate processes and findings, and to justify investigation conclusions, proposals and solutions. They evaluate different points of view and form evidence-based arguments about contemporary local, national and global issues that involve science. They are provided opportunities to work both individually and in teams. Students may go on to access further study, and to a variety of careers and jobs related to science.

## Aims

Science aims to ensure that students develop:

* an interest in science as a way of expanding their curiosity and willingness to investigate the changing world they live in
* a solid foundation of knowledge of the biological, chemical, Earth and space, and physical sciences
* an understanding of the dynamic nature of scientific knowledge, including historical and global contributions, and the roles of evidence, peer review and consensus
* an ability to select and integrate scientific knowledge and practices to explain, predict and understand phenomena and to apply understanding to new situations and events
* an understanding of scientific inquiry and the ability to use a range of scientific inquiry practices
* skills in data generation, representation, interpretation, analysis and evaluation
* an ability to solve problems, evaluate and debate scientific explanations and arguments, and justify conclusions and claims with evidence
* an ability to communicate scientific understanding and findings to a range of audiences
* an understanding of the relationship between science and society, including the diversity of science careers.

## Structure

The Science curriculum is presented in a 3-level band for Foundation to Level 2, and in 2-level bands for Levels 3 to 10.

Science comprises 3 interrelated strands:

* Science as a Human Endeavour
* Science Understanding
* Science Inquiry.

Together, the 3 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 and its concepts, nature and uses through clearly described inquiry practices.

Content under each strand is further organised into sub-strands, as shown below.

| Strand | **Science as a Human Endeavour**  | **Science Understanding** | **Science Inquiry**  |
| --- | --- | --- | --- |
| Sub-strands | Nature and development of scienceUse and influence of science | Biological sciencesChemical sciencesEarth and space sciencesPhysical sciences | Questioning and predictingPlanning and conductingProcessing, modelling and analysingEvaluatingCommunicating |

### Science as a Human Endeavour

In this strand, students learn about the nature of science, including the role of scientific inquiry in developing scientific knowledge, and the factors that affect the use and advancement of science. Students learn that, through science, we seek to improve our understanding of and explanations for the world, and that we refine and revise scientific knowledge as new evidence becomes available. They appreciate that science influences society when scientists pose and respond to ethical, environmental and social questions, and that individual and collective 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.

The Science as a Human Endeavour strand comprises the following 2 sub-strands.

#### Nature and development of science

Students develop an appreciation of the unique nature of science and scientific knowledge, including that scientific knowledge is based on empirical evidence and can be modified in light of new or reinterpreted evidence. They explore historical and global contributions to scientific knowledge, and appreciate that individual and collaborative scientific endeavours are influenced by cultural perspectives and worldviews.

In this sub-strand, students develop core concepts that:

* scientific inquiry values curiosity, creativity, precision, objectivity, open-mindedness, perseverance and scepticism
* scientific knowledge is a result of individual and collaborative efforts, and advances reflect historical and global contributions
* scientific knowledge is built on empirical evidence; however, all scientific knowledge can be changed in light of new or reinterpreted evidence.

#### Use and influence of science

Students explore how scientific knowledge and applications affect individuals and communities, including informing their decisions and identifying responses to contemporary issues. They learn that ethical, environmental and social implications must be taken into account when making decisions about science practices and applications. Students gain an appreciation for the ways in which science is influenced by the needs and priorities of society.

In this sub-strand, students develop the core concepts that:

* scientific knowledge, practices and products are influenced by ethical, environmental, social and economic factors
* science, technology and engineering are interconnected – advances in one field can lead to advances in other fields
* scientific knowledge, balanced with ethical and social considerations, contributes to understanding complex contemporary issues and identifying responses.

### Science Understanding

In this strand, students learn to select and integrate relevant scientific knowledge to explain and predict phenomena, and apply that knowledge to new situations. Scientific knowledge refers to facts, concepts, principles, laws, theories and models that have been established over time.

The Science Understanding strand comprises the following 4 sub-strands.

#### Biological sciences

Students develop an understanding of living things, including animals, plants and microorganisms, and their interdependence and interactions within ecosystems. They explore life cycles, body systems, structural adaptations and behaviours; how these features aid survival; and how characteristics are inherited by one generation from the previous generation. They consider the interdependence of biological systems at a range of scales, and identify how these systems respond to change.

In this sub-strand, students develop the core concepts that:

* living things have evolved on Earth over hundreds of millions of years; this continuous process has led to rich diversity
* the form and features of living things are related to the functions of their body systems
* biological systems are interdependent, and interact with each other and their environments.

#### Chemical sciences

Students develop an understanding of the composition and behaviour of substances. They describe substances in terms of their state, such as being a solid, liquid or gas; and they classify matter in terms of its composition, such as being an element, compound or mixture. They explore physical changes, such as changes of state, and investigate how new substances form during chemical reactions. Students recognise that all substances consist of atoms, and that atoms in substances rearrange and recombine during chemical reactions to form new substances. They explore chemical systems at a range of scales, from sub-atomic to macroscopic, to examine relationships between atoms, properties of substances and energy.

In this sub-strand, students develop the core concepts that:

* the chemical and physical properties of substances are determined by their structure at a range of scales
* substances change and new substances are formed when atoms rearrange; these changes involve energy transfer and energy transformation.

#### Earth and space sciences

Students develop an understanding of Earth’s dynamic structure and Earth’s place in the universe. They learn to 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 revolution around the Sun. Students explore the interactions and interdependencies of the systems that constitute the Earth system: the atmosphere, biosphere, hydrosphere and lithosphere. They appreciate that living things depend on sustainability of the Earth system, and investigate the influence of human activity on key processes, cycles and relationships.

In this sub-strand, students develop the core concepts that:

* the Earth system comprises dynamic and interdependent systems; interactions between these systems cause continuous change over a range of scales
* all living things are connected through Earth’s systems and depend on sustainability of the Earth system
* Earth is part of an astronomical system; interactions between Earth and celestial bodies influence the Earth system.

#### Physical sciences

Students develop an understanding of forces and motion, and matter and energy. They investigate how an object’s motion is influenced by a range of forces, such as frictional, magnetic, gravitational and electrostatic forces, and learn how to represent and predict the effects of these forces on an object’s motion. They develop an increasingly rich 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 the atomic scale to the scale of the universe itself.

In this sub-strand, students develop the core concepts that:

* forces affect the motion and behaviour of objects
* energy can be transferred and transformed, and is conserved within systems.

### Science Inquiry

This strand is concerned with investigating ideas, developing explanations, solving problems, drawing valid conclusions, evaluating claims and constructing evidence-based arguments. Students learn the essential practices of science, including identifying and posing questions; planning, conducting and evaluating investigations; processing, analysing and interpreting evidence; and communicating findings.

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. They can involve a range of methodologies and activities including experimental testing, fieldwork, locating and using information sources, conducting surveys and interviews, investigating case studies, and using modelling and simulations. The approach taken will depend on the context and aims of the investigation. All scientific methodologies include empirical observation (observation of the world), systematic observation, replicable methods, provisional results (open to question and debate) and objectivity.

The Science Inquiry strand comprises the following 5 sub-strands.

#### Questioning and predicting

Students learn to identify and construct questions, propose hypotheses and predict possible outcomes. Students appreciate the role of questions, predictions and hypotheses as critical and creative drivers of scientific inquiry.

In this sub-strand, students develop the core concepts that:

* scientific inquiry involves making observations and predictions, asking questions, and constructing and testing explanations for natural and physical phenomena
* scientific inquiry may be done to describe a phenomenon, explore relationships, test a theory or model, or design solutions.

#### Planning and conducting

Students learn to make decisions about how to investigate or solve a problem and carry out an investigation, and generate and record data safely. They consider ethical and cultural issues and protocols associated with the generation or use of data, and recognise and manage risk and safety. Students appreciate the important considerations and practices involved in the design of scientific investigations.

In this sub-strand, students develop the core concept that:

* scientific inquiries should be designed to systematically generate or collect valid and reliable primary and secondary data in safe, ethical and interculturally aware ways.

#### Processing, modelling and analysing

Students learn to analyse and represent data in meaningful and useful ways, and identify trends, patterns and relationships in data. Students engage in the key practices involved in generating scientific evidence.

In this sub-strand, students develop the core concept that:

* mathematical thinking underpins the science practices of representing objects and events, analysing data and modelling relationships.

#### Evaluating

Students learn to consider the quality of available evidence by critically evaluating methods used to generate data and whether these produce data of sufficient validity to enable a meaningful conclusion. Students assess the merit or significance of a claim, proposition, explanation or argument with reference to that evidence. Students engage in the practices involved in refining and revising scientific ideas.

In this sub-strand, students develop the core concept that:

* evaluating evidence enables development of explanations, decision-making and designed solutions.

#### Communicating

Students learn to convey information or ideas to others in ways appropriate to the purpose and audience. Students engage in the practices involved in effective and purposeful communication for a range of audiences.

In this sub-strand, students develop the core concept that:

* critiquing and communicating science ideas effectively is critical to advancing science, and influencing environmental, social and economic futures.

### Achievement standards

Achievement standards describe what students are typically able to understand and do, and they are the basis for reporting student achievement.

In Science, students progress along a learning continuum that provides the first achievement standard at Level 2, and then at Levels 4, 6, 8 and 10.

### Content descriptions

In Science, content descriptions sequence and describe the knowledge, understanding and skills that teachers need to teach and students are expected to learn.

### Elaborations

Elaborations are examples that provide guidance on how the curriculum may be transformed into a classroom activity or learning opportunity. They are provided as advisory material only.

## Learning in Science

### Integrating the strands

In the practice of science, the 3 strands of Science (Science as a Human Endeavour, Science Understanding and Science Inquiry) are closely integrated – the work of scientists seeks to respond to and influence society’s needs, reflects the nature and development of science, and is built around scientific inquiry. Students’ experiences of science at school should mirror and connect to the multifaceted nature of science.

To achieve this, the 3 strands of Science should be taught in an integrated way. The content descriptions of the 3 strands have been written so that at each level this integration is possible. The content of Science Understanding can inform students’ understanding of everyday phenomena, as well as contemporary issues such as resource use, emerging technologies, climate change and protection of biodiversity. The importance of these areas of science can be emphasised through the content of Science as a Human Endeavour, and students can be encouraged to view historical and contemporary science critically through aspects of the Science Inquiry strand, for example by evaluating and communicating.

To support teachers and students to make connections across the strands, sample inquiry questions are provided within each band overview. These optional inquiry questions can give students context and motivation as they develop their scientific knowledge, understanding and practices. An inquiry question might provide a useful prompt for a class discussion or a series of learning experiences.

### Key ideas

An overarching set of key ideas supports teachers and students to make connections across the 3 strands of Science. Exploring the key ideas supports the coherence of scientific understanding within and across levels, enabling students to connect diverse phenomena and frame their deepening understanding in the context of systems thinking. Systems thinking also underpins scientific inquiry practices and contributes to developing students’ appreciation of science.

Six key ideas are important to integrating the 3 strands of Science.

#### Patterns, order and organisation

An important aspect of science is recognising patterns in the world around us, and ordering and considering phenomena at different scales. As students progress from Foundation to Level 10, they build skills and understanding that will help them to observe and describe patterns at different scales, and to develop and use classifications to organise events and phenomena, and make predictions. As students progress from Foundation to Level 6, they become more proficient at identifying and describing the relationships that underpin patterns, including cause and effect. Students increasingly recognise that scale has an important role in the observation of patterns – some patterns may only be evident at certain timescales and spatial scales.

#### Form and function

Many aspects of science are concerned with the relationships between form (the make-up of an aspect of an object or organism) and function (the way in which that aspect works). As students progress from Foundation to Level 10, they see that the functions of living and non-living things rely on their forms. Students’ understanding of forms – such as the features of living things and the properties of various materials, and their related functions or uses – is initially based on observable behaviours and properties. From Level 3, 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. From Foundation, 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 Level 10, they also recognise that phenomena (such as properties of objects and relationships between living things) can appear stable at one timescale or spatial scale, but may change at larger or smaller scales. Students begin to appreciate that stability can be the result of competing but balanced forces or processes. 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 scientific understanding because it enables the comparison of observations. However, students often find it difficult to comprehend scales outside their everyday experience – these include the vast distances in space, the incredibly small size of atoms and the slow processes that occur over geological time. As students progress from Foundation to Level 10, their understanding of relative sizes and rates of change develops, and they conceptualise events and phenomena at a broader range of scales. They progress from working with scales related to their everyday experiences, comparing events and phenomena using relative language (such as ‘bigger’ or ‘faster’), and informal measurement, to working with scales beyond direct 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 levels, they become increasingly able to explain phenomena in terms of the flow of matter and energy. From Foundation, students focus on direct experience and observation of phenomena and materials. From Level 3, they connect observable phenomena with ideas about particles, forces, and energy transfer and transformation that are more abstract. They use these understandings to describe and model phenomena and processes involving matter and energy.

#### Systems

Science often involves systems thinking, modelling and analysing to understand, explain and predict events and phenomena. As students progress from Foundation to Level 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 Levels 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. At Levels 7 to 10, they are introduced to the processes and relationships 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. For a system to be in a steady state, these factors need to be in a state of balance or equilibrium. Students 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 considerations

Two key considerations are important to integrating the 3 strands of Science.

#### Safety

Identifying and managing risk in Science involves addressing the safe use of equipment and materials as well as safe behaviours in field, classroom and 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 principal to ensure that duty of care is exercised in relation to the health and safety of all students, and that school practices comply with health and safety requirements. Teachers and students should observe appropriate safety precautions and cultural responsiveness when undertaking practical investigations, and all laboratory work should be supervised by the teacher.

Schools should refer to the relevant Acts, regulations, codes and standards (see the support materials for specific references). Teachers should ensure they access up-to-date versions of all Acts, regulations, codes and standards.

In Victoria, the relevant legislation for electrical safety is the *Electricity Safety Act 1998* and associated regulations. Only persons who hold an appropriate current electrical licence are permitted to carry out electrical work on products or equipment that require voltages greater than 50 V AC or 120 V ripple-free DC. This requirement means that students are not permitted to carry out any electrical work on the internal components of electrical products or equipment that operate above these voltages.

Students are permitted to work with approved apparatus, appliances and testing equipment that operate at voltages up to 240 V (e.g. appliances such as electric drills or electric soldering irons); however, they must not access or modify any component on such apparatus or appliances.

Any product that requires voltages up to 50 V AC or 120 V DC in a supervised class must comply with ‘Wiring rules’ (AS/NZS 3000:2000) and the general requirements for electrical equipment in ‘Approval and test specification’ (AS/NZS 3100:2002).

For investigations involving food, care must be taken with regard to food safety and specific food allergies, including 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. [Allergen awareness training](https://foodallergytraining.org.au/) is available.

For investigations involving animals, teachers should refer to the [Victorian Department of Education Teaching with Animals policies, guidance and resources](https://www2.education.vic.gov.au/pal/teaching-with-animals/policy).

#### Ethics

##### Animal ethics

Any teaching activities that involve caring for, using or interacting with animals must comply with the National Health and Medical Research Council’s [Australian Code for the Care and Use of Animals for Scientific Purposes](https://www.nhmrc.gov.au/about-us/publications/australian-code-care-and-use-animals-scientific-purposes). In accordance with legislative requirements, every Victorian school using animals for scientific teaching and learning must be covered by a Scientific Procedures Premises Licence. A single licence held by the Victorian Department of Education covers all government schools.

Catholic and independent schools must apply for individual licences, obtained through [Agriculture Victoria](https://agriculture.vic.gov.au/livestock-and-animals/animal-welfare-victoria/animals-used-in-research-and-teaching/licensing-to-use-animals-in-research-or-teaching/about-teaching-with-animals).

The [Victorian Schools Animal Ethics Committee](https://www2.education.vic.gov.au/pal/teaching-with-animals/guidance/about-victorian-schools-animal-ethics-committee) (VSAEC) assists Victorian schools to comply with relevant legislation in the responsible care of animals used in teaching. VSAEC is available to government, Catholic and independent schools.

For further information about relevant guidelines, or to access your local animal ethics committee, see the Victorian Department of Education guidelines [Care and Use of Animals in Victorian Schools](https://www.education.vic.gov.au/Documents/school/principals/curriculum/animalguidelines.pdf)[.](https://www.education.vic.gov.au/Documents/school/principals/curriculum/animalguidelines.pdf%22%20%5Co%20%22Opens%20in%20a%20new%20window%22%20%5Ct%20%22_blank)

##### Ethical conduct of scientific investigations

As part of Science, teachers and students may be involved in teaching and learning activities that involve practical work and scientific investigations using human subjects. Teachers and schools have a legal and moral responsibility to ensure that students always demonstrate ethical conduct when undertaking such activities. Teachers should refer to the support materials for links to detailed advice.

# Curriculum

## Foundation to Level 2

### Band description

From Foundation to Level 2, students build an understanding that science involves making and organising observations to identify patterns and relationships, and that these patterns and relationships are the basis of scientific predictions.

A focus for students at these levels is on exploring changes in the world around them, including changes they can initiate themselves, such as making things move or change shape. They observe that changes to objects and events can be large or small and happen quickly or slowly. Their investigations of the properties of materials lead them to recognise that those properties stay the same when a material is changed physically. Students begin to link function with observable properties, such as comparing the features of animals and plants that enable them to survive. They identify the components of simple systems and explore the ways that components in a system interact.

Students develop scientific skills by observing using their senses, posing questions and conducting investigations to seek answers to questions. They use counting and informal measurements to make comparisons. They appreciate that organising observations in tables makes it easier to identify and represent patterns, recognising that some patterns can only be observed over certain timescales.

Inquiry questions can help stimulate students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration of the key science ideas:

* Why is sorting important?
* How are a spider and a fly alike and different?
* How do we know what season it is?
* Is using handspans a good way to measure length?
* How can we make and sense music?
* What is the difference between a star and a planet?

### Achievement standard

By the end of Level 2, students make and compare observations about the world around them. They describe situations in their lives where they ask questions about natural phenomena and use patterns from their observations to make scientific predictions.

Students group plants and animals based on observable features, and identify how living things meet their needs in the places they live. They explain how the features of plants and animals enable their survival. They describe the observable properties of the materials that make up objects. They provide examples of objects and mixtures that are made from a combination of materials, and distinguish between the properties of objects or mixtures and those of the materials from which they are made. They identify ways to change materials without changing their material composition. They identify daily and seasonal changes and describe ways these changes affect everyday life. They identify celestial objects and describe patterns they see in the sky. They suggest ways that the use of common materials can be reduced, re-used and recycled, and explain the importance of these actions for sustainability. They identify factors that influence the movement of objects. They describe and predict how different strengths and directions of pushes and pulls change the motion and shape of objects. They describe the effect of sound energy on objects and demonstrate how different sounds can be produced.

Students pose questions about observed patterns or relationships and make predictions related to familiar objects and events. They suggest steps to be followed in an investigation, and follow safe procedures to make and record observations, including informal measurements. They use provided tables and organisers to sort and order data, and represent simple patterns in data. With guidance, they compare their own observations and predictions with those of others, and identify further questions for investigation. They use everyday and some scientific vocabulary to communicate observations, findings and ideas.

### Content descriptions and elaborations

#### Strand: Science as a Human Endeavour

##### Sub-strand: Nature and development of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge is based on observations of the natural world using the senses, and scientific tools and instrumentsVC2S2H01 | * exploring what an observation is, and different ways to make observations using the 5 senses, through guided discussion
* viewing examples of observations, for example recorded in rock paintings, bark drawings, age-appropriate written reports, labelled drawings or photographs, to explore ways that people make and record observations
* listening to people involved in scientific work – such as arborists, nurses, engineers and meteorologists – and asking questions about the importance of observations in their work
* interacting with stories or documentaries about scientists and noticing the ways that they make their observations, such as through drawings, collections, sound recordings and photography, and how they ask questions about what they think they will observe and find
* recognising that astronomers use patterns of movement of celestial objects, such as stars and comets, in the sky to make predictions about future appearances
 |

##### Sub-strand: Use and influence of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| science is used by people in their daily lives, including asking questions and using patterns from observations of the world around them to make scientific predictionsVC2S2H02 | * identifying ways that scientific knowledge is used in the care of the local environment to meet the needs of native animals and in designing supports to meet the needs of those animals, such as building frog and insect hotels and nesting boxes or recycling materials to provide habitat
* recognising how Aboriginal and/or Torres Strait Islander Peoples observe cyclic changes of night and day length, star patterns in the sky and seasons to predict when events occur, for example following seasonal calendars such as the Gariwerd calendar of the Djab Wurrung and Jardwardjali Peoples to associate the appearance of the emu constellation with the wildflower season during September to November
* sharing examples of how people use scientific knowledge at home, such as by listening to or viewing weather forecasts or observing weather patterns when planning family events or outings, and wearing appropriate clothing for the season
* discussing how people manage light and sound at home to ensure that they do not disturb each other or their neighbours, such as quietly closing doors, turning down the lights, taking off shoes on wooden floors and using window coverings
* learning from people who work with materials, such as woodworkers, product designers and artists (such as fibre artists and sculptors), about how they observe and learn about properties of materials and how they use creativity when manipulating materials
* investigating toys and digital tools that are sound-activated or voice-activated, and engaging in guided discussions about how some devices use voice patterns to recognise the unique features of an individual’s voice or to help people manage daily activities such as turning on lights and communicating with others
 |

#### Strand: Science Understanding

##### Sub-strand: Biological sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| plants and animals have observable features that can be used to group them in different waysVC2S2U01 | * observing fruits and vegetables and identifying them as parts of plants such as roots, flowers, fruit and leaves
* grouping animals as vertebrates (animals that have backbones or spinal columns, such as amphibians, birds, fish, mammals and reptiles) or invertebrates (animals that have no backbones or bony skeletons inside them, such as insects, spiders, worms, snails, lobsters and jellyfish; some have outer shells while others have no hard parts in their bodies)
* recognising humans as animals, describing external features of humans, and exploring similarities to and differences with other animals
* using magnifying glasses or digital cameras to observe and identify external features of plants, including seeds, flowers, fruits and roots, or of animals, such as eyes, body coverings, legs and wings
* sorting collections of model animals and explaining different grouping strategies
* investigating how Aboriginal and/or Torres Strait Islander Peoples’ observations of external features have been represented in expressions of material culture from Deep Time to today, such as through rock art or cultural dances, for example in paintings of Genyornis newtoni, a megafaunal species that lived during the most recent Ice Age
 |
| plants and animals have basic needs, including air, water, food and shelter; the places where they live meet those needsVC2S2U02 | * identifying the places where plants and animals live, including in homes and in local areas such as ponds, national parks, gardens and zoos
* identifying what they do to look after pets or plants at home, and grouping these activities
* identifying and comparing the needs of a variety of plants and animals, including humans, based on their own experiences
* creating a diorama of a place a plant or animal lives, and identifying the features that enable it to meet its needs
* recognising how cultural protocols (ethical principles that guide behaviour in particular situations when interacting with Aboriginal and/or Torres Strait Islander Peoples and that are designed to protect Aboriginal and Torres Strait Islander cultural and intellectual property rights) around caring for Country and Place result in the promotion, preservation and protection of living things and the environment
* exploring why caring for plants and animals is important, including as sources of food and fibre
 |
| plants and animals have external features that perform different functions to enable their survival; in plants these features include roots, stems, leaves, flowers, fruit, bulbs, trunks and branches while different features in animals enable them to move, breathe, eat and respond to their environmentVC2S2U03 | * comparing the roots, leaves, flowers and stems of different plants
* investigating the movement of water in plants by observing what happens when a celery stick is placed in a glass of water to which food colouring has been added
* exploring how the 5 human sensory organs (eyes, ears, skin, nose and tongue) detect and respond to what is happening around them, and comparing the importance of sensory organs for different animals, such as in echolocation used by bats
* exploring why animals, including humans, have different teeth and how this relates to diets (herbivores, carnivores and omnivores)
* investigating how Aboriginal and/or Torres Strait Islander Peoples’ observations of external features of living things, such as the way that different animals move and behave, can be represented in traditional dance
* grouping animals on the basis of common features, for example identifying how different animals use their tails or comparing body coverings of different animals, such as scales, fur, hair and skin
 |

##### Sub-strand: Chemical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| objects can be made of one or more different materials; these materials have observable propertiesVC2S2U04 | * observing and manipulating objects to identify the materials these are made from and recognising that some objects are made of more than one type of material
* identifying and naming materials in the classroom, and grouping objects made of similar materials or combinations of materials
* recognising that tools such as magnifying glasses enable observation in more detail
* sorting and grouping materials based on observed properties such as colour, hardness, texture and flexibility
* investigating the ways that Aboriginal and/or Torres Strait Islander Peoples have constructed and continue to construct material culture (physical aspects of the objects that surround people including the creation and use of objects such as tools, housing and clothing, including the trade of articles, as well as the behaviours, norms and rituals associated with these objects) for different purposes by combining different materials, such as hafted stone artefacts (stone points that are put into a spear and secured with sinew) and eel baskets (fibre technologies crafted together, e.g. eel baskets woven by the Gunditjmara People from local river weeds and spear grass)
* creating a display of different materials, naming each material and exploring language to describe the properties of materials
* using a digital camera to collect images of objects on a materials scavenger hunt, and sorting the images into those that show objects made of one material and those that show objects made of 2 or more different materials
 |
| materials can be combined in a variety of ways for particular purposes; the properties of objects and mixtures can differ from the properties of the materials from which they are madeVC2S2U05 | * predicting and comparing how different materials can be combined for different purposes
* investigating how food can be mixed to form different products such as jelly, ice cream and cake
* suggesting why different parts of everyday objects such as toys and clothes are made from different materials
* investigating the ways that Aboriginal and/or Torres Strait Islander Peoples have constructed and continue to construct material culture for different purposes by combining different materials, for example sewing together possum pelts with sinew to make cloaks and decorating them with ochre or constructing contemporary jewellery that includes feathers, woven fibre technologies and shells
* investigating how different proportions of sand and water, as examples of mixtures, can affect the construction and stability of sandcastles
 |
| materials can be changed physically by different actions without changing their material composition, including by bending, twisting, stretching, crushing, squashing and breaking into smaller piecesVC2S2U06 | * exploring how materials can be physically changed to suit a particular purpose, such as twisting strands of cotton or wool together to make the thread stronger, and folding paper to make it fly
* manipulating materials such as paper and fabric, and determining ways that these can be physically changed by scrunching, twisting or bending, or broken into smaller pieces by cutting, tearing or crushing
* crushing a stick of chalk into a powder, comparing the properties of the stick and the powder, and discussing whether it is still the same material
* investigating how Aboriginal and/or Torres Strait Islander Peoples make physical changes to natural materials to produce material culture, for example in fibre technologies (such as basketry and fishing lines), pigments (such as ochre and medicines) and timberworking (such as working saplings to form boundary markers)
* creating an ‘odd one out’ game by providing samples of the same material that has been physically changed in different ways and one sample of a different material, and challenging other students to identify the odd one out
 |

##### Sub-strand: Earth and space sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| daily and seasonal changes in the weather and the environment can be observed and affect decisions made in everyday lifeVC2S2U07 | * making and recording observations of phenomena such as changes to weather, and seasonal changes to plants such as colour and dropping of leaves, and growth of flowers and fruit
* noticing how daily weather indicators and seasonal patterns help them to make plans for activities in their daily lives
* exploring how Aboriginal and/or Torres Strait Islander Peoples use particular concepts of time and weather patterns to explain how things happen in the world
* exploring how people make clothing choices using predictions of weather or knowledge of seasonal changes
* investigating how seasonal changes affect plants and animals, including animals that hibernate and migrate
* recognising the extensive knowledges of daily and seasonal changes in weather patterns and landscape held by Aboriginal and/or Torres Strait Islander Peoples, for example the use of local seasonal calendars to manage natural resources sustainably, such as knowing the best times for hunting specific animals or when certain plants are in season for harvesting
 |
| Earth is one of 8 planets in our solar system; observing the sky reveals patterns in the changing positions of the Sun, Moon, planets and stars VC2S2U08 | * exploring images, models and representations of the solar system and identifying Earth and other planets, such as images or videos of Earth from space, artworks depicting space, star trail images and physical models of the solar system
* observing that some phenomena in the sky are only visible during the day and others during the night
* creating a class Moon diary across a month, identifying patterns in the changing shape of the Moon and making predictions
* observing and describing short-term and longer-term patterns of events, and regular and irregular events, that occur in the sky, such as the appearance of the Moon and stars at different times of the month or year, the appearance of a full moon, and ‘blue’, ‘blood’ and ‘super’ moons
* exploring how cultural stories of Aboriginal and/or Torres Strait Islander Peoples describe the patterns in the changing positions of the Sun, Moon and stars
* observing the retrograde motion of a visible planet (Mercury, Venus, Mars, Jupiter or Saturn) relative to the background stars each night for a period of time and discussing how this is explained by the oral stories of different Aboriginal and/or Torres Strait Islander groups, for example the Wardaman People’s descriptions of this phenomenon as the old ancestor spirits walking the zodiacal path, both forwards and backwards
 |
| taking care of Earth’s water, land and air involves consideration of reducing, re-using and recycling materials to conserve Earth’s resourcesVC2S2U09 | * exploring why the release of helium balloons is illegal in Victoria and the alternatives to releasing balloons when celebrating special occasions
* identifying different objects and materials that can be re-used and/or recycled, and then collecting a range of recyclable materials and re-using them to make an object, such as creating a toy or an object that can move in a particular way
* exploring how compost can reduce the amount of food waste that is sent to landfill
* brainstorming ways of reducing water usage and ways that water can be saved
* exploring and asking questions about how physically changing materials helps people to re-use them in a variety of ways, and decrease waste
* exploring where different foods grow at different times of the year and making a list of foods that are currently in season to reduce ‘food miles’
 |

##### Sub-strand: Physical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the way objects move depends on a variety of factors including their size, shape and materialVC2S2U10 | * observing how toys move, and grouping these based on their movements
* observing and describing movements of different and unusually shaped objects such as blocks, tubes and boiled eggs when rolled down a slope
* comparing the way different-sized, similar-shaped objects such as tennis balls, golf balls, marbles and basketballs roll and bounce
* exploring how the material a ball is made from, such as plastic, foam, cloth or rubber, affects the way it moves
* investigating how the size and shape of Aboriginal and/or Torres Strait Islander Peoples’ traditional educational toys for children influence the toys’ movement; for example, the ball used in marngrook, a football game played by some Aboriginal groups at gatherings and celebrations, was traditionally played with a possum-skin ball in south-western Victoria, but in some other areas the ball was made from materials such as kangaroo skin
 |
| pushes and pulls are forces that can change an object’s movement or shape and can be represented in terms of strength and direction VC2S2U11 | * observing and manipulating everyday objects such as playground equipment, toys, windows and doors, and identifying the forces used to move these objects
* investigating how the design of age-appropriate sporting equipment such as paddles, plastic bats and racquets helps to produce stronger pushes and pulls
* recognising that pushing or pulling an object can start or stop its motion, or change its direction of travel
* exploring ways that the shape of modelling dough can be changed when pushed or pulled
* designing playground equipment, toys or games, and representing the push and pull forces involved, using models, digital drawings or role-play
* exploring how traditional Asian toys and games such as a kendama, Daruma Otoshi and hanetsuki are played using a push or a pull
 |
| sound can make materials vibrate and vibrating materials can make sound; different actions can be used to produce sounds of varying pitch and volume VC2S2U12 | * identifying how sounds are made, associating some of them with something vibrating, and then investigating how sound energy makes things vibrate, such as when speaking, using tuning forks, observing vibrations produced by a ‘twanged’ ruler held on a desk, experimenting with different ways of holding or positioning the ruler to produce observably different vibrations and sounds, and observing music speakers
* designing and making instruments that produce different sounds, such as drums, rainsticks, thongophones and box guitars, and using them to build vocabulary such as ‘loudness’ and ‘pitch’ to describe the sounds
* exploring different ways to produce sound using familiar objects, and actions such as striking, blowing, scraping, plucking and shaking
* making earmuffs from a variety of different materials to investigate which provides the best insulation against sound
* finding patterns between the pitch of a sound and features of the object that produced it, or between the volume of a sound and the strength of the vibrations that produced it
* discussing situations where echoes are produced and exploring how some people with vision impairment, and animals such as dolphins and bats, use echolocation to locate objects in their environments
 |

#### Strand: Science Inquiry

##### Sub-strand: Questioning and predicting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| experiences can be used as a basis for posing questions to explore observed patterns and relationships, and to make predictions VC2S2I01 | * asking questions about everyday objects and the materials these are made from, such as ‘What can shoes be made from?’ and exploring materials that can be used to make shoes (e.g. leather, wood, fur, plastic) and materials that cannot be used to make shoes (e.g. glass)
* asking questions that can be explored, such as how animals meet their needs in particular places: ‘Where does it shelter? Where does it get water from?’
* posing questions to explore patterns and relationships about the appearance or position of celestial objects in space across time, such as ‘I wonder if the Moon will look the same tomorrow or next week as it does today?’
* making predictions before fieldwork, such as about which plants and animals might be observed in the school grounds
* making predictions about explorations, such as ‘I think a plant will die if it doesn’t get enough water’
* making predictions based on experience, such as about what might occur when tissue paper is pulled with different amounts of force
 |

##### Sub-strand: Planning and conducting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific questions and predictions can be investigated safely by following procedures that have sequenced steps VC2S2I02 | * following safe procedures to record a plant’s seasonal changes by taking photographs, videos, drawings or making measurements
* exploring different ways of investigating science questions through guided discussion
* following steps in a guided investigation to determine how different objects move when pushed or pulled or suggesting steps for setting up and packing away equipment
* following visual or verbal steps to construct a musical instrument or manipulate a material
* suggesting safe procedures to observe the Sun, and taking measurements such as drawing chalk lines and using a length of string to measure shadows
* suggesting the materials and equipment that could be used to test predictions and measure the loudness of sounds made by different objects
 |
| observations are made using the senses and recorded, including informal measurements, using digital tools as appropriateVC2S2I03 | * exploring what an observation is, and different ways to make observations, through guided discussion
* safely following instructions to record the touch, smell, sight or sound of materials and explaining why it is not appropriate to taste materials
* using senses (except for taste), binoculars or magnifying glasses to identify plants and animals, and recording observations using numbers, dots or drawings
* using informal measurements to measure and record the change in shape or movement of an object using handspans, blocks, pencil lengths or a length of string
* exploring how digital tools can be used to make and record observations, such as simple clap-o-meter apps that measure sound volume, time-lapse digital photography for observing the apparent movement of celestial objects or slow-motion videos for observing a vibrating ruler
 |

##### Sub-strand: Processing, modelling and analysing

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data and information can be sorted and ordered using provided tables and organisers, and visual or physical models, to show simple patternsVC2S2I04 | * using provided tables to record how an object moves in a straight line
* suggesting tables or visual models that could be used to record weather or seasonal changes across days, months or a year
* using, with guidance, provided tables, visual models or physical models to record how far a material can stretch before tearing
* grouping the common features of plants and animals
* finding patterns in the sounds that are made by different objects such as saucepan lids of different sizes or elastic bands of different thicknesses
* sorting and ordering the changing appearance of the Moon to show a monthly cycle
 |

##### Sub-strand: Evaluating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| observations can be compared to predictions and the observations of others, which may lead to further questions being identifiedVC2S2I05 | * comparing observations of weather at different times of day with those of others, and making predictions about weather patterns in the next week
* comparing observations of different ways to physically change a material, such as by cutting and folding different types of paper, and exploring further questions to investigate physical changes to different materials
* identifying differences between observations of plants and animals by different people
* comparing, with guidance, observations with predictions about the way similar and different objects move
* identifying, after exploration, further questions that arise from comparing observations of sound with observations of others and considering if everyone senses sound in the same way
* suggesting, with guidance, reasons for differences between tracking methods recognised by Aboriginal and/or Torres Strait Islander Peoples to identify tracks or plants, and the counting of animals by students
 |

##### Sub-strand: Communicating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| observations, findings and ideas can be shared with others by using everyday and some scientific vocabularyVC2S2I06 | * using discussions, circle groups, drawings, blocks, modelling clay, craft materials or paper to share observations of external features of animals and plants
* using everyday language to describe push and pull forces, through role-play, labels, arrows or time-lapse drawings
* using scientific language to describe a collage that represents and displays all the ways that a material can be physically changed
 |

## Levels 3 and 4

### Band description

At Levels 3 and 4, students recognise that scientific inquiry leads to the development of explanations for phenomena and can be used by people to develop solutions to problems.

Students explore the value of grouping and classifying objects and events based on similarities and differences, and begin to recognise that classifications are not always easy to define or apply. Investigations of different materials lead to a deeper understanding of the relationship between form and function, and an appreciation that classification can enable prediction. Students recognise that change is described and measured in terms of differences over time and they begin to quantify their observations to enable comparisons. Their explorations related to forces and energy allow them to appreciate that some interactions result from phenomena that cannot be seen with the unaided eye. They learn that key processes such as heat transfer can cause predictable changes in simple systems. They extend their understanding of systems as interactions between related components and analyse patterns to identify that these interactions can occur in predictable ways.

Students learn more sophisticated ways of identifying and representing relationships, including the use of tables and graphs to identify patterns and relationships. They understand that science involves conducting fair tests to answer questions, test predictions or draw conclusions, and that scientific explanations are based on data. They recognise the value of using standard units of measurement to measure and compare the attributes of systems.

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 of the key science ideas:

* Is jelly a liquid or a solid?
* Are fossils just bones?
* How can we keep food fresh and safe to eat without using plastic?
* Can you do science without a fair test?
* Why is a spoon hot in soup and cold in ice cream?
* How do we get snow?

### Achievement standard

By the end of Level 4, students explain the role of data in scientific inquiry. They provide examples to explain how needs have been met or problems have been solved through applying scientific knowledge, skills and data.

Students classify and compare the characteristics of living, once-living and non-living things. They compare the life cycles of different plants and animals, and describe similarities and differences between parents and offspring at different stages of growth. They identify the roles of organisms in a habitat, and construct food chains. They classify solids, liquids and gases based on observable properties, and describe how heating and cooling can cause a change of state. They relate the use and re-use of materials to the materials’ properties. They explain how Earth’s resources can be used in a variety of ways. They list sources of water on Earth, identify key processes in the water cycle, and describe how water can cycle through the environment. They distinguish between weather and climate and explain how human activity can impact climate, and how these impacts may be reduced. They identify different sources of heat energy and measure temperature changes that may occur when heat is transferred from one object to another. They identify forces acting on objects and describe the effects of these.

Students pose questions to identify patterns and relationships, and make predictions based on observations. They plan investigations using planning scaffolds, identify key components of fair tests and describe how they conduct investigations safely. They use familiar classroom instruments and simple procedures to record observations and results, including formal measurements. They construct representations to organise data and information, and identify patterns and simple relationships. They compare their findings with those of others, assess the fairness of their investigations, propose further questions for investigation and draw conclusions. They communicate observations, findings and ideas for an identified purpose and audience, using scientific vocabulary and digital tools where appropriate.

### Content descriptions and elaborations

#### Strand: Science as a Human Endeavour

##### Sub-strand: Nature and development of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data from observations obtained through scientific inquiry can be used to develop explanations of natural phenomenaVC2S4H01 | * exploring how farmers use soil tests to determine whether their crops are growing in ideal conditions
* investigating how Aboriginal and/or Torres Strait Islander Peoples used observations about the conduction of heat to determine the best materials to be used as conductors and insulators in ground ovens, for example the Torres Strait Islander Kup Murri earth oven used in traditional feasting ceremonies
* recognising how food scientists use thermometers to monitor and manage the condition of food stored in refrigerators and freezers
* investigating how ecologists use food chain data to develop explanations for decline in numbers of native plants and animals such as the Richmond birdwing butterfly, and to develop strategies to increase their numbers
* exploring how hydrologists use rainfall and water-use data to explain the amount of water flowing in rivers and why this changes over time
 |

##### Sub-strand: Use and influence of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge, skills and data can be used by people to explain how they will meet a need or solve a problemVC2S4H02 | * investigating how understanding of life cycles of insect pests such as fruit flies led to effective control strategies
* investigating how engineers test the insulation properties of materials, and how this information is used to design food and beverage packaging, building insulation and clothing
* exploring how knowledge of the properties of plastic has influenced people to change how they purchase, use and dispose of plastic products
* recognising Aboriginal and/or Torres Strait Islander Peoples’ knowledges and understandings of evaporation and how the effect of evaporation can be reduced to conserve water, such as by digging flask-shaped wells designed to limit evaporation by creating a narrow entrance
* investigating human-constructed ways to store water such as dams, wells, artificial lakes, irrigation canals, pipes and water towers, and considering why people are encouraged to save and recycle water and to take actions that can be taken to reduce water consumption and waste
* examining how people use knowledge of friction to improve car and bicycle safety on slippery surfaces such as wet or icy roads
* investigating how knowledge of magnetic force is used to sort metals in recycling, mining and food processing
 |

#### Strand: Science Understanding

##### Sub-strand: Biological sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| living things have characteristics that distinguish them from non-living things and things that were once living, including fossils VC2S4U01 | * classifying a collection of objects as living, once-living or non-living and explaining their reasoning
* making fossil impressions using natural materials such as sea shells, leaves, flowers and bark, or using plastic or metal dinosaur or animal toys set into clay or modelling dough
* exploring differences between living things, once-living things and products of living things
 |
| plants and animals have different life cycles; offspring are similar, but not identical, to their parentsVC2S4U02 | * observing and describing differences between metamorphic life cycles of animals, such as those of butterflies, beetles and frogs, and non-metamorphic life cycles of animals, including those of humans
* comparing the physical characteristics of an animal such as a frog or moth with its activity at different stages of its life cycle
* representing stages of a plant or animal’s life cycle using drawings, digital photographs, graphic organisers or physical three-dimensional models
* observing photographs of different animals and their offspring, for example purebred and crossbred dog litters
* investigating how Aboriginal and/or Torres Strait Islander Peoples understand the life cycles of certain species, and use that knowledge, for example Aboriginal Peoples’ use of grass trees at various stages of the plant’s life cycle in ways that support and sustain the growth of the trees and ensures that the plant continues to yield resources such as using the young, soft leaves for food; the older leaves for meat-cutting tools and roofing material; the butt of the tree to construct educational toys called kamma; the dried stem as drill sticks for starting fires; and resin from the tree for waterproofing and as an adhesive
 |
| consumers, producers and decomposers have different roles and interactions within a habitat; food chains can be used to represent feeding relationshipsVC2S4U03 | * describing how animals, including humans, obtain their food from plants and other animals
* observing living things in a local habitat and categorising them as producers, consumers or decomposers
* researching the different types of decomposers and the importance of these within a habitat
* representing feeding relationships of producers and consumers as a food chain and comparing food chains across different habitats
* investigating the impact of introduced predators such as foxes on small mammal species in Australia
* researching how the removal of a food source from within a habitat, such as through an insect or rodent infestation, affects other living things within that habitat
 |

##### Sub-strand: Chemical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| solids, liquids and gases have observable properties; adding or removing heat energy leads to a change of state between solids, liquids and gasesVC2S4U04 | * investigating observable changes of state between solids and liquids, such as investigating ice melting or water freezing in a sealed bag and explaining their observations, or using ice cubes, butter or chocolate to explore how changes of state involve the removal or addition of heat
* holding a balloon near a heat source and observing its inflation, then placing the balloon in a bucket of iced water to observe it deflating
* demonstrating a chemical reaction that shows a change in state, for example reacting baking soda (a solid) with vinegar (a liquid) in a bottle and showing the production of carbon dioxide (a gas) by placing a balloon over the mouth of the bottle and watching the balloon inflate
* observing the properties of substances and classifying the substances as solids (which hold their shape), liquids (which take the shape of their containers) or gases (which expand to fill the available space in a container)
* investigating how changes of state in some materials used by Aboriginal and/or Torres Strait Islander Peoples are important for their use (e.g. beeswax and resins are heated to increase their malleability and subsequently used in the manufacture and repair of implements); to attach decorative materials to the hair, body and regalia; to waterproof items; and to improve the durability and longevity of such items
* exploring how changes from solid to liquid and from liquid to solid can help in the recycling of materials such as glass, aluminium and plastics
 |
| the properties of natural and made materials, including fibres, metals, glass and plastics, influence their use and re-useVC2S4U05 | * exploring vocabulary for describing properties; observing different fibres, metals, glass and plastics; and using appropriate terms to describe, compare and contrast the materials’ properties
* investigating familiar objects such as shoes, drink containers and backpacks, examining the combination of materials used to make them and suggesting reasons for those combinations based on properties of materials
* considering how Aboriginal and/or Torres Strait Islander Peoples have used and continue to use materials, such as those used to make tools, clothes and shelter, for different purposes, based on a material’s properties
* investigating how changes of state in some materials used by Aboriginal and/or Torres Strait Islander Peoples, such as beeswax and resins, are important for the materials’ uses
* designing, building and testing an object or structure such as a tent, lunch box or bird-feeder for a specific purpose
* investigating which materials can be recycled, and researching alternatives for materials such as single-use plastics
 |

##### Sub-strand: Earth and space sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| rocks, minerals and soils are important Earth resources and have observable properties that enable them to be used in a variety of waysVC2S4U06 | * examining different soils from local areas and using magnifying glasses to observe their non-living components, such as pebbles and sand, as well as living things such as plant matter, earthworms and insects, and describing ways that living things, including humans, depend on soils for things such as food production, habitats, and for storing and filtering water
* recognising that minerals are the building blocks of rocks and that the different characteristics of rocks depend on the minerals within them
* exploring the school grounds or a local area and observing or collecting different types of rocks, and describing similarities or differences such as texture, colour, grain and crystal size
* identifying rocks as key components of built and natural environments and recognising uses of minerals, such as for gemstones in jewellery, graphite in pencils and table salt in food
* investigating Aboriginal and/or Torres Strait Islander Peoples’ use of different rock and mineral types and how they were and continue to be used, for example the use of igneous rocks for stone blades and sedimentary rocks for grindstones and in pigments
* investigating which rocks or minerals are quarried or mined locally or regionally, and how those resources are used
 |
| water is an important Earth resource that originates from various sources; water cycles through the environment by moving through the sky, landscape and ocean, and involves processes including precipitation, evaporation, transpiration, condensation, melting, freezing, crystallisation, infiltration and run-off VC2S4U07 | * comparing the distribution of salt water and fresh water on Earth, and recognising that only 2.5% of Earth’s water is fresh water, with only a little more than 1.2% of this fresh water available for use as surface water
* recognising that the land, sea and water are central to Aboriginal and Torres Strait Islander Peoples’ culture and spirituality and that connection to water includes the responsibility to care for water on Country and Place, particularly in remote areas where water can be scarce
* identifying sources of fresh water (such as rivers, lagoons, lakes, wetlands, groundwater, groundwater currents, aquifers, icebergs, glaciers, ice caps and ice fields) and local water sources and exploring how they change over time, such as rain puddles that evaporate, a local creek that flows faster after rain and a river system that dries out after drought
* exploring a game or simulation of the water cycle, identifying key processes and discussing representations of the water cycle
* identifying everyday examples of precipitation (rain and snow), evaporation (drying of wet washing or paint) and condensation of water (water droplets forming on a cold water bottle)
* exploring where tap water comes from and predicting what happens to water that goes down a drain
* recognising that clouds are tiny water droplets suspended in air, observing a ‘cloud in a bottle’ demonstrated by a teacher and discussing what conditions are needed for clouds to form and for rain or snow to fall
 |
| weather events and climate have impacts on the land, air, water and living things; human activity can affect climateVC2S4U08 | * distinguishing between weather patterns over a week, and climate patterns over years, for a selected parameter such as temperature or rainfall
* comparing how human activities such as deforestation, agriculture, urbanisation and pollution can cause changes in weather and climate
* proposing strategies to reduce the effects of human activities such as deforestation, agriculture, urbanisation and pollution on climate
* researching how the Australian climate has changed during the time that people have been on the Australian continent and adjacent islands, including the most recent Ice Age, the Holocene and the Anthropocene, and analysing how people have responded to changing climate
 |

##### Sub-strand: Physical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| heat energy can be generated from different sources; temperature changes may happen when heat is transferred from one object to anotherVC2S4U09 | * exploring how we sense heat, and identifying sources of heat such as the Sun, fire, electrical devices and geothermal springs
* recognising that temperature can be measured using a thermometer and, with assistance, measuring what happens when a cold object is placed in direct contact with a warm object, and proposing explanations
* modelling the movement of heat from one object to another using drawing or role-play
* investigating how well heat is transferred by different types of materials such as metals, plastics and ceramics, and identifying how materials are used to keep things hot or cold
* exploring how Aboriginal and/or Torres Strait Islander Peoples developed clothing from animal skins such as possum furs and kangaroo-skin cloaks, which trap heat close to the body and keep the wearer warm, and comparing the thermal properties of these materials with other natural fibres such as wool and cotton
* investigating traditional fire-starting methods used by Aboriginal and/or Torres Strait Islander Peoples and their understandings of the transformation of energy
 |
| forces, including frictional, gravitational, electrostatic and magnetic, can be exerted by one object on another through direct contact or from a distance and affect the motion (speed and direction) of objects VC2S4U10 | * investigating different forces, for example the effect of magnets on other magnets and how a magnet does not need to touch an object for the magnetic forces to pull the object, or observing how the pushing force of a liquid enables some objects to float
* exploring the positive and negative effects of friction on everyday experiences, such as how friction causes objects to slow down and perhaps stop, for example examining shoe-sole design and identifying patterns in sole design and use related to friction
* recognising that gravity is the force that pulls all objects towards the centre of Earth and that gravitational force acts on an object regardless of whether it is moving or not moving
* watching a video of astronauts walking on the Moon or dropping objects on the Moon’s surface, and discussing the forces that are acting
* investigating the effect of forces on the movement of objects in Aboriginal and/or Torres Strait Islander Peoples’ traditional toys and games, for example seeing who can kick a ball made from possum fur or similar materials the highest through direct contact forces after the ball is dropped onto the foot using non-contact gravitational force (as in the game marngrook, which was played in western Victoria) and hitting a ball through direct contact with a bat crafted from a stick on a beach where the frictional force from the sand impacts the speed of the ball (as in the game kokan played by the Mabuiag People)
* exploring how force arrows can be used to represent the direction and magnitude of forces acting on an object
 |

#### Strand: Science Inquiry

##### Sub-strand: Questioning and predicting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| observations can be used as a basis for posing questions to identify patterns and relationships, and to predict the outcomes of investigationsVC2S4I01 | * posing questions to explore the relationship involving the distance between magnets and the way the magnets attract or repel each other
* making predictions based on previous observations of potential changes about the mass of ice in a sealed container as the ice melts, such as predicting how quickly ice will melt at different ambient temperatures or predicting whether the mass of ice in the sealed container will change when the ice has melted
* predicting which objects will reach the highest temperature when they are heated
* predicting the effect on food chains when living things are removed from or die out in an area, based on current observations and discussion
* posing questions about why some materials are used more often than others for particular products
* posing questions about substances that are difficult to classify as solids, liquids or gases, such as toothpaste, slime, foam and hair gel
 |

##### Sub-strand: Planning and conducting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific investigations to answer questions or test predictions can be planned and conducted using provided scaffolds, including identifying the attributes of fair tests, and considering the safe use of materials and equipment VC2S4I02 | * using an investigation scaffold to plan and identify what to change and what to keep the same when identifying which type of shoe has the greatest or least friction
* using a provided framework or graphic organiser to plan and identify what to change and what to keep the same when measuring if the mass of ice in a sealed container changes when melted
* predicting the interactions of forces in a game or toy design, and building and testing a prototype
* using equipment and demonstrating safe behaviours at field sites when identifying animals in field locations using call or scat identification or pitfall traps, for example wearing personal safety equipment and clothing such as gloves when working with soil
* consulting with the local Aboriginal and/or Torres Strait Islander community to guide the planning of scientific investigations, including safety considerations for field investigations
* predicting effects of changing numbers of producers and consumers, and using a virtual or role-play food chain simulation to explore possible outcomes by running the simulation several times
 |
| observations, including formal measurements, can be made and recorded by following procedures to use familiar scaled instruments and digital tools as appropriateVC2S4I03 | * using appropriate equipment to make and record observations, for example using digital cameras and audio- or video-recording devices to document the life cycle of a living thing or to compare observations of local water sources at different times of the day or on different days
* using familiar scaled instruments with appropriate increments such as thermometers and measuring cups to make readings of ice or water in insulated containers
* rounding up or down when reading scaled instruments
* collaboratively designing a table to record observations in the form of numerical data, written descriptions, drawings or photographs
 |

##### Sub-strand: Processing, modelling and analysing

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data and information can be organised and represented to identify patterns and simple relationships by constructing tables, graphs and visual or physical models VC2S4I04 | * using graphic organisers to compare the properties of solids and liquids
* using virtual or role-play food chain simulations to investigate effects of the changing numbers of producers or consumers in a habitat
* constructing pictorial maps to illustrate the locations of different climates across Australia
* constructing a table that compares the measured distances moved by an object over surfaces that have different frictional forces
* constructing a column graph that records the properties of a range of natural and made materials
* using column graphs to show melting time for ice in containers with different insulating layers
 |

##### Sub-strand: Evaluating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| findings can be compared to those of others, including, as appropriate, whether a test was fair or not, to enable conclusions to be drawn, and may lead to the identification of further questions for investigationVC2S4I05 | * comparing findings from role-play or virtual investigations with peers and asking questions about factors that may have led to any differences in findings
* comparing findings, such as about best insulators, with those of others and asking further questions based on findings
* discussing the use of different methods and conclusions when classifying substances that are difficult to classify, such as toothpaste, slime and hair gel
* comparing the findings of water-use surveys between each other’s homes and school to identify differences in methods and conclusions
* developing a checklist to ensure that an investigation design is fair, and using the checklist to evaluate the investigation of a peer
* determining how a method can be modified to be more fair
 |

##### Sub-strand: Communicating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| observations, findings and ideas can be communicated for an identified purpose and audience by using scientific vocabulary and digital tools as appropriateVC2S4I06 | * representing heat transfer using diagrams, digital drawings, arrows or labels that include scientific vocabulary
* discussing how to communicate scientific findings, for example presenting their results from their investigations of the properties of solids, liquids and gases to share their predictions, methods, results and conclusions with their peers by writing simple reports, producing collages or drawings that represent examples and properties of solids, liquids and gases, or creating a story that involves characters made from different states of matter, for example a character made of water who can turn into ice or steam depending on the situation
* constructing an advertisement for a particular audience that describes why a high-friction surface is appropriate as flooring
* writing a life-cycle story from the perspective of a living thing, including appropriate scientific terms for life stages
* using digital tools to create a poster, song, slideshow or performance to illustrate the causes of soil erosion
* creating an advertisement to promote a new insulated container design to parents of primary-school-aged children
 |

## Levels 5 and 6

### Band description

At Levels 5 and 6, students learn that scientific knowledge changes over time and is built through collaboration. They investigate observable phenomena and analyse patterns to identify that these phenomena have sets of characteristic behaviours.

Students conduct investigations that involve observing, measuring and recording changes in energy, materials and the environment, which may occur quickly or slowly. They select and use instruments with the correct scale to measure and compare properties and parameters. Students begin to explain how matter gives structure to the world around them. They continue to explore the relationship between form and function by investigating how features and behaviours of organisms enable them to survive in their habitats. They identify stable and dynamic aspects of systems and develop an understanding of interdependencies between systems. They recognise that models are useful for investigating relationships between system components and can be used to predict the effects of changes. They describe energy flows in terms of transfers and transformations.

Students further develop their understanding of the role of controlling variables in fair testing. They recognise the importance of repeating their measurements and reflecting on their methods to identify potential sources of error. They generalise about relationships between events, phenomena and systems, and use identified patterns, trends and relationships to develop scientific explanations and draw reasoned conclusions.

Inquiry questions can help stimulate students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration of the key science ideas:

* Are you more likely to win a Nobel Prize in science as a team or as an individual?
* Is camouflage always an advantage?
* Why does my shadow change?
* Why should experiments be repeated?
* How does a periscope work?
* What if Earth were not on a tilt?

### Achievement standard

By the end of Level 6, students describe examples of advances in science achieved by scientists who work individually and in teams, building on the work of others. They discuss examples that illustrate how individuals and communities use scientific knowledge, skills and data to inform their actions and make decisions.

Students explain how natural and human-induced changes in the physical conditions of a habitat affect the survival of organisms. They provide examples of how organisms have changed over time and explain how the structural features and behaviours of organisms enable them to survive. They relate the movement and arrangement of the particles present in solids, liquids and gases to their observable properties, and model the particles in different mixtures. They classify and compare reversible and irreversible changes to substances. They model key processes that change Earth’s surface. They identify natural hazards and propose human actions that can reduce their impacts. They model the relationship between the Sun and planets of the solar system and explain how the relative positions of Earth and the Sun relate to the observable phenomena of variable day and night length. They identify sources of light and model different pathways of light to explain observed phenomena. They distinguish between electrical insulators and conductors, and identify the role of circuit components in the transfer and transformation of electrical energy.

Students make reasoned predictions, describe patterns and test relationships when investigating observable phenomena. They plan different scientific investigations including fair tests, describe how risks and ethical issues associated with investigations have been managed, and identify cultural considerations when planning fieldwork. They use equipment to generate and record data, including repeat trials. They construct representations to organise and process data and information, and describe patterns, trends and relationships. They compare their methods and findings with those of others including identification of possible sources of error, suggest improvements to their own and others’ investigations, pose questions for further investigation and select evidence to develop reasoned conclusions. They communicate ideas, findings, patterns, trends and relationships for a specific purpose and audience, including using various presentation formats, scientific vocabulary and digital tools where appropriate.

### Content descriptions and elaborations

#### Strand: Science as a Human Endeavour

##### Sub-strand: Nature and development of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge changes over time, often resulting from collaboration or by building on the work of others, and leads to advances in scienceVC2S6H01 | * researching how the discovery of a biofluorescent flying squirrel led to discoveries of more fluorescent mammals, such as wombats, bilbies, echidnas and bandicoots, as scientists collaborated with other scientists across fields of science and internationally
* researching why European naturalists and scientists first thought the platypus was a fake animal, and how scientists such as those in the Australian Platypus Conservancy are collaborating in ongoing research to understand the features and behaviours of platypuses
* exploring why developing new erosion mitigation techniques such as contour banks and strip-cropping requires the collaboration of geologists, hydrologists and farmers
* researching how contemporary restorative ecology adapts and builds on the traditional ecological knowledges of Aboriginal and/or Torres Strait Islander Peoples
* researching how scientists, manufacturers and farmers collaborated to use compressed gases such as carbon dioxide (CO2) in the development of fire extinguishers, planting crops and paintball
* examining why ecologists collaborate with engineers and computer scientists to develop remote sensing techniques, identify patterns in habitat change and make predictions about the survival of organisms
* constructing a timeline to show how contributions and collaborations of scientists, mathematicians, engineers and astronomers from many countries have advanced ideas about space and the solar system through development of models, gathering of evidence and, more recently, space exploration
 |

##### Sub-strand: Use and influence of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge, skills and data can be used by individuals and communities to identify problems, consider responses and make decisionsVC2S6H02 | * examining how communities use knowledge of erosion processes to design landscape features that reduce erosion in fragile environments
* examining how knowledge of erosion is used by park rangers to design rules such as keeping to paths and not climbing sandstone, as well as built features such as channel drains on paths, railings and barriers to protect park environments and Aboriginal and/or Torres Strait Islander Peoples’ cultural sites
* researching the impacts of light pollution and exploring how communities have used scientific knowledge to reduce light pollution, such as by using covered light bulbs facing downwards in streetlights, automated systems to turn off streetlights, and motion sensors on outdoor lights in homes and in public places
* investigating how people use knowledge of conditions that reduce mould or bacterial growth when considering food packaging and storage
* investigating why underground power cables were developed and how local government authorities use scientific knowledge about power safety when considering converting to underground power
* exploring how communities consider the impact of reversible reactions when designing guidelines about the ability of materials to be recycled
 |

#### Strand: Science Understanding

##### Sub-strand: Biological sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| habitats can be described by their physical conditions; changing the physical conditions of a habitat, including by human activity, may affect the growth and survival of organisms VC2S6U01 | * identifying the physical conditions in an aquatic or terrestrial habitat and how they change over time
* investigating how changes to physical conditions such as salinity, soil type, sunlight and temperature affect plant growth
* examining how changes in physical conditions such as temperature, light availability and rainfall affect animals such as corals, honey bees and flying foxes, and predict impacts of these changes
* investigating Aboriginal and/or Torres Strait Islander Peoples’ knowledges and understandings of the physical conditions necessary for the survival of certain plants and animals, for example researching the collaborative work of the Aboriginal Peoples of the Murray–Darling Basin wetlands with government and scientific groups to restore the wetlands through water research, planning and management, including reintroducing salt-tolerant native flora to improve ecosystem health and biodiversity
* investigating changes in physical conditions that are the result of human activity, and exploring the impact of these on organisms, such as the impact of urban lighting on nocturnal and migratory animals
* investigating the effect of physical conditions on the growth of bread-mould colonies in sealed plastic bags
* recognising that environmental conditions can affect stages of life, such as ponds drying up, seeds requiring water to germinate, and temperatures being too high or low for eggs to hatch
 |
| organisms have evolved over time, as seen in fossils and scientific records; the structural features and behaviours of living organisms enable them to thrive in their environments VC2S6U02 | * identifying physical and behavioural characteristics that enable a plant or animal to survive, such as being able to see in dim light or being nocturnal
* exploring features of plants and animals that enable them to survive in Australia’s desert environments, such as those of the bottle tree (boab) and the water-holding frog
* analysing the advantages and disadvantages of particular adaptations, for example having 2 or 4 feet, having different-shaped beaks, having gills/lungs, having coloured/scented flowers or having smooth/hairy leaves
* investigating how camouflage is used by animals to hide from predators and to ambush prey
* using physical or digital simulations to investigate how the shapes of animals’ body parts, such as the beak of a particular bird species, influence their ability to find food and survive in a specific environment
* exploring how variation in offspring over time has resulted in animals being more or less able to survive in particular environments, for example how the necks of modern giraffes are longer than those of their ancestors, or the ability of chameleons to change colour and the long hibernation time of eastern pygmy possums
* investigating Aboriginal and/or Torres Strait Islander Peoples’ knowledges of the structural features of certain species and how those features can be utilised through biomimicry, for example construction of fishing spears that demonstrate the adoption of stingray defence mechanisms such as the barb on a stingray’s tail
 |

##### Sub-strand: Chemical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the observable properties of matter (solids, liquids and gases) can be explained by modelling the motion and arrangement of their particles; mixtures (including solutions) can be formed by combining 2 or more different substances VC2S6U03 | * using role-play to model the arrangement and motion of particles in solids, liquids and gases, and exploring, with guidance, ideas about what exists between particles
* using a large plastic syringe to observe the compressibility of air compared with that of liquids, and observing a virtual demonstration of coloured gases being compressed and providing an explanation for the change in colour intensity
* exploring examples that demonstrate that gases have mass, such as blowing air through straws to move objects and using a balance to compare an empty balloon to one filled with air
* investigating mixtures by setting up sensory bins with a variety of materials that can be sorted and mixed, such as beads, rice, pasta, buttons, coins and plastic lids
* identifying common examples of mixtures and solutions in their daily lives
* making lemonade (a solution) by dissolving lemon juice and sugar (solutes) into water (a solvent)
* recognising Aboriginal and/or Torres Strait Islander Peoples’ knowledges and understandings of solids, liquids and gases, and how these knowledges are applied in a range of processes and practices, including the use of ochres and in cooking
 |
| changes to substances may be reversible, in which case the substance may be recovered, or irreversible, in which case new substances are formed; for most substances a change of state or dissolving in water is reversible, while irreversible changes include cooking and rustingVC2S6U04 | * discussing what makes a change reversible or irreversible, using everyday examples
* examining the substances produced in cooking and rusting, and comparing them with the original substances
* comparing how the amount of heat energy added may affect whether a change in state or an irreversible change occurs, such as when heating chocolate
* investigating solubility by observing which common substances dissolve in water, for example sand, salt, sugar, oil, metals and plastic
* describing how dissolved substances are reclaimed from solutions
* exploring how reversible changes can be used to recycle materials
* investigating Aboriginal and/or Torres Strait Islander Peoples’ knowledges of reversible processes such as the use of resins as adhesives in toolmaking to allow repair and reshaping, and of irreversible processes such as when using fuels for torches
 |

##### Sub-strand: Earth and space sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| geological processes including weathering, erosion, transportation and deposition can cause slow or rapid changes to Earth’s surfaceVC2S6U05 | * identifying types of weathering caused mechanically, such as in wind abrasion, cycles of extreme heat or cold and frost-wedging, and biologically, such as by plants and tree roots
* exploring how erosion can be caused by moving air or moving water and how substances such as surface soil are relocated, and identifying examples of erosion on a local or regional scale
* analysing the difference between weathering and erosion, and comparing the timescales over which these processes can occur
* modelling the effects of erosion on a simulated landscape and exploring factors that mitigate them
* investigating how humans have changed local landscapes and predicting the possible effects of these changes on rates of erosion
* considering how Aboriginal and/or Torres Strait Islander Peoples have been and are impacted by the rapid erosion of sand dunes, and the effect of salt water on culturally significant freshwater swamps
 |
| sudden geological changes or extreme weather conditions can affect Earth’s surface and atmosphere; the impacts of natural hazards, including earthquakes, volcanic eruptions, wildfires and floods, can be reduced by human actions and technological innovations VC2S6U06 | * considering the effects of significant rainfall, such as during the monsoon season, on the transportation and deposition of river sediments in the Asia–Pacific region
* investigating major geological events such as earthquakes, volcanic eruptions and tsunamis
* recognising that earthquakes can cause tsunamis
* considering the effect of drought on living and non-living parts of the environment
* recognising the impact that natural hazards can have on Aboriginal and Torres Strait Islander Peoples’ cultural heritage and ways that this can be reduced, for example the impact of bushfires on rock art sites and the impact of severe storms on the erosion of coastal shell midden sites
 |
| the force of gravity keeps Earth and other planets in the solar system in orbit around the Sun; cyclic observable phenomena, including variable day and night length, can be related to Earth’s tilt, rotation on its axis and revolution around the SunVC2S6U07 | * exploring simulations of the solar system, such as a pocket solar system, to appreciate the distances and relationships between the Sun and planets
* recognising that gravity keeps the planets in orbit around the Sun
* using three-dimensional models or role-play to model how Earth’s rotation on its axis causes day and night
* using virtual simulations or real-time views of Earth from space to investigate why different regions on Earth, such as the South Pole, have a long period of sunlight and a long period of darkness during one revolution of Earth around the Sun
* using three-dimensional models to investigate how the tilt of Earth points one hemisphere towards the Sun and the other away at different times of the year, and predicting how this affects the amount of sunlight on the surface of different regions on Earth
* researching Aboriginal and/or Torres Strait Islander Peoples’ understandings of the night sky and its use for timekeeping purposes as evidenced in oral cultural records, rock paintings, paintings and stone arrangements
 |

##### Sub-strand: Physical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| light can be produced from many sources; light travels in a straight path, can form shadows, and can be absorbed, transmitted, reflected or refracted by objectsVC2S6U08 | * distinguishing between natural sources of light (such as glow-worms, the Sun and stars) and artificial ones (such as light bulbs and candles)
* investigating the shadows that are formed when light is completely or partially blocked by an object, such as when using a sundial or shadow puppets, and how shadow length changes with the changing position of the Sun
* observing refraction of light using prisms or water droplets and examining the rainbow effect produced
* exploring how hologram videos use the refractive properties of light to create an image that appears to be three-dimensional
* exploring the use of reflection of light by mirrors, such as in periscopes and mirror mazes
* recognising Aboriginal and/or Torres Strait Islander Peoples’ understanding of refraction as experienced in spearfishing and in shimmering body paint, and of reflection as evidenced by materials selected for construction of housing
 |
| materials may be electrical insulators or conductors; energy can be transferred and transformed in electrical circuits where the components of a circuit play particular roles in the function of the circuit VC2S6U09 | * identifying necessary components for an electric circuit, such as a source of electrical energy; a conducting material such as metal wire, a key or a switch; and a light or electrical device such as a buzzer
* constructing a real or virtual electrical circuit to examine requirements to allow the flow of electricity, including exploring the construction and role of switches
* constructing representations of electrical circuits and their components using accepted conventions
* using electrical circuits and components to demonstrate electrical energy transfer and the transformation of electrical energy into heat, light and sound
* investigating different electrical conductors and insulators, and examining why they may be used
* exploring how electricity is used in homes, and identifying electrical hazards and safety measures used to mitigate these hazards
 |

#### Strand: Science Inquiry

##### Sub-strand: Questioning and predicting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| investigable questions and reasoned predictions can be used in guiding investigations to identify patterns and test relationshipsVC2S6I01 | * posing questions that can be investigated scientifically, such as ‘Do all animals in desert habitats have ways to survive without water?’
* posing investigable questions to identify patterns, such as ‘What type of material is the best conductor and what is the best insulator of electricity?’
* making predictions to test relationships, such as whether a particular arrangement of mirrors will enable viewing around corners
* making reasoned predictions about the properties of an unknown solid, liquid or gas
* predicting the relationship between the loudness of a sound and the distance of the sound from its source
 |

##### Sub-strand: Planning and conducting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| repeatable scientific investigations to answer questions can be planned and conducted, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests, considering potential risks, planning for the safe and ethical use of equipment and materials, and obtaining permissions for investigations conducted on Country and Place or in protected areasVC2S6I02 | * considering different ways to undertake investigations, such as researching, using trial and error, experimental testing, field observations, using digital tools to record observations, conducting surveys and using simulations
* using a map or aerial photographs to predict local sites likely to be affected by erosion, and collaboratively planning a field excursion to collect observations
* identifying the variable being tested, the variable being measured and variables that need to be kept the same in their investigation of the amount of heat energy needed to cause a reversible or irreversible reaction
* planning and recording the method used in an investigation about the amount of erosion on slopes so that the method is repeatable
* identifying potential risks to themselves or others when identifying electrical hazards at home and explaining rules for safe processes and use of equipment and materials
* recognising that scientific investigations on or about Country and Place should involve Aboriginal and/or Torres Strait Islander knowledge holders, and that there may be cultural protocols (ethical principles that guide behaviour in particular situations when interacting with Aboriginal and/or Torres Strait Islander Peoples and that are designed to protect Aboriginal and Torres Strait Islander cultural and intellectual property rights) in place restricting or prohibiting access
 |
| equipment can be used to observe, generate, measure and record data with reasonable precision for repeated measurements, using digital tools as appropriateVC2S6I03 | * recording data using standard units such as the volt, ampere, gram, second and metre, and developing the use of standard prefixes for metric units, such as ‘kilo-’ and ‘milli-’
* using digital tools such as digital thermometers and soil moisture probes to collect data over time, and recording data in spreadsheets
* discussing why precision is important in measurement, and comparing the precision of different class data sets, for example the growth of radish seeds in different soil environments and the length of shadows at different times of the day
 |

##### Sub-strand: Processing, modelling and analysing

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data and information can be organised and processed to show patterns, trends and relationships by constructing representations including tables, graphs and visual or physical models VC2S6I04 | * using annotated digital photography or field sketches to describe structural features of plants or animals
* developing a physical model of the Sun and Earth using objects or role-play to describe their relative positions when a place on Earth is in day or night
* organising information in graphic organisers
* using maps to identify patterns in erosion-site locations or aerial photographs to show effects of erosion over time
* representing electrical circuits using virtual simulations or circuit diagrams, and indicating the direction of electricity flow
 |

##### Sub-strand: Evaluating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| methods and findings can be compared with those of others to identify sources of error, to select evidence in support of reasoned explanations and conclusions, and to develop further questions for investigationVC2S6I05 | * recognising errors that could have occurred while classifying solids, liquids and gases, such as incorrect measuring or misreading of measurements of volume or mass of gases
* recognising errors that could have occurred during testing of the effects of temperature, light availability and rainfall on plants or animals, including changing too many variables, measuring incorrectly or misreading measurements, and in relation to changes in environmental factors
* discussing the difference between data and evidence when considering weathering, erosion, transportation and deposition, and examining how evidence is selected
* comparing and contrasting data collected by different individuals or groups to discuss similarities and differences in findings, and posing questions for further investigation
 |

##### Sub-strand: Communicating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific ideas, findings, patterns, trends and relationships can be communicated for a specific purpose and audience, using various presentation formats, scientific vocabulary and digital tools as appropriateVC2S6I06 | * constructing a persuasive text for local council to argue for the use of an erosion mitigation strategy in a local area
* constructing a scientific report to share findings, such as how plants responded to changes in physical conditions such as temperature and salinity, and using appropriate vocabulary, data representations, units and sentence structures
* exploring whether there is a ‘correct’ way of representing particles, and creating an animation to teach other students about the motion and arrangement of particles in solids, liquids and gases
* acknowledging and exploring Aboriginal and/or Torres Strait Islander Peoples’ ways of representing and communicating understandings of the night sky, and its use in timekeeping, as evidenced in rock paintings, paintings and stone arrangements
* constructing a poster or slideshow comparing everyday examples of reversible and irreversible changes
 |

## Levels 7 and 8

### Band description

At Levels 7 and 8, students develop a broader view of scientific knowledge, which includes different perspectives and worldviews, consideration of socio-scientific issues, and the importance of communicating scientific knowledge.

Students continue to develop their understanding of the role of classification in ordering and organising information, including at microscopic scales. They connect form and function through practical explorations such as seeing cells as microscopic structures that explain macroscopic features of living systems. They develop models to explain the flow of energy and matter, and explore how interactions of matter and energy at the sub-microscopic scale determine macroscopic properties. They extend their experience of scale and measurement as they consider geological timescales and astronomical distances, recognising that some patterns may only be evident at certain times and spatial scales. Students use experimentation to isolate relationships between components in systems and explain these relationships through increasingly complex representations. They describe the role of energy in causing change in systems.

Models are used and developed to represent and analyse the impact of changing components within systems across a range of timescales. Students also construct and use models to test hypotheses about phenomena at scales that are difficult to study directly, and they use these observations and other evidence to draw conclusions. They pay increasing attention to the precision of measurements, and use appropriate units to describe the magnitude of properties and events. They process data and use representations to show patterns of change, such as considering the effects of various forces when explaining changes in an object’s motion.

Inquiry questions can help stimulate students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration of the key science ideas:

* How have systems of classification changed over time?
* How is a leaf like a lung?
* Can we predict changes to the shape and position of continents?
* How can we best measure what we cannot directly see?
* Why is being able to separate mixtures important?
* Is perpetual motion possible?

### Achievement standard

By the end of Level 8, students explain how new evidence can lead to changes in scientific knowledge. They discuss how people with different understandings, skills, perspectives and worldviews have worked in multidisciplinary teams to develop scientific knowledge. They discuss the relevant ethical, environmental, social and economic considerations associated with a proposed scientific response to a selected socio-scientific issue. They analyse the importance of science communication in shaping viewpoints, policies and regulations.

Students explain how biological diversity is ordered and organised. They explain the role of specialised cell structures and organelles in cellular function, and distinguish between cells in selected examples of plants and animals, and unicellular and multicellular organisms. They analyse the relationship between structure and function at organ and body system levels for a selected plant and an animal, and explain how a disorder in the cells, tissues or organs of these systems affects the survival of each organism. They represent flows of matter and energy in ecosystems and use real and hypothetical scenarios and population data to interpret and predict the effects of environmental changes. They use the particle and kinetic theories of matter to explain the structure, properties and behaviour of substances. They distinguish between pure substances and mixtures, and design procedures to separate mixtures. They classify and represent matter as elements, compounds or mixtures, and distinguish between physical and chemical changes. They distinguish between renewable and non-renewable resources, evaluate the sustainable use of different resources, and compare the benefits and risks of resource extraction and energy production. They apply the theory of plate tectonics to explain geological phenomena including volcanoes, earthquakes, mountain formation and the distribution of earthquakes and volcanic zones around the globe. They explain how the properties of rocks relate to their formation and influence their use. They model the Earth–Sun–Moon system’s cyclic changes to explain the observable phenomena of seasons and tides. They demonstrate how simple machines can be used for a purpose. They represent and explain the effects of forces acting on objects. They compare different forms of energy and represent energy transfers and transformations in simple systems. They undertake a household energy audit and propose ways to decrease energy consumption. They design and construct series and parallel circuits, and observe and make predictions about voltage and current and about energy transfer in the circuits.

Students develop hypotheses and make reasoned predictions to identify patterns, test relationships and analyse and evaluate scientific models when investigating phenomena at various scales. They plan a range of reproducible scientific investigations, document procedures and identify potential ethical issues and intercultural considerations required for fieldwork or use of secondary data. They select and use equipment to generate and record data with precision. They select and construct appropriate representations to organise and process data and information. They analyse and connect data and information to identify and explain patterns, trends, relationships and anomalies. They identify assumptions and sources of error in methods and analyse conclusions and claims with reference to conflicting evidence and unanswered questions. They provide science-based explanations for findings, and use evidence to support conclusions and evaluate claims. They select and use appropriate presentation formats, scientific vocabulary, models and other representations when communicating their ideas, findings and arguments for specific purposes to specific audiences.

### Content descriptions and elaborations

#### Strand: Science as a Human Endeavour

##### Sub-strand: Nature and development of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge, including models and theories, can change because of new evidenceVC2S8H01 | * 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
* investigating how Aboriginal and/or Torres Strait Islander Peoples’ traditional ecological and zoological knowledge informs sustainable harvesting practices of species such as dugongs, turtles, the short-finned eel and the Bogong moth
* investigating how aeronautical engineers’ understanding of the nature of the forces acting in flight has led to changes in the design of aircraft
* investigating how the interpretations of Aboriginal and/or Torres Strait Islander Peoples’ Deep Time cultural sites can change with new scientific evidence, such as Cloggs Cave on Gunaikurnai Country in East Gippsland and Budj Bim Cultural Landscape on Gunditjmara Country in south-western Victoria
* examining the evidence that led to the acceptance of the theory of plate tectonics rather than the theory of continental drift to explain the movement of continents
* investigating how advances in deep Earth imaging techniques have enabled identification of mineral, energy and water resources beneath surface sedimentary rock
* researching reasons for different forms of the periodic table
 |
| multidisciplinary endeavours to advance scientific knowledge make use of people’s different perspectives and worldviewsVC2S8H02 | * exploring how the personal beliefs and ethical positions of a scientist may influence the questions the scientist chooses to pursue and how they investigate those questions, such as the political views of geneticist Richard Levins, who chose to focus on population ecology, or those of physicist Joseph Rotblat, who refused to work on science that might lead to development of an atomic bomb
* 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
* researching how David Unaipon, a Ngarrindjeri man from the Coorong region of South Australia, used his cultural knowledge and understanding of the aerodynamic properties of boomerangs to conceptualise a vertical lift flying machine in 1914
* investigating how seasonal calendars are used by many Aboriginal and/or Torres Strait Islander Peoples today to interpret and utilise ecological patterns and seasonal phenomena, and how their publication has informed Western scientific understandings across a wide range of disciplines such as botany, zoology, ecology and meteorology
* researching how cultural building techniques, such as those used to build bamboo houses, led to the development of structures and materials better able to withstand the effects of earthquakes
* investigating how collaboration between religious leader Swami Vivekananda and inventor and physicist Nikola Tesla, who held different worldviews, led to an exploration of the relationship between mass and energy
* analysing how worldviews relating to fairness in sport have led to the development of rapid chemical tests to identify performance-enhancing drugs
 |

##### Sub-strand: Use and influence of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| proposed scientific responses to socio-scientific issues impact on society and may involve ethical, environmental, social and economic considerationsVC2S8H03 | * examining how laboratory-grown meat might reduce impacts on ecosystems, and considering any social, ethical and economic implications of developing laboratory-grown meat for wide consumption
* investigating the contributions of Aboriginal and/or Torres Strait Islander Peoples’ knowledges in the identification of medicinal properties of endemic plants, and the ethical, environmental, social and economic implications of others using these knowledges
* investigating the ethical, environmental, social and economic implications of proposed scientific responses that involve cross-cultural partnerships and build on Aboriginal and/or Torres Strait Islander Peoples’ land management techniques
* researching how properties of gases were used in relation to gas warfare in World War I, and the subsequent development of the Geneva Protocol and later adoption of the Chemical Weapons Convention international arms control treaty
* investigating how scientific responses, including new building materials, improved predictions and early warning systems, have supported communities living in countries in the Asia–Pacific region located near plate boundaries, such as Japan, Indonesia and New Zealand
* exploring how the development of biodegradable materials has led to more sustainable packaging and reductions in landfill
 |
| communication of scientific knowledge has a role in informing individual viewpoints, and community policies and regulationsVC2S8H04 | * examining how science communication about endangered species has led to policies and regulations related to fishing catch and hunting limits
* 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
* 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
* investigating relevant campaigns designed to increase community engagement, such as promoting increased rates of registration as an organ donor, debating nuclear power as an energy option and increasing recycling rates
* investigating how promotion of biodegradable materials and the importance of using them has informed individual viewpoints
* examining how the inclusion of Aboriginal and/or Torres Strait Islander Peoples’ scientific knowledges can enrich policies and regulations, for example cultural burning practices informing planned burning in Victoria
* researching how science organisations and high-profile science communicators influence people’s attitudes to science
 |

#### Strand: Science Understanding

##### Sub-strand: Biological sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| there are similarities and differences within and between groups of organisms living on Earth; the development and use of classification tools, including dichotomous keys, help order and organise human understanding of the diversity of lifeVC2S8U01 | * considering the reasons for classifying organisms, such as for identification and communication
* identifying the differences in ways that selected organisms achieve the common requirements for life: movement, respiration, sensitivity, growth, reproduction, excretion and nutrition
* using provided dichotomous keys to identify organisms surveyed on a field trip
* creating and modifying a dichotomous key to classify organisms into groups, and groups within groups
* naming and classifying species using scientific conventions from the Linnaean hierarchical classification system, such as the levels of kingdom, phylum, class, order, family, genus and species
* investigating Aboriginal and/or Torres Strait Islander Peoples’ systems of classifying organisms and how these systems differ from the Linnaean system of classification
* researching how biological classification has changed over time through improvements in microscopy
 |
| cell theory describes cells as the basic units of life; organisms may be unicellular or multicellular and have specialised structures and organelles (including cell walls, cell membranes, cytoplasm, nuclei containing DNA, mitochondria, ribosomes, chloroplasts and vacuoles) that perform specific functions VC2S8U02 | * exploring an augmented or virtual reality tour of a plant, animal, bacterium and fungus to ‘zoom in’ and understand the scale of cells
* examining a variety of cells, including single-celled organisms, using a light microscope, a digital microscope, simulations and photomicrographs
* comparing wet-mount slides of onion cells prepared by students with purchased slides viewed under a light microscope
* comparing the similarities and differences between cells in plants, animals, bacteria and fungi represented in digital or physical models
* designing and constructing a physical or digital model of a cell and seeking peer feedback about the strengths and limitations of the model
* conducting and documenting a practical investigation to model a cell process related to a specific organelle or cellular structure, such as cellular respiration (facilitated by mitochondria), photosynthesis (facilitated by chloroplasts) or diffusion (occurring across cell membranes)
* identifying how technological developments, such as those related to microscopes and medical imaging, have led to improved understanding of cells, tissues and organs
 |
| the structure of cells, tissues and organs in a plant and an animal organ system are related to their function; plant and animal organ systems enable survival of the organismVC2S8U03 | * using two-dimensional and three-dimensional representations to locate and compare the structure and function of analogous systems in a plant and an animal
* examining the specialised cells and tissues involved in the structure and function of particular organs in an organ system
* describing the structure of each organ in a system and relating its function to the overall function of the system
* researching how a disorder of cells or tissues can affect an organ’s function, such as how hardening of the arteries can lead to poor circulation or heart disease
* researching and discussing ethical issues that arise from organ transplantation
* investigating how an artificial organ mimics or augments the functions of a real organ
* relating the loss of a non-vital organ such as the tonsils, appendix, spleen, gall bladder or a reproductive organ to effects on body systems
 |
| matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids; populations will be affected by changing biotic and abiotic factors in an ecosystem including habitat loss, climate change, seasonal migration and introduction or removal of speciesVC2S8U04 | * analysing food webs to show feeding relationships between organisms in an ecosystem and the role of microorganisms
* using food pyramids to represent the difference in the amount of energy at each trophic level in a food web, with primary producers forming the first trophic level
* predicting the effects on local ecosystems when organisms such as pollinators or predators are removed from or die out in an area
* examining how events such as seasonal changes, destruction of habitat and introduction of a species impact abiotic and biotic factors and cause changes to populations
* investigating Aboriginal and/or Torres Strait Islander Peoples’ responses to invasive species and their effect on food webs that many communities are a part of, and depend on, for produce and medicine, for example collaboration between the Traditional Owners (Kungarakan and Warai Peoples) of the Rum Jungle mine site near Darwin and the Australian Government to mitigate dispersal of gamba grass seeds by means of seed eradication and foliage spraying to control the spread of the gamba grass as well as reduce impacts on vulnerable ecosystems
* considering how Aboriginal and/or Torres Strait Islander Peoples’ fire management practices over tens of thousands of years have changed the distribution of flora and fauna in most regions of Australia, for example researching changed Australian landscapes over time from rainforest vegetation to sclerophyll vegetation, including the impact of Aboriginal cultural burning practices, and looking at the ecological effects of disruptions to long-held Aboriginal cultural burning practices, such as the wildfires that swept through the Leadbeater’s possum habitat in the Central Highlands of Victoria and caused significant population decline in an already-endangered species
 |

##### Sub-strand: Chemical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the particle and kinetic theories of matter can be used to describe the arrangement and motion of particles in a substance, including the attraction between particles, and to explain the properties and behaviour of substances, including melting point, boiling point, density, compressibility, gas pressure, viscosity, diffusion, sublimation, and expansion and contractionVC2S8U05 | * using and constructing virtual simulations such as claymation videos, models or diagrams to represent changes in particle arrangement and properties as substances change state
* comparing attractive forces in the solid, liquid and gaseous states of the same substance and relating this to relative position and movement of particles
* examining how the changing motion and energy of particles are affected by the amount of heat energy absorbed or released
* comparing the properties of different substances and explaining differences using particle theory
* comparing the viscosity of different substances such as honey, treacle and oil, and developing representations to suggest an explanation for their different viscosities
* constructing a density column using liquids of different densities
 |
| matter can be classified as pure substances such as elements and compounds or impure substances such as mixtures (including solutions), and can be modelled using the particle model; mixtures may have a uniform (homogeneous) or non-uniform (heterogeneous) composition and can be separated based on the properties of their components using techniques including filtration, decantation, evaporation, crystallisation, magnetic separation, distillation and chromatographyVC2S8U06 | * using representations of particles to show the difference between samples of pure substances and mixtures, and identifying examples of each
* using coloured beads or buttons to represent different substances, and then mixing these ‘particles’ in different containers to demonstrate both uniform (homogeneous) and non-uniform (heterogeneous) mixtures, and to demonstrate the difference between dilute, concentrated, saturated and supersaturated solutions
* analysing how the physical properties of substances in mixtures, such as particle size, density and volatility, determine the separation technique used
* using paper chromatography to separate the components of different coloured inks or food dyes
* investigating separation techniques used by Aboriginal and/or Torres Strait Islander Peoples, such as hand-picking, sieving, winnowing, yandying, filtering, cold-pressing and steam distilling, for example in the extraction of oils from plants
* designing, making, testing and refining a ‘separating machine’ to separate the components of a mixture
* exploring and comparing separation methods used in a variety of situations such as in homes, recycling industries and for purifying water, or viewing simulations or videos showing the separation of crude oil into its components, including the isolation of contaminants
 |
| the atomic theory of matter can be used to model and explain the difference between elements, compounds and mixtures; elements, compounds and mixtures can be represented as two-dimensional and three-dimensional models, elements can be represented by symbols, and molecules and compounds can be represented by chemical formulasVC2S8U07 | * using virtual and physical models to distinguish between elements and compounds in terms of types of atoms
* examining how Dmitri Mendeleev arranged the elements in the first version of the periodic table and comparing his arrangement with the current version
* explaining why elements are represented by symbols, why compounds and molecules are represented by chemical formulas, and why mixtures are represented by percentages
* using representations to show the classification of matter as elements, compounds and different types of mixtures such as solutions, suspensions and colloids
* examining the information conveyed by different types of representations of elements and compounds, and identifying where and why these different representations are used
 |
| physical changes can be distinguished from chemical changes; a chemical change can be identified by a colour change, a temperature change, the production of a gas (including laboratory preparation and testing of oxygen, carbon dioxide and hydrogen gases) or the formation of a precipitate VC2S8U08 | * performing simple chemical reactions to identify the indicators of chemical change, such as gas production, solid production, colour change and temperature change
* 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
* examining how the physical and chemical properties of a substance will affect its production or use
* discussing where indicators of chemical change are used for identifying the presence of particular substances, such as in soil, water and medical testing kits
* applying knowledge of common chemical changes to identify a set of ‘mystery’ powders, for example using iodine solution, vinegar, water and universal indicator to distinguish between baking soda, cream of tartar, corn starch and baking powder
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##### Sub-strand: Earth and space sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the sustainable use of Earth’s resources is influenced by whether the resources are renewable or non-renewable; the processes involved in resource extraction and energy production come with both benefits and risks to sustainabilityVC2S8U09 | * considering what is meant by the term ‘renewable’ in relation to Earth’s resources
* considering timescales for regeneration of resources
* creating an infographic to illustrate the risks and benefits of different forms of energy production
* preparing a case study for the regeneration of an old mine
* examining how the use of desalination plants to produce fresh water has impacted marine ecosystems at desalination plant sites
* examining 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 the exploration of environmental considerations
 |
| Earth is a dynamic planet as demonstrated by tectonic activity, including the formation of geological features at divergent, convergent and transform plate boundaries; the theory of plate tectonics is supported by scientific evidenceVC2S8U10 | * examining patterns of earthquake and volcanic activity over time and proposing explanations
* evaluating the impact of tectonic events on human populations and examining engineering solutions designed to reduce the impact
* modelling interactions at plate boundaries and investigating the relative significance of different forces involved in tectonic plate movement including slab pull, ridge push and convection
* relating the extreme age and stability of a large part of the Australian continent to its plate tectonic history
* exploring how geologist and oceanographic cartographer Marie Tharp’s topographic maps of the Atlantic Ocean floor provided support for the acceptance of the theory of plate tectonics
* researching Aboriginal and/or Torres Strait Islander Peoples’ cultural accounts that provide evidence of earthquakes and volcanoes, for example the oral records of the Bungandidj People that have preserved, for at least 4000 years, the knowledge of volcanic events that formed the crater lakes at Budj Bim National Park in south-western Victoria
 |
| key processes of the rock cycle occur over different timescales; the properties of sedimentary, igneous and metamorphic rocks not only reflect their formation but also impact their usefulness and determine the methods used when minedVC2S8U11 | * comparing the observable properties of different types of rocks and identifying them using a provided dichotomous key
* exploring the major processes of the rock cycle including weathering, erosion, deposition, melting, crystallisation, uplift, heat and pressure in the formation of different types of rocks
* analysing the role of forces and heat energy in the formation of different types of rocks and comparing how quickly or slowly different processes can occur
* examining fossil evidence, such as that found in body, trace and opalised fossils, to predict how and when a rock was formed
* investigating how Aboriginal and/or Torres Strait Islander Peoples have used quarrying to access rocks for use as or production of everyday objects such as grindstones, hammerstones, anvils and cutting tools, for example stone hatchets sourced at the Mount William Stone Hatchet Quarry National Heritage Place in Central Victoria and used for food-gathering, construction, canoe-building and the manufacture of shields, clubs and spears
* exploring how the mining of ores and minerals impacts on local environments, and examining environmental rehabilitation initiatives
 |
| cyclic changes in the relative positions of Earth, the Sun and the Moon can be modelled to show how these cycles cause eclipses and influence predictable phenomena on Earth, including seasons and tidesVC2S8U12 | * using physical models or virtual simulations to explain how Earth’s tilt and position relative to the Sun cause differences in light intensity on Earth’s surface, resulting in seasons
* examining the effect of the gravitational attraction of the Moon and Sun on Earth’s oceans and describing how the positions of the Moon and Sun in relation to Earth result in tidal variations
* using physical models or virtual simulations to explain the cyclic patterns of lunar phases and eclipses of the Moon and Sun
* researching knowledges held by Aboriginal and/or Torres Strait Islander Peoples about the phases of the Moon and the connection between the lunar cycle and ocean tides; for example, understanding by Torres Strait Islander Peoples of the relationship between lunar cycles and neap tides enables prediction of the safest periods to reef-dive for lobster
* investigating some examples of Aboriginal and/or Torres Strait Islander Peoples’ seasonal calendars and how these can be used to predict seasonal changes; for example, the seasonal calendar of the people of D’harawal Country (south-west of Sydney) identifies the cries of tiger quolls in search of mates as indicating that the lilly pilly fruit has started to ripen and that falling lilly pilly fruit is a sign that the people of the D’harawal Country should begin their annual journey to the coast in search of other seasonal resources
* researching Aboriginal and/or Torres Strait Islander Peoples’ oral traditions and cultural recordings of solar and lunar eclipses, and investigating similarities and differences with contemporary understandings of these celestial phenomena
 |

##### Sub-strand: Physical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| simple machines, including the lever, inclined plane, wedge, pulley, screw, and wheel and axle, alter the direction and magnitude of forces VC2S8U13 | * evaluating different simple machines for their mechanical advantage
* designing a series of simple machines that take a specified time to move an object a specific height
* investigating how simple machines such as levers and pulleys are used to change the magnitude of force needed to perform a task
* investigating the effect of forces through the application of simple machines, for example the spearthrowers used by Aboriginal and/or Torres Strait Islander Peoples as examples of levers that operate as an extension of the arm; and the bows and arrows used by Torres Strait Islander Peoples, with the bow acting as a flexible lever and the arrow as a projectile (rather than a simple machine)
* identifying the simple machines in a complex machine such as a Rube Goldberg machine
* designing and constructing Rube Goldberg machines that use at least 3 different simple machines to perform a specified task
 |
| balanced and unbalanced forces acting on objects, including gravitational force, may be investigated and represented using force diagrams; changes in an object’s motion can be related to its mass and the magnitude and direction of the forces acting on itVC2S8U14 | * investigating the effects of applying different forces to familiar objects of the same mass and different masses
* analysing the effect of balanced and unbalanced forces on an object’s motion, such as starting, stopping and changing direction
* measuring the magnitude of a force using a force meter, and representing the magnitude and direction of forces acting on an object using force diagrams
* investigating how Earth’s gravitational force is the attractive force that pulls objects towards the centre of Earth and how its magnitude is related to the mass of an object
* examining how gravity affects objects in space, including moons, planets, stars, galaxies and black holes
* analysing the forces acting on boomerangs and how early Aboriginal and/or Torres Strait Islander Peoples designed an air-foil profile that could be varied and had several applications
 |
| energy exists in different forms, including thermal, chemical, gravitational and elastic, and may be classified as kinetic or potential; energy transfers (conduction, convection and radiation) and transformations occur in simple systems and can be analysed in terms of energy efficiency VC2S8U15 | * investigating relationships between kinetic and potential energy in a simple system such as a roller-coaster or Newton’s cradle, or in devices such as a catapult or a water wheel, and using representations such as flow diagrams to illustrate changes between different forms of energy in these systems and devices
* using Sankey diagrams to show energy inputs, changes and outputs in a system
* identifying where heat energy is produced as a by-product of energy transfer, such as in filament light bulbs, during exercise, and during battery charging and use
* observing or constructing a Rube Goldberg machine and identifying the energy transfers and transformations involved
* investigating traditional fire-starting methods used by Aboriginal and/or Torres Strait Islander Peoples and their understandings of the transformation of energy, for example methods of friction to generate heat to start a fire such as the fire drill method (uses a drill stick in a twisting action to create friction), the fire plough method (uses a drill stick in a forward-and-backward motion to create friction) and a fire saw method (uses 2 halves of a branch split in the middle and rubbed together in a sawing motion to create friction), and the use of the percussion method involving the striking of 2 stones to generate sparks that are directed to set tinder alight
* comparing energy changes in physical events such as car accidents, motion of pendulums, and lifting and dropping of objects
 |
| household energy consumption can be analysed using an energy audit and is affected by appliance choice, building design, season and climateVC2S8U16 | * conducting an energy audit to determine the energy efficiency of a particular household
* examining the meaning of energy star ratings given to appliances such as refrigerators and washing machines, and criteria used to determine these ratings
* exploring the principles of passive solar building design and constructing a model of a building that includes these principles
* investigating how building designs in different climates affect the energy efficiency of houses, such as the ‘Queenslander’ house design
* investigating how different building materials, such as mudbrick, polystyrene panels and insulation, affect the energy efficiency of a particular building design
* investigating how household energy usage varies with time of day and/or time of year and how this relates to needs for energy storage or generation
 |
| electrical circuits transfer energy when current flows and can be designed for diverse purposes using different components; the operation of circuits can be explained using the concepts of voltage and currentVC2S8U17 | * investigating parallel and series circuits and measuring voltage drops across and currents through various components
* investigating the properties of components such as LEDs (light-emitting diodes), and temperature and light sensors
* comparing electrical circuit design to household wiring, for example identifying common components used in both electrical circuit design and household wiring (such as resistors, switches and power sources), considering the arrangement of electrical components within devices, considering how voltage and current are managed in both electrical circuits and household wiring, or analysing the safety features and precautions in circuits and household wiring, recognising the importance of circuit protection devices such as fuses and circuit breakers in preventing electrical hazards
* exploring the use of sensors in robotics and control devices
 |

#### Strand: Science Inquiry

##### Sub-strand: Questioning and predicting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| investigable questions, reasoned predictions and hypotheses can be developed in guiding investigations to identify patterns, test relationships and analyse and evaluate scientific modelsVC2S8I01 | * discussing what is meant by a causal relationship and examining how causation is different from correlation
* developing investigable questions to test relationships, such as ‘How does the volume of a balloon change as it is heated and cooled?’ and ‘What happens to the height of the tide at different points of the lunar cycle?’
* developing investigable questions to analyse and evaluate scientific models, such as ‘How does particle theory explain the properties of substances?’
* formulating hypotheses such as ‘An earthquake of greater magnitude will cause more damage’ and ‘The image of a candle formed by a concave mirror gets larger as the candle moves closer to the mirror’
 |

##### Sub-strand: Planning and conducting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying independent, dependent and controlled variables where applicable, stating assumptions, recognising and managing risks, considering ethical issues and following protocols when accessing cultural sites and artefacts on Country and PlaceVC2S8I02 | * identifying assumptions relating to variables that are assumed to be constant, such as ambient temperature, properties of materials used and purity of substances
* identifying assumptions related to testing a hypothesis using analogous models, such as using dialysis tubing to model the properties of plant cell walls
* investigating the fire triangle to illustrate how heat, fuel and oxygen are required for a fire to burn, for example using a lit candle to represent fire, covering the candle with a glass jar to limit oxygen, then removing the jar to re-introduce oxygen, and then using their observations to discuss safe laboratory practices in the laboratory when working with heat or flames
* discussing why it is important to identify variables and assumptions when planning an investigation, and designing reproducible investigations that specifically test variables of a causal relationship and control the remaining variables
* acknowledging and considering ethical principles when using or citing secondary data (such as acknowledging sources), and/or respecting cultural protocols (ethical principles that guide behaviour in particular situations when interacting with Aboriginal and/or Torres Strait Islander Peoples and that are designed to protect Aboriginal and Torres Strait Islander cultural and intellectual property rights) about sharing of particular information
* recognising and acknowledging Aboriginal and/or Torres Strait Islander Peoples’ artefacts and sites of cultural significance such as ceremonial grounds and traditional quarries, and ensuring permission is sought to enter and that no harm is caused to cultural sites and artefacts during any permitted fieldwork
 |
| equipment can be selected and used to generate and record data with attention to precision, using digital tools as appropriate VC2S8I03 | * selecting and using equipment with required precision, such as reading the bottom of a meniscus to determine the precise volume of a liquid in a reproducible way
* 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
* using digital tools such as sensors to measure abiotic factors, and apps with image or call recognition to make field identifications
* using digital tools such as digital microscopes, simulations and video-recording devices, as appropriate, to observe, measure and record qualitative and quantitative data for cells
* using conventions related to dependent and independent variables with relevant units when constructing tables and spreadsheets
* using appropriate positive and negative signs for standard units, number of decimal points and exponential notation, where relevant, when recording data
 |

##### Sub-strand: Processing, modelling and analysing

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data and information can be organised and processed by selecting and constructing representations including tables, graphs, keys, models and mathematical relationshipsVC2S8I04 | * examining the strengths and limitations of representations such as physical models, diagrams and virtual simulations, and selecting the most appropriate representation to use
* constructing dichotomous keys to classify and identify an object from a collection of different objects, for example an assortment of leaves collected in the school grounds, or pooled keys or stationery
* constructing representations of chemical and physical changes, such as creating a visual model or symbolic representation
* constructing representations to illustrate a scientific concept or process or to sort data, such as creating a visual key or an interactive presentation, or coding a simple program
* constructing energy flow diagrams to represent energy changes in a system such as a roller-coaster or rocket launch
* using simple formulas in spreadsheets to organise and process generated or collected data
 |
| information and processed data can be analysed to show patterns, trends and relationships, and to identify anomaliesVC2S8I05 | * analysing data, including secondary data, to determine mathematical relationships such as tidal variations over the course of a lunar cycle
* examining secondary data related to causes of population changes to identify trends, patterns and relationships, for example the effects of established invasive animals such as rabbits and feral pigs, and invasive plants such as blackberry and aloe; seasonal migration of flying foxes, short-tailed shearwaters and southern right whales; and habitat loss due to climate change and human activities such as native forest logging
* identifying correlational relationships in data, such as ‘Dropping a mass from a greater height produces a larger indentation’, and analysing these relationships for causality
* comparing temperature differences obtained by reacting different proportions of the same chemicals to determine whether there is a relationship
 |

##### Sub-strand: Evaluating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific methods, conclusions and claims can be analysed to identify assumptions, possible sources of error, conflicting evidence and unanswered questionsVC2S8I06 | * identifying sources of error in a method, such as inconsistent control of variables and inaccuracies in procedures or measurements, and explaining how the method could be improved
* evaluating the method used in an investigation of the forces acting on a parachute, identifying assumptions made about variables that should be controlled, suggesting ways that the method could be improved and giving reasons for the suggested changes
* analysing conclusions to identify facts about or premises relating to physical or chemical changes that are widely accepted as true, and discussing the reasonableness of those assumptions with others
* identifying the evidence being cited to justify a claim about the components of a mixture and evaluating conflicting evidence
* analysing what evidence would be necessary to justify a conclusion that all buildings in an earthquake area should be made of bamboo
* comparing results with other groups or secondary sources to examine consistency and describing where there may be conflicting results or conclusions
* analysing a conclusion or claim to determine if there are further questions that should be investigated to verify the conclusion or claim
 |
| evidence-based arguments can be constructed to support conclusions or evaluate claims, including consideration of ethical issues and protocols associated with using or citing secondary data or informationVC2S8I07 | * exploring how to determine the credibility of a source
* evaluating the quality of evidence of primary and secondary sources used when constructing an argument to support a conclusion or claim
* acknowledging and considering the ethical issues or ethical principles when using or citing secondary data (such as acknowledging sources), and/or respecting cultural protocols (ethical principles that guide behaviour in particular situations when interacting with Aboriginal and/or Torres Strait Islander Peoples and that are designed to protect Aboriginal and Torres Strait Islander cultural and intellectual property rights) about sharing of particular information
* investigating the cultural, historical and archaeological evidence used in the scientific debate about the involvement of early Aboriginal and/or Torres Strait Islander Peoples in the extinction of Australian megafauna
* researching the development of commercial products that are founded on the traditional knowledges and practices of Aboriginal and/or Torres Strait Islander Peoples and discussing related ethical considerations associated with biopiracy and intellectual property rights
 |

##### Sub-strand: Communicating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| communicating ideas, findings and arguments for specific purposes and audiences involves the selection and use of appropriate presentation formats, scientific vocabulary, models and other representations, and may include the use of digital toolsVC2S8I08 | * exploring the role of active and passive voice in scientific writing and analysing contemporary journal articles to identify the use of language features such as voice or tense
* creating an animation that explains particle theory to a peer audience
* writing a report on a scientific investigation of the major properties of different types of rocks using appropriate scientific conventions and representations, including a discussion of how assumptions and possible sources of error may have affected the results
* acknowledging and exploring Aboriginal and/or Torres Strait Islander Peoples’ ways of communicating their understanding of the internal systems of organisms
* filming a documentary on the dynamic nature of the geosphere and selecting appropriate language, models or analogies to engage a specific audience
* justifying a particular ethical response to a selected socio-scientific issue
* considering how publication of Aboriginal and/or Torres Strait Islander Peoples’ seasonal calendars in collaboration with scientific institutions throughout Australia exemplifies how First Nations’ extensive ecological scientific knowledge has contributed to the dissemination of that knowledge among school communities and the general public
 |

## Levels 9 and 10

### Band description

At Levels 9 and 10, students develop a more sophisticated understanding of scientific models and theories, recognising that scientific knowledge is contestable, and is validated, scrutinised and refined over time. They recognise that the application of, or reference to, scientific knowledge has consequences and that it can be misused during public debate through the selective sharing of data or inferences. They explore factors that contribute to the broader adoption of scientific knowledge and practices by society.

Various systems are studied at both macroscopic and microscopic levels, including how these systems respond to external changes in order to maintain stability. Students 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 develop an understanding of the evolutionary feedback mechanisms that ensure the continuity of life. They extend their understanding of the relationship between form and function through investigations such as an exploration of the properties and uses of different types of mechanical waves or an explanation of radioactive decay. Students analyse and evaluate how models simulate the flow of energy and matter to explain and predict phenomena and events. They begin to consider how well a sample or model represents the phenomena under study. They learn that all models involve assumptions and approximations, and that this can limit the reliability of predictions based on those models. Students examine evidence for different theories. They understand that motion and forces are related by applying physical laws and can be modelled mathematically. They build on their understanding of atomic theory to investigate patterns and relationships within the periodic table.

Students analyse and synthesise data from systems at various scales to develop evidence-based explanations for phenomena. They evaluate investigations and use a range of evidence to support their conclusions. They appreciate the need for ethical and cultural considerations when acquiring data and use appropriate units to describe proportional relationships.

Inquiry questions can help stimulate students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration of the key science ideas:

* How is scientific consensus established? What if it isn’t?
* Could synthetic organs make organ donation obsolete?
* Why is accelerating climate change a threat to biodiversity?
* How have advanced computing and big data changed science?
* Why was the discovery of neutrons important?
* Can athletes catch a ‘dropped ruler’ faster than non-athletes?

### Achievement standard

By the end of Level 10, students analyse the importance of different scientific methods, critique, replication, publication and peer review in the development of scientific knowledge. They examine the relationship between science, engineering and technologies. They examine how different projected outcomes of the application of scientific knowledge to a selected socio-scientific issue may lead to varied support from individuals and groups in society. They discuss how scientific information and misinformation may inform personal and social decision-making and influence priorities for scientific research.

Students describe how the processes of sexual and asexual reproduction enable survival of the species. They explain the processes that underpin heredity and genetic diversity, and predict the outcomes of monohybrid crosses. They explain how the nervous and endocrine systems use negative feedback to support homeostasis in the body’s internal environment. They distinguish between infectious and non-infectious disease, and compare different infectious disease control measures. They describe the evidence supporting the theory of evolution by natural selection. They explain how ideas about the structure of the atom have changed over time, and model natural radioactive decay to illustrate how stable atoms are formed. They describe patterns and trends in the periodic table. They demonstrate the Law of Conservation of Mass in chemical reactions, and write word and balanced chemical equations for these reactions. They classify energy changes in chemical reactions as exothermic or endothermic. They predict the products of reactions and the effect of changing reaction conditions. They explain how interactions within and between Earth’s interrelated systems affect the carbon cycle. They describe trends in patterns of global climate change and propose strategies to mitigate contributing factors. They discuss the advantages and disadvantages of space exploration. They distinguish between different features in the universe and sequence key events in the origin and evolution of the universe, including an outline of the supporting evidence for the big bang theory. They explain how wave and particle models describe energy transfer, and compare the properties, features and applications of waves. They analyse and represent energy conservation, including efficiency, in systems, and model how different forms of energy are transformed into electrical energy. They use Newton’s laws to describe and predict the motion of objects in a system.

Students formulate and refine questions and hypotheses to make reasoned predictions, test relationships and develop explanatory models when investigating scientific questions, problems and claims. They plan a range of valid, reproducible and safe scientific investigations and explain how they have addressed any ethical and cultural considerations when generating or using primary and secondary data. They select and use equipment to generate and record data, ensuring the use of suitable sample sizes and assessing the precision of multiple measurement readings. They select and construct a range of appropriate representations to organise, process and summarise data and information. They analyse and compare a variety of data and information to identify and explain qualitative and quantitative patterns, trends, relationships, assumptions and anomalies. They evaluate the validity and reproducibility of investigation methods including ways to improve the quality of data, and the validity of conclusions and claims. They provide evidence-based explanations for findings and construct logical arguments based on the evaluation of multiple sources of evidence to justify conclusions and assess claims. They select and use appropriate presentation formats, scientific content, vocabulary, models, conventions, formulas and other representations to achieve their purpose when communicating and justifying their ideas, findings, arguments and proposals to diverse audiences.

### Content descriptions and elaborations

#### Strand: Science as a Human Endeavour

##### Sub-strand: Nature and development of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| scientific knowledge is contestable and is validated and refined over time through expanding scientific methods, replication, publication, peer review and consensusVC2S10H01 | * exploring why the work of Professor Barry Marshall and Dr Robin Warren in relation to the cause of peptic ulcers was first rejected for publication and later validated
* examining the scientific consensus supporting global warming and examining why scientists use different climate change models when there is a climate change consensus among scientists
* examining how Marie and Pierre Curie’s discoveries of new elements were validated
* examining how the work of Rosalind Franklin and Raymond Gosling was critical to determining the double-helix structure of DNA, reported by James Watson and Francis Crick
* exploring the role of large data sets and statistical analysis in validating scientific findings, such as Gregor Mendel’s experiments with pea plants
* investigating how the development of the periodic table has been disputed and refined as science has progressed and new elements have been discovered
* distinguishing between science and pseudoscience, and identifying examples of pseudoscientific claims such as astrology, dowsing, graphology and phrenology
 |
| advances in technologies have enabled advances in science, while science has contributed to developments in technologies and engineeringVC2S10H02 | * considering the impact of technological advances developed in Australia, such as the cochlear implant pioneered by Professor Graeme Clark, Monash Vision Group’s work on a bionic eye, Professor Fiona Woods’s development of spray-on skin and Dr John O’Sullivan and CSIRO’s invention of wi-fi
* recognising that the development of fast computers has made possible the analysis of DNA sequencing, radio astronomy signals and other data generated by major international science projects such as the Event Horizon Telescope, Large Hadron Collider, Laser Interferometer Gravitational-Wave Observatory and Australian Square Kilometre Array Pathfinder
* considering how computer modelling has improved knowledge and predictability of phenomena such as climate change and atmospheric pollution, and how quantum computers enhance modelling of complex weather and climate systems
* investigating how satellites generate global data including for ocean temperatures, sea levels, and forest and ice cover, and examining how that data is used to evaluate the effects of climate change
* examining how the recent use of female crash-test dummies has shown that women are at greater risk of injury in a car accident, and considering implications for changing car safety features
* investigating how the development of super-strong, lighter alloys has enabled engineers to improve structural components in building, transportation and industry and to design products such as improved armour for police and soldiers
 |

##### Sub-strand: Use and influence of science

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the use of scientific knowledge to address socio-scientific issues and shape a more sustainable future for humans and the environment may have diverse projected outcomes that affect the extent to which scientific knowledge and practices are adopted more broadly by societyVC2S10H03 | * researching citizen science projects related to public health and examining why people would choose to be involved
* examining how government initiatives such as Landcare support adoption of effective land-restoration practices that improve soil quality and increase carbon sequestration in soils
* analysing factors that have led to the adoption of solar panels and battery storage by individuals, communities and industries
* investigating why agricultural practices have changed to include widespread use of genetically engineered crops
* examining statistics to compare bicycle or electric scooter injuries sustained by riders with and without helmets, and relating these to helmet-wearing requirements
* considering how the traditional ecological knowledges of Aboriginal and/or Torres Strait Islander Peoples are being recognised by Western science and how these practices are being used by Traditional Owners in carbon farming initiatives to increase carbon sequestration and reduce greenhouse gas emissions
 |
| scientific knowledge may be interpreted in different ways by individuals and groups in society; the values and needs of society can influence the focus of scientific researchVC2S10H04 | * investigating how the need to minimise greenhouse gas production has led to scientific and technological advances
* researching innovative energy-transfer devices, including those used in transport and communication
* considering how the development of new materials and procedures has contributed to safe sound levels for humans in the workplace and during leisure activities
* exploring how data and its analysis or interpretation can bias results to align with specific viewpoints
* examining why many manufacturers are adopting green chemistry processes
* researching how particular values in 19th- and early 20th-century Australia, combined with scientific misconceptions about heredity and evolution, have influenced policies and attitudes about Aboriginal and/or Torres Strait Islander Peoples
* recognising that financial support from governments or commercial organisations is needed for scientific developments and that this can determine what research is undertaken
 |

#### Strand: Science Understanding

##### Sub-strand: Biological sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the structures of reproductive cells and organs in plants and animals are related to their functions; processes of sexual and asexual reproduction enable survival of a speciesVC2S10U01 | * examining how the reproductive organ structures work collectively in males and females as systems
* explaining how the forms of male and female gametes relate to their specific functions
* identifying and comparing sexual and asexual reproductive strategies in plants
* exploring how sexual reproduction produces a greater rate of variation among offspring compared with asexual reproduction
* examining how the reproductive strategies of multicellular animals are related to their environments and the complexity of the organisms
* examining how the number of offspring produced by animals is related to the amount of parental care
 |
| the nervous and endocrine systems work together to regulate and coordinate the body’s response to stimuli, ensuring homeostasis, including through negative feedback mechanismsVC2S10U02 | * exploring the body’s observable responses to external stimuli (such as changes in light or temperature, and presence of danger or pathogens) or internal stimuli (such as dehydration and hunger)
* using models, flow diagrams and virtual simulations to investigate and represent the relationships between body systems that are necessary to coordinate a response to a stimulus
* comparing the roles and functions of electrical impulses and hormones in the body’s responses to external stimuli
* modelling how the process of regulation is monitored and adjusted by connections between the receptor, command centre and effector
* examining how negative feedback mechanisms serve to maintain balance in internal systems, such as those for body temperature, blood sugar, iron levels and extracellular pH, and how an understanding of feedback mechanisms has enabled the development of pharmaceuticals (such as insulin for type 1 diabetes) and products to maintain or enhance performance (such as electrolyte solutions)
* examining the effects of a condition such as diabetes-induced blindness or hypothermia on a feedback system
 |
| infectious and non-infectious diseases are caused by different organisms and agents; measures to control the transmission of infectious diseases include personal hygiene, quarantine protocols, medical treatment and public education programsVC2S10U03 | * differentiating between infectious diseases that are caused by different pathogens, such as tuberculosis (caused by bacteria), influenza (caused by viruses), candidiasis (caused by a fungus) and tapeworm infection (caused by a parasite)
* conducting an investigation to compare the effectiveness of handwashing by counting the number of bacterial colonies growing on agar plates
* visualising biological processes associated with diseases, such as viewing an animation about how a vaccine works or constructing a model to simulate blood flow in an artery blocked by cholesterol
* exploring the data and rationale for different strategies to stop the spread of infectious diseases, such as handwashing, mask-wearing, isolation and surface disinfection
* researching how factors such as genetics, age, malnutrition, environment and lifestyle may cause non-infectious diseases such as cancer, asbestosis, Alzheimer’s disease, diabetes and epilepsy
* researching the impact of diseases introduced with the arrival of Europeans to Australia, for example the severity of the impact of smallpox was partly because this virus was new to Aboriginal communities and so they lacked an immune response to it
* storyboarding for a social media clip that explains how healthy lifestyles may contribute to lower risk of non-infectious diseases
 |
| genetic inheritance involves the function of DNA, chromosomes, genes and alleles, and the roles of mitosis and meiosis in passing on genetic information to the next generation; the principles of Mendelian inheritance can be used to predict ratios of genotypes and phenotypes in monohybrid crosses involving dominant and recessive traitsVC2S10U04 | * using models and diagrams to represent the relationship between genes, chromosomes and DNA of an organism’s genome
* explaining how genetic information passed on to offspring from both parents by meiosis and fertilisation increases the variation of a species
* using the concept of 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
* using pedigree diagrams to show patterns of inheritance of simple dominant and recessive characteristics through multigenerational families
* exploring the role of DNA in cancer or genetic disorders such as haemochromatosis, sickle cell anaemia, cystic fibrosis and Klinefelter syndrome
 |
| the theory of evolution by natural selection includes the processes of variation, isolation and adaptation and is supported by evidence including the fossil record, biogeography and comparative embryology; the theory explains past and present biodiversity and demonstrates how all organisms have some degree of relatedness to each otherVC2S10U05 | * outlining processes involved in natural selection including variation, isolation and selection
* examining biodiversity as a function of evolution
* analysing evidence for the theory of evolution by natural selection, including the fossil record, chemical and anatomical similarities, and geographical distribution of species
* 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
* relating genetic characteristics to survival and reproductive rates
* investigating some of the structural and physiological adaptations of Aboriginal and/or Torres Strait Islander Peoples to the Australian environment
* considering the debates and research regarding whether humans or climate change were causal factors in Australia’s Pleistocene megafaunal extinction
 |

##### Sub-strand: Chemical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the model of the atom changed following the discovery of electrons, protons and neutrons; natural radioactive decay results in a change from unstable to stable atomsVC2S10U06 | * comparing the masses and charges of protons, neutrons and electrons, and examining how the discovery of these particles resulted from experimental evidence and answered questions related to properties and behaviours of atoms
* 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
* describing in simple terms how different unstable isotopes decay, such as radon-222 emitting an alpha particle, iodine-131 emitting a beta particle and cobalt-60 emitting gamma radiation to form stable atoms
* defining half-life, examining the timescales of decay of different elements such as carbon-14 and uranium-238, and simulating or using digital simulations to examine radioactive decay, including half-life
* researching how radiocarbon and other dating methods including optically stimulated luminescence have been used to establish that Aboriginal and Torres Strait Islander Peoples have been present on the Australian continent for at least 65,000 years
* identifying where applications of radioactivity are used in medicine and industry, such as in diagnosing and treating cancer, and when checking for faults in materials used in aircraft and spacecraft
 |
| the organisation of the elements in the periodic table is related to the structure and properties of atoms; patterns and trends include the significance of rows and periods, metallic and non-metallic properties, atomic size and reactivity VC2S10U07 | * examining the significance of groups and periods in the periodic table
* analysing patterns in chemical reactivity of some elements in the periodic table by reacting them with oxygen, water and acids to discern that elements in the same group of the periodic table have similar properties
* investigating the physical properties of some metals and non-metals
* using the Bohr model of the atom to describe the structure of atoms in terms of electron shells, and relating the electron arrangements in different atoms to the properties and positions of their elements in the periodic table
* deducing that repeating patterns of the periodic table reflect patterns of electrons in outer electron shells
* conducting flame tests for a selection of elements and examining emission spectra
 |
| chemical reactions are described by the Law of Conservation of Mass and involve the rearrangement of atoms; they can be modelled using a range of representations, including word and simple balanced chemical equationsVC2S10U08 | * identifying reactants and products in chemical reactions
* using models and representations to show the rearrangement of atoms in chemical reactions and to illustrate the Law of Conservation of Mass
* investigating chemical reactions in closed and open systems and relating data obtained to the Law of Conservation of Mass
* writing symbol equations that are easy to balance and explaining the rationale for balancing chemical equations with reference to the Law of Conservation of Mass
* investigating why most elements are not found in their elemental state
* explaining how implementing ideas related to green chemistry principles, such as minimising the amount of unusable waste products, energy use and using more environmentally friendly chemical processes, will affect the environment
 |
| chemical reactions include synthesis, decomposition and displacement reactions and can be classified as exothermic or endothermic; reaction rates are affected by factors including temperature, concentration, surface area of solid reactants, and catalystsVC2S10U09 | * defining and representing synthesis, decomposition and displacement reactions using a variety of formats such as molecular models, diagrams, and word and balanced symbol equations
* identifying reaction type and predicting the products of a reaction
* 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
* investigating how hot and cold packs work as applications of exothermic and endothermic reactions
* investigating the effect of a range of factors such as temperature, concentration, surface area and catalysts on the rates of chemical reactions
* investigating chemical reactions employed by Aboriginal and/or Torres Strait Islander Peoples in the production of useful substances, for example fermentation to produce ethanol, pyrolysis to produce charcoal, and calcination to produce plaster and pigments such as iron oxide
* investigating some of the chemical reactions and methods employed by Aboriginal and/or Torres Strait Islander Peoples to convert toxic plants into edible food products, for example the detoxification of cycad seeds by the Rainforest Aboriginal Peoples of North Queensland that involved speeding up the rate of reaction by increasing temperature and surface area
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##### Sub-strand: Earth and space sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| carbon is cycled on Earth through key processes including photosynthesis, respiration, fire, weathering, vulcanism and the combustion of fossil fuels; these processes change the composition of Earth’s interrelated systems (atmosphere, biosphere, hydrosphere and lithosphere) over timeVC2S10U10 | * identifying Earth as a system, differentiating between Earth’s 4 systems and discussing interactions between these systems, such as pesticides applied to soils (lithosphere) leaching into waterways (hydrosphere) and affecting organisms (biosphere)
* examining the carbon cycle using diagrams, animations or simulations and explaining the role of photosynthesis and respiration in that cycle
* investigating the greenhouse effect and relating it to the role of carbon dioxide in maintaining temperatures that support life on Earth
* investigating how Aboriginal and/or Torres Strait Islander Peoples use fire-mediated chemical reactions to facilitate energy and nutrient transfer through the practice of cultural burning
* investigating how Aboriginal and/or Torres Strait Islander Peoples are reducing Australia’s greenhouse gas emissions by reinstating cultural burning practices
* 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
* identifying how carbon dioxide is captured and stored naturally or using technologies
 |
| the dynamics of global climate change can be modelled and explained by examining the interactions between greenhouse gas emissions and energy exchanges within and between Earth’s systems; mitigating human-induced climate change requires addressing various activities including power generation, deforestation, manufacturing, transportation, food production and resource consumption VC2S10U11 | * examining how interactions of radiation from the Sun with the atmosphere, ocean and land are the foundation for the global climate system
* investigating indicators of climate change such as changes in ocean and atmospheric temperatures, sea levels, biodiversity, species distribution, permafrost and sea ice
* identifying changes in global climate over time, exploring visualisations and using simulations to investigate why energy balances have changed
* examining the factors, including energy, that drive deep ocean currents, their role in regulating global climate and their effects on marine life
* predicting changes to the Earth system and identifying strategies designed to reduce climate change or mitigate its effects
* calculating an individual’s carbon footprint, examining the impact of human activities on atmospheric carbon dioxide levels and suggesting strategies to reduce carbon dioxide emissions
 |
| space exploration seeks to expand knowledge of the origins and structure of the universe and to resolve the challenges of humans travelling and living away from Earth’s surfaceVC2S10U12 | * creating a story about a day in the life of a person living on Mars
* designing and launching simple water or air rockets to understand the principles of rocket propulsion, using altimeters to measure the altitude reached by the rockets and discussing the challenges of escaping Earth’s gravitational pull
* researching and designing their own space suits, including creating scaled-down prototypes or artistic representations, following a discussion about the necessary features for survival in space, such as protection from radiation, temperature regulation and life support systems
* developing a report about the current research and inhabitants of the International Space Station
* exploring the effects of microgravity on the human body by simulating it in the laboratory using reduced-gravity aircraft simulations or creating simple experiments to demonstrate how fluids behave differently in microgravity
* researching items and technologies that are a result of space research or examining the link between scientific research and real-world applications such as in new materials development
 |
| the universe contains features including galaxies, stars, solar systems and black holes; the big bang theory models the origin and evolution of the universe and is supported by evidenceVC2S10U13 | * researching Aboriginal and/or Torres Strait Islander Peoples’ knowledges of celestial bodies and explanations of the origin of the universe
* identifying the different technologies used to collect astronomical data and the types of data collected, and describing the major components of the universe using appropriate scientific terminology and units, including astronomical units, scientific notation and light-years
* examining how the light spectra and brightness of stars are used to identify compositional elements of stars, their movements and their distances from Earth
* constructing a timeline to show major changes in the universe that are thought to have occurred from the big bang until the formation of the major components such as planets, stars and galaxies, and recognising that the age of the universe can be derived by applying knowledge of the big bang theory
* explaining how each different type of evidence, such as cosmic microwave background radiation, red shift or blue shift of galaxies, Edwin Hubble’s observations and proportion of matter in the universe, supports the big bang theory
* exploring recent advances in astronomy, including the Australian Square Kilometre Array Pathfinder, and in astrophysics, such as the discovery of gravitational waves, dark matter and dark energy, and identifying new knowledge that has emerged
 |

##### Sub-strand: Physical sciences

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| wave and particle models can be used to describe energy transfer (conduction, convection and radiation) through different media; waves (electromagnetic and mechanical) have different properties, features (including amplitude, wavelength, frequency and speed) and applicationsVC2S10U14 | * describing the processes underlying convection and conduction of heat in terms of the particle model
* modelling the transfer of sound energy as waves using slinky springs and relating to the medium through which the sound is transferred
* investigating the relationship between the volume of a sound wave and the amplitude of the wave, or the relationship between the pitch or tone of a sound wave and its frequency
* examining how the particle model of electricity explains static electricity and electrical current and relating this to voltage, conductors and insulators
* discussing the wave and particle models of energy transfer, including the concept of photons, and how these models are useful for understanding aspects of light and other forms of electromagnetic radiation
* examining how properties of electromagnetic radiation relate to the uses of this radiation, such as in radar, medicine, sanitation, mobile phone communications, remote sensing and microwave cooking
* investigating the impact of material selection on the transfer of sound energy in Aboriginal and/or Torres Strait Islander Peoples’ traditional musical, hunting and communication instruments
 |
| the Law of Conservation of Energy can be analysed in systems, including Earth systems, by assessing the efficiency of energy inputs, outputs, transfers and transformationsVC2S10U15 | * recognising that the Law of Conservation of Energy explains that total energy is maintained in energy transfers and transformations
* recognising that energy transfers and transformations can have several steps and that systems are not 100% efficient, which means that usable energy is reduced
* creating a Sankey diagram of the transformation of energy as light travels from the Sun to Earth
* investigating the energy efficiency of ground ovens used by Aboriginal and/or Torres Strait Islander Peoples
* examining how improving efficiency in energy transfer and transformations in sporting activities such as pole-vaulting and archery improves athletic performance
* comparing the efficiency of electricity generation from different sources, for example coal, nuclear, hydroelectricity, gas, solar and wind
 |
| electricity can be generated as alternating current (AC) using magnets (via turbines turned by wind, water, tides or steam that is generated by the combustion of oil, gas or coal or by nuclear energy) or as direct current (DC) using photovoltaic cells or batteriesVC2S10U16 | * building a simple AC generator
* creating a Venn diagram that compares the production of AC and DC power
* investigating a power source used to turn a turbine
* researching the difference between fission and fusion as energy sources
* building and investigating the power generated by a wind vane
 |
| Newton’s laws of motion can be used to quantitatively analyse the relationship between force, mass and acceleration of objects VC2S10U17 | * investigating a moving object and using mathematical representations including graphs and algebraic formulas to quantitatively determine relationships between distance, time, speed, force, acceleration and mass
* investigating how Aboriginal and/or Torres Strait Islander Peoples achieved an increase in speed and subsequent impact force using spearthrowers and bows
* modelling how a change in net force acting on an object affects its motion, and relating this to the purpose of safety features such as seatbelts, airbags and crumple zones in vehicles
* investigating the application of Newton’s laws in sport and how these are applied to improve an athlete’s performance or safety
* constructing an argument, supported by data, to support lower speed limits for vehicles near schools or for trucks in urban environments
* investigating how driverless vehicles apply Newton’s laws of motion to brake at the right times
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#### Strand: Science Inquiry

##### Sub-strand: Questioning and predicting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| investigable questions, reasoned predictions and hypotheses can be used in guiding investigations to test and develop explanatory models and relationshipsVC2S10I01 | * asking investigable 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?’
* generating investigable questions about the relationship between crash impact force and speed, and developing a hypothesis that can then be tested
* investigating how changing surface area, concentration and temperature affect the rate of a chemical reaction, and developing reasoned predictions about a further investigation as an experiment extension
* making prisms of different shapes using gelatine (half concentration) poured into moulds and shining a torch through them to predict and investigate how light is bent and dispersed
 |

##### Sub-strand: Planning and conducting

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| valid, reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying and controlling for possible sources of error and bias in sampling or in making observations; safe, ethical investigations include undertaking risk assessments and following protocols when accessing cultural sites and artefacts on Country and PlaceVC2S10I02 | * discussing the ethical and social issues involved in the care and use of animals for scientific purposes before starting an investigation involving animal reproduction
* recognising and implementing ethical requirements when collaborating with Aboriginal and/or Torres Strait Islander people to develop commercial products that utilise traditional ecological knowledges, for example the use of emu oil as an anti-inflammatory product, kangaroo apple as an analgesic and banksia flowers in antiseptic formulations
* planning investigations using a range of scientific investigation methodologies such as fieldwork, locating and using information sources, conducting surveys, and using modelling and simulations, case studies, participant observations and interviews
* researching how Torres Strait Islander communities collaborate with research organisations and government agencies to conduct scientific investigations about the ecology of various pests, diseases and weeds, possible arrival pathways and methods of spreading, and how they conduct surveillance, quarantine and monitoring activities to minimise these potential threats to Australia’s biosecurity
* using secondary data to analyse evidence for the theory of evolution by natural selection, including the fossil record, chemical and anatomical similarities, and geographical distribution of species
* determining the reproducibility of a field investigation using survey techniques that seek to answer a question such as ‘How much traffic passes the school during a designated period of time?’
* identifying the potential hazards of chemicals or biological materials and processes used in experimental investigation of chemical reactions, and how these should be addressed
 |
| equipment can be selected and used to generate and record data sets that show precision, including consideration of sample size and using digital tools as appropriate VC2S10I03 | * ensuring instruments are correctly calibrated before use and planning for recalibration as necessary between uses to improve reliability of results
* considering an appropriate sample size for an investigation into carbon sequestration in an ecosystem, and how the use of digital tools might enable more efficient data collection for larger sample sizes
* explaining how estimation affects precision, and examining the uncertainty introduced when reading between scale markings
* discussing the amount of data needed to produce a useful sample size and why sample size is important, for example in considering the differences between an epidemic and a pandemic or determining whether a scientific idea can be classified as a theory or a law
* deciding how much data is needed to draw valid conclusions, for example determining how many data points are required to establish the mathematical relationship between force and acceleration or how many trials should be completed in investigating the effects of temperature on the rate of a chemical reaction such as the displacement reaction between zinc and dilute sulfuric acid to form zinc sulfate
 |

##### Sub-strand: Processing, modelling and analysing

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| data and information can be organised, processed and summarised by selecting and constructing representations including tables, graphs, descriptive statistics, models, symbols, formulas and mathematical relationshipsVC2S10I04 | * using spreadsheet software to carry out mathematical analyses of data
* describing sample properties such as mean, median, range and large gaps visible on a graph to make generalisations, while acknowledging uncertainties and the effects of outliers
* applying ratios to accurately represent usable and waste energy in transfer and transformation diagrams such as Sankey diagrams
* representing speed and acceleration data from investigations or simulations in tables and graphs and comparing how these facilitate the identification of relationships
* modelling the spread of infectious disease using phenolphthalein solution and sodium carbonate, Na2CO3 (washing soda)
* exploring how algorithms can be applied to calculate carbon storage of different vegetation types (above-ground biomass and below-ground biomass) through the collection of data such as satellite imagery, LiDAR (light detection and ranging) data or aerial photographs that provide information about vegetation cover and structure
* comparing the information provided by molecular models, and word and balanced symbolic chemical equations, when examining the Law of Conservation of Mass
 |
| information and processed data can be analysed and compared to identify and explain qualitative and quantitative patterns, trends, relationships and anomaliesVC2S10I05 | * 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’
* comparing merits and limitations of patterns as represented by the periodic table with graphical representations of patterns such as melting point and boiling point, and considering anomalies
* 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
* examining tables, graphs and digital simulations of radioactive decay half-lives to predict changes in mass over time
* analysing vaccination data to identify trends, patterns and relationships, and drawing conclusions about vaccinations and the occurrence of diseases such as measles, polio, tetanus, chickenpox and whooping cough; and infections such as influenza, COVID-19 (coronavirus) and human papillomavirus (HPV)
* comparing the merits and limitations of patterns as represented in the periodic table with graphical representations of patterns such as for melting points and boiling points, including consideration of anomalies
* distinguishing between causal relationships (e.g. bacterial infection and disease) and correlational relationships (e.g. sunspot activity and climate change)
 |

##### Sub-strand: Evaluating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| the validity and reproducibility of investigation methods and the validity of conclusions and claims can be evaluated, including by identifying assumptions, conflicting evidence, biases that may influence observations and conclusions, sources of error and areas of uncertaintyVC2S10I06 | * evaluating the strength of a conclusion that can be inferred from a particular data set
* distinguishing between random and systematic errors and how these can affect investigation results
* analysing methods for and conclusions about heat transfer through multiple layers of an insulating material to identify facts or premises that are widely accepted as true, and evaluating the reasonableness of those assumptions
 |
| arguments based on a variety of evidence can be constructed to support conclusions or evaluate claims, including consideration of any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information VC2S10I07 | * judging the validity of science-related media reports on genetic diseases and how these reports might be interpreted by the public
* researching the methods used by scientists in studies reported in the media to evaluate the validity of headlines on the amount of carbon dioxide in the atmosphere
* constructing a scientific argument showing how a range of evidence supports a claim relating to the age of the universe
* justifying a conclusion based on the primary data generated through an investigation
* acknowledging and considering the ethical issues or ethical principles when using or citing secondary data (such as acknowledging sources), and/or respecting cultural protocols (ethical principles that guide behaviour in particular situations when interacting with Aboriginal and/or Torres Strait Islander Peoples and that are designed to protect Aboriginal and Torres Strait Islander cultural and intellectual property rights) about sharing of particular information
 |

##### Sub-strand: Communicating

| Content descriptionsStudents learn that: | ElaborationsThis may involve students: |
| --- | --- |
| communicating and justifying scientific ideas, findings and arguments for diverse audiences involves the selection of appropriate presentation formats, content, scientific vocabulary, conventions, models and other representations, and may include the use of digital tools VC2S10I08 | * 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
* creating an infographic that illustrates the relationship between mass, acceleration and force
* developing an interactive presentation that shows feedback loops in human body systems
* creating a digital infographic to highlight the lines of evidence data for polar ice caps, ocean temperatures and extreme weather to explain how climate change is impacting Earth
* justifying a position taken in relation to a selected socio-scientific issue
* planning a social media campaign to encourage young people to reduce their carbon footprints
* acknowledging and examining Aboriginal and/or Torres Strait Islander Peoples’ ways of representing and communicating understandings of the night sky and its use in timekeeping through art and stone arrangements; for example, the Wotjobaluk People used the message stick to communicate the distance to the gathering place, what a community may be required to bring, and the number of people invited, with each community then using their own ways of monitoring time, including the tracking of constellations and the appearance of stars in the night sky, to synchronise their timing for the event
 |