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CURRICULUM ELEMENTS

Year 7

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| **Year level description** |
| In Year 7 students explore the diversity of life on Earth and continue to develop their understanding of the role of classification in ordering and organising information. They use and develop models to represent and analyse the flow of energy and matter through ecosystems and explore the impact of changing components within these systems. They investigate relationships in the Earth-sun-moon system and use models to predict and explain events. They extend their understanding of the particulate nature of matter and explore how interactions of matter and energy at the sub-microscopic scale determine macroscopic properties. They consider the effects of multiple forces when explaining changes in an object’s motion. Students make accurate measurements and analyse relationships between system components. They construct and use models to test hypotheses about phenomena at scales that are difficult to study directly and use these observations and other evidence to draw conclusions. They begin to understand the relationship between science and society and appreciate the need for ethical and cultural considerations when acquiring data.Inquiry questions can help excite students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: * Mosquitoes are so annoying! What would the impact be if we got rid of them?
* What would Australian ecosystems look like without fire?
* How do simple machines make our lives easier?
* Why is being able to separate mixtures important?
* How have systems of classification changed over time? How do they differ across cultures?
 |
| **Achievement standard** |
| By the end of Year 7 students explain how biological diversity is ordered and organised. They represent flows of matter and energy in ecosystems and predict the effects of environmental changes. They model cycles in the Earth-sun-moon system and explain the effects of these cycles on Earth phenomena. They represent and explain the effects of forces acting on objects. They use particle theory to explain the physical properties of substances and develop processes that separate mixtures. Students identify the factors that can influence development of and lead to changes in scientific knowledge. They explain how scientific responses are developed and can impact society. They explain the role of science communication in shaping viewpoints, policies and regulations. Students plan and conduct safe, reproducible investigations to test relationships and aspects of scientific models. They identify potential ethical issues and intercultural considerations required for field locations or use of secondary data. They use equipment to generate and record data with precision. They select and construct appropriate representations to organise data and information. They process data and information and analyse it to describe patterns, trends and relationships. They identify possible sources of error in methods and identify unanswered questions in conclusions and claims. They identify evidence to support their conclusions and construct arguments to support or dispute claims. They select and use language and text features appropriately for their purpose and audience when communicating their ideas and findings. |

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| **Strand: Science understanding** | **Year 7** |
| **Sub-strand: Biological sciences** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| investigate the role of classification in ordering and organising the diversity of life on Earth and use and develop classification tools including dichotomous keys AC9S7U01 | * observing and identifying the similarities and differences of particular features within and between groups of organisms
* 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 kingdom, phylum, class, order, family, genus, species
* considering the reasons for classifying living things, such as identification and communication
* examining how biological classification has changed over time through improvements in microscopy
* using provided dichotomous keys to identify organisms surveyed on a field trip
* investigating First Nations Australians’ systems of classifying living things and how these systems differ from those used by contemporary science
 |
| use models, including food webs, to represent matter and energy flow in ecosystems and predict the impact of changing abiotic and biotic factors on populations AC9S7U02 | * analysing food webs to show feeding relationships between organisms in an ecosystem and the role of microorganisms
* modelling how energy flows into and out of an ecosystem via the pathways of food webs
* predicting the effects on local ecosystems when living things such pollinators or predators are removed from or die out in an area
* examining how events such as seasonal changes, destruction of habitat or introduction of a species impact abiotic and biotic factors and cause changes to populations
* investigating First Nations Australians’ responses to invasive species and their effect on food webs that many communities are a part of, and depend on, for produce and medicine
* considering how First Nations Australians’ fire management practices over tens of thousands of years have changed the distribution of flora and fauna in most regions of Australia
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| **Sub-strand: Earth and space sciences** |
| model cyclic changes in the relative positions of the Earth, sun and moon and explain how these cycles cause eclipses and influence predictable phenomena on Earth, including seasons and tides AC9S7U03 | * using physical models or virtual simulations to explain how Earth’s tilt and position relative to the sun causes differences in light intensity on Earth’s surface, resulting in seasons
* examining the effect of the gravitational attraction of the moon and the sun on Earth's oceans and describing how the relative positions of the moon and sun with respect to Earth result in tidal variations
* using physical models or virtual simulations to explain the cyclic patterns of lunar phases and eclipses of the sun and moon
* researching knowledges held by First Nations Australians regarding the phases of the moon and the connection between the lunar cycle and ocean tides
* investigating First Nations Australians’ calendars and how they are used to predict seasonal changes
* researching First Nations Australians’ oral traditions and cultural recordings of solar and lunar eclipses and investigating similarities and differences with contemporary understandings of such phenomena
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| **Sub-strand: Physical sciences** |
| investigate and represent balanced and unbalanced forces, including gravitational force, acting on objects, and relate changes in an object’s motion to its mass and the magnitude and direction of forces acting on it AC9S7U04 | * investigating the effects of applying different forces to familiar objects of the same and different mass
* 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 arrow diagrams
* investigating how Earth's gravitational force is the attractive force which pulls objects to the centre of Earth and its magnitude is related to the mass of an object
* investigating how simple machines such as levers and pulleys are used to change the magnitude of force needed to perform a task
* examining how gravity affects objects in space, including moons, planets, stars, galaxies and black holes
* analysing the forces acting on boomerangs and how early First Peoples of Australia designed an air foil profile which allowed for multiple variations and applications
* investigating the effect of forces through the application of simple machines, such as the bow and arrows used by Torres Strait Islander Peoples or the spearthrowers used by First Peoples of Australia
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| **Sub-strand: Chemical sciences** |
| use particle theory to describe the arrangement of particles in a substance, including the motion of and attraction between particles, and relate this to the properties of the substance AC9S7U05 | * using and constructing models, diagrams or virtual simulations to represent changes in particle arrangement as substances change state
* relating motion and energy of particles to distances between particles of the same substance in different states
* 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 is affected by the amount of heat energy absorbed or released
* comparing the properties of different states of matter and explaining differences using particle theory
* investigating properties of materials such as density, melting point and compressibility and explaining these in terms of particle arrangement
* explaining the process of diffusion in a liquid and a gas in terms of particles
 |
| use a particle model to describe differences between pure substances and mixtures and apply understanding of properties of substances to separate mixtures AC9S7U06 | * using representations of particles to show the difference between samples of pure substances and mixtures, and identifying examples of each
* examining different solutions and identifying the solvent and solute
* investigating and using a range of physical separation techniques such as filtration, decantation, evaporation, crystallisation, chromatography and distillation
* exploring and comparing separation methods used in a variety of situations such as in the home, recycling industries and purifying water
* analysing how the physical properties of substances in mixtures, such as particle size, density or volatility, determine the separation technique used
* investigating separation techniques used by First Nations Australians, such as hand-picking, sieving, winnowing, yandying, filtering, cold-pressing and steam distilling
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| **Strand: Science as a human endeavour** | **Year 7** |
| **Sub-strand: Nature and development of science** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| explain how new evidence or different perspectives can lead to changes in scientific knowledge AC9S7H01 | * 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 the land management practices of First Nations Australians inform contemporary management of the environment to protect biodiversity
* investigating how First Nations Australians’ traditional ecological and zoological knowledges inform sustainable harvesting practices of certain species, such as dugongs and turtles
* researching developments in the understanding of astronomy, such as the predictions of eclipses and the calculation of the length of the solar year by Abu Abdallah Mohammad ibn Jabir ibn Sinan al-Raqqi al-Harrani al-Sabi al-Battani in the 10th century
* investigating how aeronautical engineers’ understanding of the nature of the forces acting in flight have led to changes in the design of aircraft
 |
| investigate how cultural perspectives and world views influence the development of scientific knowledge AC9S7H02 | * investigating classification systems used by First Nations Australians and how they differ in context and use from those used by contemporary science
* investigating how First Nations Australians have developed sustainable harvesting practices and cultural protocols based on deep ecological understandings
* exploring how the personal beliefs of a scientist may influence the questions they choose to pursue and how they investigate those questions, such as Richard Levins, whose political views led him to focus on population ecology, or Joseph Rotblat, a physicist who refused to work on science that might lead to development of an atomic bomb
* 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
* exploring the work of Wang Zhenyi, an acclaimed female scholar of 18th-century China, including her experiments in studying lunar eclipses
* exploring how David Unaipon, a Ngarrindjeri man from 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
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| **Sub-strand: Use and influence of science** |
| examine how proposed scientific responses to contemporary issues may impact on society and explore ethical, environmental, social and economic considerations AC9S7H03 | * investigating how scientific knowledge that larger reserves are better for maintaining ecosystem function might interact with competing viewpoints, values and interests for land use when planning ecological reserves
* examining how laboratory-grown meat might reduce impact on ecosystems and considering any social, ethical and economic implications of developing laboratory-grown meat for wide consumption
* examining how the use of desalination plants to produce fresh water has impacted marine ecosystems where the desalination plants are located
* investigating the contributions of First Nations Australians’ 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 First Nations Australians’ land management techniques
* discussing how scientific knowledge of the forces involved in flight has led to changes in aircraft design and any ethical, environmental, social and economic considerations of these changes
* researching how properties of gases were utilised in the gas warfare in First World War and the subsequent development of the Geneva Protocol and the later adoption of the Chemical Weapons Convention international arms control treaty
 |
| explore the role of science communication in informing individual viewpoints and community policies and regulations AC9S7H04 | * investigating how, through two-way approaches, First Nations Australians are communicating their knowledge and viewpoints, such as Caring for Country and Place initiatives to influence related policies
* examining how science communication of endangered species has led to policies and regulations related to fishing catch and hunting limits
* exploring how Dame Jane Goodall’s communication of her research resulted in changed individual viewpoints and conservation policies
* 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
* reflecting on the role of contemporary First Nations Australians astronomers and astrophysicists, such as Wiradjuri astrophysicist and science communicator Kirsten Banks, in promoting First Nations astronomy knowledges and understandings
* 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
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| **Strand: Science inquiry**  | **Year 7** |
| **Sub-strand: Questioning and predicting** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| develop investigable questions, reasoned predictions and hypotheses to explore scientific models, identify patterns and test relationships AC9S7I01 | * discussing the features of investigable and non-investigable questions, including consideration of school and web-based resources available, and examining their own and others’ questions
* consulting with First Nations Australians to clarify questions based on their traditional ecological knowledges, such as predictions regarding the impact of invasive species
* developing investigable questions to explore scientific models, such as: ‘How does particle theory explain the properties of substances?’
* developing investigable questions to test relationships, such as: ‘How does the volume of a balloon change as it is heated and cooled? What happens to the height of the tide at different points of the lunar cycle?’
* discussing the relationship between a reasoned prediction and a hypothesis, identifying essential elements of a hypothesis and using a provided scaffold to develop hypotheses
* formulating hypotheses such as: ‘If the surface area of the parachute is decreased, the parachute will descend more quickly because there will be less air resistance’
 |
| **Sub-strand: Planning and conducting**  |
| plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country/Place AC9S7I02 | * comparing the method with the hypothesis and examining the reasonableness of the method for testing that hypothesis
* discussing why it is important to identify variables and assumptions when planning an investigation
* examining the features of reproducible investigations, constructing methods and reviewing other students’ methods
* identifying assumptions relating to variables that are assumed to be constant, such as ambient temperature, properties of materials used or purity of substances
* identifying risks to themselves and others in investigations and considering actions that can be taken to avoid or manage those risks
* considering ethical issues relating to interactions with living things
* recognising state and territory laws as they relate to First Nations Australians’ heritage sites and artefacts
* collaborating with First Nations Australians communities and organisations to conduct investigations about ecosystems, ensuring mutually beneficial outcomes
* acknowledging and recognising First Nations Australians’ artefacts and heritage sites, such as human stonework and scatter sites in comparison with rocks changed by natural processes, and understanding not to harm or disturb sites
 |
| select and use equipment to generate and record data with precision, using digital tools as appropriate AC9S7I03 | * selecting and using equipment appropriate to the investigation, such as ensuring a selected thermometer can measure within the range of temperatures expected, or selecting an appropriate-capacity measuring cylinder for the volume of liquid needed
* examining how the use of digital tools such as stopwatches and digital scales can enable the generation of more precise data
* constructing tables, spreadsheets and graphic organisers to collect data and information
* using appropriate standard units and performing simple unit conversions when recording data
* using digital tools such as sensors to measure abiotic factors and apps that use image or call recognition to make field identifications
 |
| **Sub-strand: Processing, modelling and analysing** |
| select and construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information AC9S7I04 | * using spreadsheets to aid the presentation and analysis of data
* constructing food webs to represent feeding relationships and flows of energy and matter in an ecosystem
* constructing representations of dichotomous keys, such as a creating a visual key or an interactive presentation, or coding a simple program
* analysing data, including secondary data, to determine mathematical relationships, such as tidal variations over the course of a lunar cycle
* distinguishing between discrete and continuous data and selecting appropriate data representations
* acknowledging, analysing and interpreting data and information from First Nations Australians’ astronomical observations
 |
| analyse data and information to describe patterns, trends and relationships and identify anomalies AC9S7I05 | * analysing change in predator and prey numbers over time to identify predator-prey cycles
* identifying patterns and relationships in data sets such as identifying qualitative relationships between the mass of a planet and its gravity
* analysing data to identify patterns in the proportions of a day spent in sunlight and in darkness and relating these patterns to the seasons
* identifying anomalies in data and investigating their effect on observed patterns or relationships
* collaborating with First Nations Australians communities to create a calendar as a representation of seasonal patterns and relationships using digital tools
 |
| **Sub-strand: Evaluating** |
| analyse methods, conclusions and claims for assumptions, possible sources of error, conflicting evidence and unanswered questions AC9S7I06 | * identifying and considering indicators of the quality of the data when analysing results to identify unanswered questions
* evaluating the method used in an investigation, identifying assumptions made about variables that should be controlled, suggesting ways it could be improved and giving reasons for the suggested changes
* analysing conclusions and claims to identify facts or premises that are taken for granted to be true, and considering their relevance to conclusions
* considering the spread of repeated measurements and observations
* identifying possible sources of error in the method used and describing how the method could be improved to remove these sources of error
* identifying the evidence being cited to support a claim and evaluating conflicting evidence
 |
| construct evidence-based arguments to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with using or citing secondary data or information AC9S7I07 | * constructing an argument supported by evidence and reasoning to support or reject a hypothesis
* drawing a logical conclusion in consideration of the method of data collection, quality of evidence and limitations or significance of a claim
* exploring how to determine credibility of a source
* investigating the cultural, historical and archaeological evidence used in the scientific debate about the role of early First Nations Australians in the extinction of Australian megafauna
* researching the development of commercial products that are founded on the traditional knowledges and practices of First Nations Australians and discussing related ethical considerations associated with biopiracy and intellectual property rights
 |
| **Sub-strand: Communicating** |
| write and create texts to communicate ideas, findings and arguments for specific purposes and audiences, including selection of appropriate language and text features, using digital tools as appropriate AC9S7I08 | * examining a range of scientific texts, inferring the purpose of the text and target audience, and identifying specific language and text features that support that inference
* reporting on a scientific investigation, incorporating diagrams, graphical representations and data as appropriate, and including examination of the accuracy and reproducibility of the data
* developing a prototype for a dichotomous key app to enable community members to classify plants or animals in a local park or reserve
* writing a letter to the editor to express a view about an environmental issue affecting local ecosystems
* creating an informative text for a younger audience to show how the tilt of Earth’s axis, rotation of Earth on that axis, and the revolution of Earth around the sun cause the seasons
* creating an animation that explains particle theory to a peer audience
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Year 8

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| **Year level description** |
| In Year 8 students are introduced to cells as microscopic structures that explain macroscopic features of living systems. They connect form and function at an organ level and explore the organisation of a body system in terms of flows of matter between interdependent organs. They continue to develop a view of Earth as a dynamic system, in which change occurs across a range of timescales. They classify different types of energy and describe the role of energy in causing change in systems, including the role of energy and forces in the geosphere. They learn to classify matter at the atomic level and distinguish between chemical and physical change. They understand that chemical reactions also involve energy. Students use experimentation to isolate relationships between components in systems and explain these relationships through increasingly complex representations. They consider the magnitude of properties and events and use appropriate units to describe proportional relationships. Inquiry questions can help excite students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: * Can we predict changes to the shape and position of continents?
* Are facts enough? How much does science communication matter?
* How can we tell if a substance has changed?
* How can we best measure what we cannot directly see?
* How is a leaf like a lung?
 |
| **Achievement standard** |
| By the end of Year 8 students explain the role of specialised cell structures and organelles in cellular function and analyse the relationship between structure and function at organ and body system levels. They apply an understanding of the theory of plate tectonics to explain patterns of change in the geosphere. They explain how the properties of rocks relate to their formation and influence their use. They compare different forms of energy and represent transfer and transformation of energy in simple systems. They classify and represent different types of matter and distinguish between physical and chemical change. Students analyse how different factors influence development of and lead to changes in scientific knowledge. They analyse the key considerations that inform scientific responses and how these responses impact society. They analyse the importance of science communication in shaping viewpoints, policies and regulations. Students plan and conduct safe, reproducible investigations to test relationships and explore models. They describe potential ethical issues and intercultural considerations needed for specific field locations 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 data and information to describe patterns, trends and relationships and identify anomalies. They identify assumptions and sources of error in methods and analyse conclusions and claims with reference to conflicting evidence and unanswered questions. They construct evidence-based arguments to support conclusions and evaluate claims. They select and use language and text features appropriately for their purpose when communicating their ideas, findings and arguments to specific audiences. |

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| **Strand: Science understanding** | **Year 8** |
| **Sub-strand: Biological sciences** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| recognise cells as the basic units of living things, compare plant and animal cells, and describe the functions of specialised cell structures and organelles AC9S8U01 | * exploring an augmented or virtual reality tour of a plant or animal to ‘zoom in’ and understand the scale of cells
* identifying the structure and function of organelles in cells including the nucleus, cell membrane, cell wall, cytoplasm, chloroplasts and vacuoles
* examining a variety of cells, including single-celled organisms, using a light microscope, a digital microscope, simulations and photomicrographs
* comparing the similarities and differences of plant cells and animal cells visible with a light microscope and represented in a digital or physical model
* designing a physical or digital model of a cell and explaining how the representation models the cell
* considering how the invention of the microscope has contributed to understanding of cell structure
 |
| analyse the relationship between structure and function of cells, tissues and organs in a plant and an animal organ system and explain how these systems enable survival of the individual AC9S8U02 | * comparing 2-dimensional and 3-dimensional representations of organ systems to understand how organs are positioned within the body
* comparing the structure and function of analogous systems in a plant and an animal
* examining the specialised cells and tissues involved in 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 in cells or tissues can affect how an organ functions, such as how hardening of the arteries can lead to poor circulation or heart disease
* investigating how an artificial organ mimics or augments the function or functions of a real organ
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| **Sub-strand: Earth and space sciences** |
| investigate tectonic activity including the formation of geological features at divergent, convergent and transform plate boundaries and describe the scientific evidence for the theory of plate tectonics AC9S8U03 | * 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
* 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
* constructing a timeline of evidence to show the development of the theory of plate tectonics
* 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 First Nations Australians’ cultural accounts that provide evidence of earthquakes and volcanoes
 |
| describe the key processes of the rock cycle, including the timescales over which they occur, and examine how the properties of sedimentary, igneous and metamorphic rocks reflect their formation and influence their use AC9S8U04 | * 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 body, trace or opalised fossils, to predict how and when a rock was formed
* explaining the uses of different types of rocks with reference to their properties and formation
* exploring the traditional geological knowledges of First Nations Australians that are used in the selection of different rock types for different purposes
* investigating how First Nations Australians have used quarrying to access rocks for use as or production of everyday objects such as grindstones, hammerstones, anvils and cutting tools
* exploring how the mining of ores and minerals impacts on local environments and examining environmental rehabilitation initiatives
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| **Sub-strand: Physical sciences** |
| classify different types of energy as kinetic or potential and investigate energy transfer and transformations in simple systems AC9S8U05 | * investigating relationships between kinetic and potential energy in a simple system such as a roller-coaster or Newton’s cradle
* classifying types of energy as either kinetic energy such as movement, heat and electricity or potential energy such as chemical, elastic and gravitational
* critiquing and using representations such as flow diagrams to illustrate changes between different forms of energy in a system
* identifying where heat energy is produced as a by-product of energy transfer, such as filament light globes, exercise, and battery charging and use
* using electrical circuits and components to demonstrate electrical energy transfer and its transformation into heat, light and sound
* observing a Rube Goldberg machine and identifying the energy transfers and transformations involved
* investigating traditional fire-starting methods used by First Nations Australians and their understandings of the transformation of energy
 |
| **Sub-strand: Chemical sciences** |
| classify matter as elements, compounds or mixtures and compare different representations of these, including 2-dimensional and 3-dimensional models, symbols for elements and formulas for molecules and compounds AC9S8U06 | * 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, compounds and molecules by formulas and mixtures 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
* creating a timeline or models to show how the concept of an element has changed over time from Democritus to John Dalton
 |
| compare physical and chemical changes and identify indicators of energy change in chemical reactions AC9S8U07 | * 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
* investigating and identifying energy changes in different chemical reactions such as differences in temperature
* 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
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| **Strand: Science as a human endeavour** | **Year 8** |
| **Sub-strand: Nature and development of science** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| explain how new evidence or different perspectives can lead to changes in scientific knowledge AC9S8H01 | * identifying how technological developments, such as those related to microscopes and medical imaging, have led to improved understanding of cells and organs
* considering how advances in technologies have enabled the repair and replacement of organs using synthetic materials
* analysing how sustainability priorities such as efficiency and limiting environmental impact have led to innovative practices in mining and mine site regeneration
* examining the evidence that led to the acceptance of the theory of plate tectonics over the idea of continental drift
* investigating how advances in deep Earth imaging techniques have enabled identification of mineral, energy and water resources beneath surface sedimentary rock
* discussing the story of Sir Isaac Newton’s discovery of gravity or the questions that Albert Einstein asked which led him to developing a new theory
* researching why Dmitri Mendeleev developed a different representation of the periodic table
 |
| investigate how cultural perspectives and world views influence the development of scientific knowledge AC9S8H02 | * investigating how world views about the role of women lead to women scientists being placed in subordinate roles and ‘written out’ of history, a phenomenon known as the Matilda effect
* researching how cultural building techniques such as houses built of bamboo led to the development of structures and materials better able to withstand the effects of earthquakes
* investigating how collaboration between Swami Vivekananda and Nikola Tesla, who held different world views, led to an exploration of the relationship between mass and energy
* analysing how world views relating to fairness in sport have led to the development of rapid chemical tests to identify performance-enhancing drugs
* investigating how First Nations Australians develop material culture through holistic world views that employ multidisciplinary knowledges and skills
 |
| **Sub-strand: Use and influence of science** |
| examine how proposed scientific responses to contemporary issues may impact on society and explore ethical, environmental, social and economic considerations AC9S8H03 | * researching and discussing ethical issues that arise from organ transplantation
* discussing how scientists’ development of organoids has impacted on the ethical, environmental, social and economic issues that arise from using live animals in a laboratory to research diseases and treatments
* investigating how scientific responses including new building materials, improved predictions and early warning systems have supported communities living in a country in the Asia-Pacific region located near plate boundaries, for example Japan, Indonesia or New Zealand
* 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 exploring environmental considerations
* exploring how the development of biodegradable materials has led to more sustainable packaging and reduction in landfill
 |
| explore the role of science communication in informing individual viewpoints and community policies and regulations AC9S8H04 | * investigating campaigns designed to increase rates of organ donation
* exploring how seismic data is collected and shared between governments across the Asia-Pacific region and how governments use this data including for tsunami alerts
* investigating how promotion of biodegradable materials and the importance of using them has informed individual viewpoints
* researching how science organisations and high-profile science communicators such as Professor Lisa Harvey-Smith or Dr Karl Kruszelnicki influence people’s attitudes to science
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| **Strand: Science inquiry**  | **Year 8** |
| **Sub-strand: Questioning and predicting** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| develop investigable questions, reasoned predictions and hypotheses to explore scientific models, identify patterns and test relationships AC9S8I01 | * discussing what is meant by a causal relationship and examining how causation is different from correlation
* developing investigable questions to test causal relationships, such as: ‘How does the concentration of a salt solution affect plant cells? How does the amount of sunlight affect the amount of electricity produced by a solar cell?’
* developing investigable questions to explore scientific models, such as: ‘How do the shapes of the continents support the theory of plate tectonics?’
* predicting what will happen when conditions change in a given scenario or phenomenon, such as: ‘When materials of less resistance are used to transfer electricity there will be less heat energy produced’
* formulating hypotheses such as: ‘An earthquake of greater magnitude will cause more damage because there is more energy transferred’
 |
| **Sub-strand: Planning and conducting**  |
| plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country/Place AC9S8I02 | * designing reproducible investigations that specifically test variables of the causal relationship and control the remaining variables
* identifying assumptions related to testing a hypothesis using analogous models, such as using dialysis tubing to model the properties of plant cell walls or a shake table to model the effects of an earthquake on buildings
* explaining why safety procedures address identified risks
* considering ethical issues relating to the access to and use of biological material and secondary data
* acknowledging and recognising First Nations Australians’ artefacts and heritage sites of significance such as ceremonial grounds and traditional quarries, and ensuring they cause no harm to heritage sites and artefacts
 |
| select and use equipment to generate and record data with precision, using digital tools as appropriate AC9S8I03 | * selecting and using equipment with required precision such as adjusting magnification to observe specific cell structures and recording this magnification and reading the bottom of the meniscus to determine the precise volume of liquid
* 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 digital microscopes, simulations and video-recording devices when appropriate to observe, measure and record qualitative and quantitative data
* 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** |
| select and construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information AC9S8I04 | * using simple formulas in spreadsheets to organise and process collected data
* using visual displays of large data sets, such as maps showing the location of volcanoes and earthquakes, charts showing the structure of body systems and graphs showing variable energy production, to identify temporal and spatial relationships
* constructing graphs using correct conventions such as naming the graph and labelling the axes, using the horizonal axis for the independent variable and the vertical axis for the dependent variable
* constructing energy flow diagrams to represent energy changes in a system such as a rollercoaster or rocket launch
* constructing representations of chemical and physical changes, such as creating a visual model or symbolic representation
* collating data from a number of sources such as different groups in the class who performed the same investigation to create a summary
* examining the strengths and limitations of representations such as physical models, diagrams and virtual simulations and selecting the most appropriate representation to use
 |
| analyse data and information to describe patterns, trends and relationships and identify anomalies AC9S8I05 | * identifying correlational relationships in data such as: ‘Dropping a mass from a greater height produces a larger indentation’ and analysing this relationship for causality
* describing measures of central tendency such as mean, mode and median and identifying outliers for quantitative data
* using spreadsheets to analyse second-hand data such as daily power output of solar panels and examining anomalies such as periods of reduced output
* analysing changes in battery energy output following recharging over many cycles and relating to available chemical potential energy
* comparing temperature differences obtained by reacting different proportions of the same chemicals to determine if there is a relationship
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| **Sub-strand: Evaluating** |
| analyse methods, conclusions and claims for assumptions, possible sources of error, conflicting evidence and unanswered questions AC9S8I06 | * identifying assumptions then examining if extra variable controls are required and how these might affect the data and conclusion
* identifying sources of error in methods such as inconsistent variable control and inaccuracies in procedures or measurements, and explaining how the method could be improved
* comparing results with other groups or secondary sources to examine consistency and describing where there may be conflicting results or conclusions
* analysing conclusions or claims to determine if there are further questions which should be explored to verify the conclusion or claim
* analysing conclusions to identify facts or premises that are taken for granted to be true, and discussing the reasonableness of those assumptions with others
 |
| construct evidence-based arguments to support conclusions or evaluate claims and consider any ethical issues and cultural protocols associated with using or citing secondary data or information AC9S8I07 | * evaluating the quality of evidence of primary and secondary sources used when constructing an argument to support a conclusion or claim
* examining competing ideas, differences in methods and sources of error when constructing an argument
* acknowledging and considering the ethical issues or cultural protocols when using or citing secondary data, such as acknowledging sources and respecting cultural protocols around sharing of particular information
* analysing what evidence would be necessary to support the conclusion that all buildings in an earthquake area should be made of bamboo
* evaluating a claim that one brand of battery lasts longer than another brand of battery
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| **Sub-strand: Communicating** |
| write and create texts to communicate ideas, findings and arguments for specific purposes and audiences, including selection of appropriate language and text features, using digital tools as appropriate AC9S8I08 | * 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
* writing a report on a scientific investigation using appropriate scientific conventions and representations, including a discussion of how assumptions and possible sources of error may have affected the results
* modifying the method for an investigation and explaining where and why the original was changed with reference to any assumptions and sources of error
* constructing a persuasive text on the use of artificial organs including scientific explanations and principles to influence a specified audience
* filming a documentary on the dynamic nature of the geosphere and selecting appropriate language, models or analogies to engage a specific audience
* creating a digital infographic to compare and contrast different forms of energy, highlighting examples of energy transfer and transformations within each
* acknowledging and exploring First Nations Australians’ ways of communicating their understanding of the internal systems of organisms
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Year 9

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| **Year level description** |
| In Year 9 students consider the operation of systems at a range of scales and how those systems respond to external changes in order to maintain stability. They explore ways in which the human body system responds to changes in the external environment through physiological feedback mechanisms and the reproductive processes that enable a species to respond to a changing environment over time. They are introduced to the notion of the atom as a system of protons, electrons and neutrons, and how this system can change through nuclear decay. They learn that matter can be rearranged through chemical change and that these changes play an important role in many systems. They are introduced to the concepts of conservation of matter and energy and begin to develop a more sophisticated view of energy transfer. They explore these concepts as they relate to the global carbon cycle. Students begin to consider how well a sample or model represents the phenomena under study and use a range of evidence to support their conclusions. Inquiry questions can help excite students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: * Why was the discovery of neutrons important?
* How is scientific consensus established? What if it isn’t?
* Could synthesised organs make organ donation obsolete?
* How does the carbon cycle affect life on Earth?
* How do different technologies help humans to communicate?
 |
| **Achievement standard** |
| By the end of Year 9 students explain how body systems provide a coordinated response to stimuli. They describe how the processes of sexual and asexual reproduction enable survival of the species. They explain how interactions within and between Earth’s spheres affect the carbon cycle. They analyse energy conservation in simple systems and apply wave and particle models to describe energy transfer. They explain observable chemical processes in terms of changes in atomic structure, atomic rearrangement and mass. Students explain the role of publication and peer review in the development of scientific knowledge and explain the relationship between science, technologies and engineering. They analyse the different ways in which science and society are interconnected. Students plan and conduct safe, reproducible investigations to test or identify relationships and models. They describe how they have addressed any ethical and intercultural considerations when generating or using primary and secondary data. They select and use equipment to generate and record replicable data with precision. They select and construct appropriate representations to organise, process and summarise data and information. They analyse and connect data and information to identify and explain patterns, trends, relationships and anomalies. They analyse the impact of assumptions and sources of error in methods and evaluate the validity of conclusions and claims. They construct logical arguments based on evidence to support conclusions and evaluate claims. They select and use content, language and text features effectively to achieve their purpose when communicating their ideas, findings and arguments to specific audiences. |

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| **Strand: Science understanding** | **Year 9** |
| **Sub-strand: Biological sciences** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| compare the role of body systems in regulating and coordinating the body’s response to a stimulus, and describe the operation of a negative feedback mechanism AC9S9U01  | * exploring the body’s observable responses to external stimuli (such as changes in light or temperature, or presence of danger or pathogens) or internal stimuli (such as dehydration or hunger)
* using models, flow diagrams and virtual simulations to explore and represent the relationships between body systems that are necessary to coordinate a response to stimuli
* comparing the role and function 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 the effects of a disorder in a feedback system, such as diabetes-induced blindness or hypothermia
* considering how understanding of feedback mechanisms has enabled the development of pharmaceuticals and other products to address issues or enhance performance, such as insulin or electrolytes in sports drinks
 |
| describe the form and function of reproductive cells and organs in animals and plants, and analyse how the processes of sexual and asexual reproduction enable survival of the species AC9S9U02  | * examining how the male and female reproductive organ structures work collectively as a system
* explaining how the forms of male and female gametes relate to their specific function
* identifying and comparing sexual and asexual reproductive strategies in plants
* exploring how sexual reproduction creates a greater rate of variation among offspring compared with asexual reproduction
* examining how the reproductive strategies of multicellular animals are related to their environment and the complexity of the organism
* examining how the number of offspring produced by animals is related to the amount of parental care
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| **Sub-strand: Earth and space sciences** |
| represent the carbon cycle and examine how key processes including combustion, photosynthesis and respiration rely on interactions between Earth’s spheres (the geosphere, biosphere, hydrosphere and atmosphere) AC9S9U03 | * identifying Earth as a system, describing Earth’s spheres and discussing examples of interactions between different spheres
* examining the carbon cycle using diagrams, animations or simulations and explaining the role of photosynthesis and respiration in that cycle
* identifying the impact of combustion reactions as a result of human activity on the carbon cycle
* investigating the greenhouse effect and relating it to the role carbon dioxide plays in maintaining temperatures that support life on Earth
* 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
* investigating how First Nations Australians use fire-mediated chemical reactions to facilitate energy and nutrient transfer through the practice of firestick farming
* investigating how First Nations Australians are reducing Australia’s greenhouse gas emissions through the reinstatement of traditional fire management regimes
* identifying how carbon dioxide is captured and stored naturally or through the use of technologies
* calculating an individual’s carbon footprint, examining the impact of human activities and suggesting strategies to reduce carbon dioxide emissions
 |
| **Sub-strand: Physical sciences** |
| use wave and particle models to describe energy transfer through different mediums and examine the usefulness of each model for explaining phenomena AC9S9U04 | * 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
* 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 they are useful for understanding aspects of light and other forms of electromagnetic radiation
* investigating aspects of heat transfer and conservation in the design of First Nations Australians’ bedding and clothing in the various climatic regions of Australia
* investigating the impact of material selection on the transfer of sound energy in First Nations Australians’ traditional musical, hunting and communication instruments
* examining the forms of electromagnetic radiation that are used in different modern communication technologies and identifying any limitations
 |
| apply the law of conservation of energy to analyse system efficiency in terms of energy inputs, outputs, transfers and transformations AC9S9U05 | * explaining that the law of conservation of energy explains that total energy is maintained in energy transfer and transformation in a system
* explaining efficiency and recognising that in energy transfer and transformation a variety of processes can occur, so that the amount of usable energy is reduced and the system is not 100% efficient
* using and critiquing representations such as Sankey diagrams to show energy inputs, changes and outputs in a system
* investigating the efficiency of ground ovens used by First Nations Australians
* comparing the efficiency of electricity generation from coal and other sources such as nuclear, hydroelectricity, gas, solar and wind
* examining the meaning of energy star ratings given to appliances such as refrigerators and washing machines and criteria used to determine these ratings
* examining how improving efficiency in energy transfer and transformations in sporting activities such as pole vaulting or archery improves athletic performance
 |
| **Sub-strand: Chemical sciences** |
| explain how the model of the atom changed following the discovery of electrons, protons and neutrons and describe how natural radioactive decay results in stable atoms AC9S9U06 | * comparing the mass and charge of protons, neutrons and electrons
* examining how the discovery of electrons, protons and neutrons 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 releasing an alpha particle, iodine-131 releasing a beta particle and cobalt-60 releasing 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
* investigating how radiocarbon and other dating methods have been used to establish that First Peoples of Australia have been present on the Australian continent for more than 60,000 years
* identifying where applications of radioactivity are used in medicine and industry such as diagnosing and treating cancer and checking for faults in materials used in aircraft and spacecraft
* discussing how mass and energy are connected at all scales and energy conversion processes within atomic nuclei
 |
| model the rearrangement of atoms in chemical reactions using a range of representations, including word and simple balanced chemical equations, and use these to demonstrate the law of conservation of mass AC9S9U07 | * identifying reactants and products in chemical reactions
* using models and representations to show the rearrangement of atoms in chemical reactions
* investigating chemical reactions in closed and open systems and relating data obtained to the law of conservation of mass
* writing symbolic equations that are easy to balance and explaining, using the law of conservation of mass, and atoms, the rationale for balancing chemical equations
* investigating why most elements are not found in their elemental state and processes which are used to obtain the element
* predicting how ideas of green chemistry such as minimising the amount of unusable waste products, energy use and using more environmentally friendly chemical processes will affect the environment
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| **Strand: Science as a human endeavour** | **Year 9** |
| **Sub-strand: Nature and development of science** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| explain how scientific knowledge is validated and refined, including the role of publication and peer review AC9S9H01 | * investigating the process of publishing a paper in a scientific journal such as *Science*, which receives about 12,000 submissions per year, and considering how editors evaluate submitted papers
* investigating how the publication of data and findings related to the reintroduction of First Nations Australians’ traditional fire regimes has informed more effective fire-reduction strategies and policies
* exploring why the work of Professor Barry Marshall and Dr Robin Warren related to the cause of peptic ulcers was first rejected for publication then later validated
* examining the scientific consensus supporting global warming
* researching how JJ Thomson’s discovery of the electron, Robert Millikan’s oil drop experiment, and Ernest Rutherford’s gold foil experiment provide consistency of evidence for the particle model of electricity
* examining how Marie and Pierre Curie’s discovery of new elements was validated
 |
| investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering AC9S9H02 | * analysing how the development of imaging technologies has improved our understanding of the functions and interactions of body systems
* considering the impact of technological advances developed in Australia such as the cochlear implant pioneered by Professor Graeme Clark, the Monash Vison Group’s work on a bionic eye, Professor Fiona Woods’s development of spray-on skin and Doctor John O’Sullivan and CSIRO’s invention of wi-fi
* researching how technological advances in monitoring greenhouse gas emissions and other environmental factors have contributed to the reinstatement of traditional fire management practices as a strategy to reduce atmospheric pollution
* examining how properties of electromagnetic radiation relate to its uses, such as radar, medicine, mobile phone communications, remote sensing and microwave cooking
* exploring how scientists and engineers make machines more energy efficient
* exploring how understanding of the nature of matter and energy has changed over time, and how modern technology has enabled exploration of energy conversion processes at all scales, from black holes to atoms to sub-atomic particles
* examining how advances in understanding of radioactivity and radioisotopes have led to new applications and technologies
 |
| **Sub-strand: Use and influence of science** |
| analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society AC9S9H03 | * researching citizen science projects related to public health and examining why people would choose to be involved
* investigating how the practices adopted by society based on research by Australian Dr Helen Mayo led to a reduction in infant mortality
* examining how assisted reproductive technologies have become widely used since their initial development
* examining how government initiatives such as Landcare support adoption of effective land restoration practices that improve soil quality and increase carbon sequestration in soils
* investigating how First Nations Australians’ fire management practices are informing and being adopted in contemporary fire management
* analysing factors that have led to the adoption of solar panels and battery storage by individuals, industries and communities
* investigating how an understanding of materials and concern for the environment have led to the adoption of widespread recycling practices
 |
| examine how the values and needs of society influence the focus of scientific research AC9S9H04  | * exploring how governments determine which scientific research projects should be funded
* exploring how Australia has developed an artificial intelligence system which is used to predict the likelihood of a viable pregnancy from transfer of a single embryo to a woman undergoing in-vitro fertilisation
* researching how First Nations Peoples of the Torres Strait are at the forefront of the development of scientific measures to prevent the transfer of certain infectious diseases and pests to the Australian continent
* investigating how the need to minimise greenhouse gas production has led to scientific and technological advances
* considering 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 leisure activities
* examining why many manufacturers are adopting green chemistry processes
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| **Strand: Science inquiry**  | **Year 9** |
| **Sub-strand: Questioning and predicting** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| develop investigable questions, reasoned predictions and hypotheses to test relationships and develop explanatory models AC9S9I01 | * discussing what is needed for a question to be investigable or a prediction to be reasoned
* generating 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?’
* developing investigable questions to explore an explanatory model, such as: ‘How is sound wave transfer affected by the density of the medium through which it travels? What causes our body temperature to rise when we are ill?’
* discussing why a scientific hypothesis has to be able to be supported or refuted through evidence
* proposing a hypothesis to test an identified relationship, such as: ‘If objects of different temperatures are placed in contact, heat energy will transfer from an object of higher temperature to an object of lower temperature until both objects reach the same temperature’
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| **Sub-strand: Planning and conducting**  |
| plan and conduct valid, reproducible investigations to answer questions and test hypotheses, including identifying and controlling for possible sources of error and, as appropriate, developing and following risk assessments, considering ethical issues, and addressing key considerations regarding heritage sites and artefacts on Country/Place AC9S9I02 | * discussing what is meant by validity and reproducibility and how they relate to the method used in an investigation
* 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 possible sources of error in methods then examining if further testing or extra variable control is needed
* identifying the potential hazards of chemicals or biological materials and processes used in experimental investigations and identifying how these should be addressed
* discussing the ethical and social issues involved in the care and use of animals for scientific purposes before starting an investigation involving animals
* recognising First Nations Australians’ heritage laws and public responsibilities to report new sites or artefacts, and developing awareness of the consequences for disturbing heritage sites on, above or below the land surface, or in waters
 |
| select and use equipment to generate and record data with precision to obtain useful sample sizes and replicable data, using digital tools as appropriate AC9S9I03 | * using an electronic balance that measures within the parameters of the required mass, and recording data to the correct number of significant figures using correct units
* using data loggers and choosing correct scale and appropriate output representation
* examining the degree of accuracy that different instruments provide, such as a measuring cylinder compared with a pipette, and recording data values to the correct degree of precision using appropriate scientific notation
* considering the replicability of data collected using different instruments, including the inaccuracies that may be introduced when taking measurements
* discussing the amount of data needed to produce a useful sample size and why sample size is important
* considering an appropriate sample size for the investigation, and how the use of digital tools might enable more-efficient data collection for larger sample sizes
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| **Sub-strand: Processing, modelling and analysing** |
| select and construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information AC9S9I04 | * using spreadsheet software to present data in tabular and graphical forms
* identifying which sample properties, such as mean, median and range, are the most appropriate to use to make generalisations
* applying algorithms to measure carbon storage of different vegetation types
* applying ratios to accurately represent usable and waste energy in transfer and transformation diagrams such as Sankey diagrams
* comparing the information provided by molecular models and word and balanced symbolic chemical equations when examining the law of conservation of mass
 |
| analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies AC9S9I05 | * discussing the validity of the data when extrapolating from a graph
* analysing representations of data from atmospheric monitoring and ice cores to identify patterns and trends in the amount of carbon dioxide in the atmosphere, highlighting inconsistencies
* 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’
* analysing data on heat transfer through multiple layers of an insulating material and identifying patterns and proportional relationships, such as: ‘When the thickness of the material is doubled the amount of heat transferred is halved’
* examining tables, graphs and digital simulations of radioactive decay half-life to predict changes in mass over time
 |
| **Sub-strand: Evaluating** |
| assess the validity and reproducibility of methods and evaluate the validity of conclusions and claims, including by identifying assumptions, conflicting evidence and areas of uncertainty AC9S9I06 | * discussing what is meant by ‘validity’ and how the validity of information in secondary sources can be evaluated
* identifying gaps or weaknesses in conclusions and relating these to the validity and reproducibility of the method
* identifying assumptions in methods and determining the impact these could have on the validity of the conclusion
* analysing methods and conclusions to identify facts or premises that are taken for granted to be true, and evaluating the reasonableness of those assumptions
* considering if areas of uncertainty could lead to a viable alternative conclusion
* considering how general practitioners manage conflicting evidence to diagnose illness
 |
| construct arguments based on analysis of a variety of evidence to support conclusions or evaluate claims, and consider any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information AC9S9I07 | * examining secondary data to determine the credibility of the source and the validity and reproducibility of the data
* identifying multiple sources of evidence that are consistent with a claim such as the effectiveness of a vaccine
* interrogating the evidence and reasoning used to justify claims regarding the age of ancient artefacts
* researching the methods used by scientists in studies reported in the media to evaluate the validity of the headlines
* examining secondary data to ensure it does not contain personal information which could potentially harm individuals, is correctly cited and is relevant to the investigation question or claim
* acknowledging and identifying the relationship between First Peoples’ knowledges and contemporary science and the co-contributions in arriving at shared understandings when working ‘both ways’
* acknowledging and constructing an argument for the contributions to medicine of First Nations Australians’ knowledges of physiological pathways and contemporary medicinal delivery systems
 |
| **Sub-strand: Communicating** |
| write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate AC9S9I08 | * comparing and contrasting scientific texts addressing similar topics for different purposes or audiences, and analysing the author’s (or authors’) selection of content or use of language and text features
* selecting appropriate content and language which is culturally responsive and maintains cultural protocols, considering sensitivities in communicating First Nations Australians’ knowledges and managing risks of offensive narratives, language, images and attributions
* writing a report on a scientific investigation including: an introductory paragraph that explains or references scientific theories, processes or other related knowledge that gives background information to the investigation; an explanation of the results obtained using scientific knowledge; and a discussion that considers validity and reproducibility
* developing an interactive presentation that shows feedback loops in human body systems
* planning a social media campaign to encourage young people to reduce their carbon footprint
* collaborating to prepare a written report for local government on estimated carbon storage across different local ecosystems and proposals to increase carbon storage across the area
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Year 10

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| **Year level description** |
| In Year 10 students explore the biological, chemical, geological and astronomical evidence for different theories, such as the theory of natural selection and the big bang theory. Through investigating natural selection and processes of heredity they come to understand the evolutionary feedback mechanisms that ensure the continuity of life. They appreciate how energy drives the Earth system and how climate models simulate the flow of energy and matter within and between Earth’s spheres. Students develop a more sophisticated understanding of atomic theory to understand patterns and relationships within the periodic table. They understand that motion and forces are related by applying physical laws and can be modelled mathematically. Students analyse and synthesise data from systems at multiple scales to develop evidence-based explanations for phenomena. They learn that all models involve assumptions and approximations, and that this can limit the reliability of predictions based on those models.   Inquiry questions can help excite students’ curiosity and challenge their thinking. Following are examples of inquiry questions that could be used to prompt discussion and exploration: * Why is the periodic table such a big deal?
* How do we know what is science and what is pseudoscience?
* Why is accelerating climate change a threat to biodiversity?
* Just because we can, should we?
* How have advanced computing and big data changed science?
 |
| **Achievement standard** |
| By the end of Year 10 students explain the processes that underpin heredity and genetic diversity and describe the evidence supporting the theory of evolution by natural selection. They sequence key events in the origin and evolution of the universe and describe the supporting evidence for the big bang theory. They describe trends in patterns of global climate change and identify causal factors. They explain how Newton’s laws describe motion and apply them to predict motion of objects in a system. They explain patterns and trends in the periodic table and predict the products of reactions and the effect of changing reactant and reaction conditions. Students analyse the importance of publication and peer review in the development of scientific knowledge and analyse the relationship between science, technologies and engineering. They analyse the key factors that influence interactions between science and society. Students plan and conduct safe, valid and reproducible investigations to test relationships or develop explanatory models. They explain how they have addressed any ethical and intercultural considerations when generating or using primary and secondary data. They select equipment and use it efficiently to generate and record appropriate sample sizes and replicable data with precision. They select and construct effective representations to organise, process and summarise data and information. They analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies. They evaluate the validity and reproducibility of methods, and the validity of conclusions and claims. They construct logical arguments based on analysis of a variety of evidence to support conclusions and evaluate claims. They select and use content, language and text features effectively to achieve their purpose when communicating their ideas, findings and arguments to diverse audiences. |

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| **Strand: Science understanding** | **Year 10** |
| **Sub-strand: Biological sciences** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| explain the role of meiosis and mitosis and the function of chromosomes, DNA and genes in heredity and predict patterns of Mendelian inheritance AC9S10U01 | * 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 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
* investigating First Nations Australians’ knowledges of heredity as evidenced by the strict adherence to kinship and family structures, especially marriage laws
* exploring environmental and other factors that cause mutations and identifying changes in DNA or chromosomes
* exploring the role of DNA in cancer or genetic disorders such as haemochromatosis, sickle cell anaemia, cystic fibrosis or Klinefelter syndrome
 |
| use the theory of evolution by natural selection to explain past and present diversity and analyse the scientific evidence supporting the theory AC9S10U02  | * 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 First Nations Australians to the Australian environment
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| **Sub-strand: Earth and space sciences** |
| describe how the big bang theory models the origin and evolution of the universe and analyse the supporting evidence for the theory AC9S10U03 | * describing the major components of the universe using appropriate scientific terminology and units including astronomical units, scientific notation and light-years
* constructing a timeline to show major changes in the universe which are thought to have occurred from the Big Bang until the formation of the major components such as stars and galaxies
* examining how stars’ light spectra and brightness is used to identify compositional elements of stars, their movements and their distances from Earth
* explaining how each different type of evidence, such as cosmic microwave background radiation, red or blue shift of galaxies, Edwin Hubble’s observations and proportion of matter in the universe, provides support for the acceptance of the big bang theory
* researching First Nations Australians’ 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
* exploring recent advances in astronomy, including the Australian Square Kilometre Array Pathfinder, and astrophysics, such as the discovery of gravitational waves, dark matter and dark energy; and identifying new knowledge which has emerged
 |
| use models of energy flow between the geosphere, biosphere, hydrosphere and atmosphere to explain patterns of global climate change AC9S10U04 | * examining the role of radiation from the sun and how its interactions with the atmosphere, ocean and land are the foundation for the global climate system
* 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 explore 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
* investigating how quantum computers enhance modelling of complex weather and climate systems
* predicting changes to the Earth system and identifying strategies designed to reduce climate change or mitigate its effects
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| **Sub-strand: Physical sciences** |
| investigate Newton’s laws of motion and quantitatively analyse the relationship between force, mass and acceleration of objects AC9S10U05 | * investigating a moving object to analyse and propose relationships between distance and time, speed, force and acceleration
* using mathematical representations including graphs and algebraic formulas to quantitatively relate force, speed, acceleration and mass
* investigating how First Nations Australians achieve an increase in speed and subsequent impact force through the use of spearthrowers and bows
* modelling how a change in net force acting on an object affects its motion and relating to the purpose of safety features such as seatbelts, airbags and crumple zones in vehicles
* 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 near schools or for trucks in urban environments
* investigating how driverless vehicles apply Newton’s laws of motion to brake in time
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| **Sub-strand: Chemical sciences** |
| explain how the structure and properties of atoms relate to the organisation of the elements in the periodic table AC9S10U06 | * examining how elements are organised in the periodic table and analysing patterns 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 this to their properties and position 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
* examining how the development of the spectroscope led to further development of the model of the atom
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| identify patterns in synthesis, decomposition and displacement reactions and investigate the factors that affect reaction rates AC9S10U07 | * defining and representing synthesis, decomposition and displacement reactions using a variety of formats such as molecular models, diagrams, and word and balanced symbolic equations
* identifying reaction type and predicting the products
* 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 the effect of a range of factors, such as temperature, concentration, surface area and catalysts, on the rate of chemical reactions
* investigating chemical reactions employed by First Nations Australians in the production of substances such as acids and ethanol
* investigating some of the chemical reactions and methods employed by First Nations Australians to convert toxic plants into edible food products
* examining reactions that are used to produce a range of useful products
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| **Strand: Science as a human endeavour** | **Year 10** |
| **Sub-strand: Nature and development of science** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| explain how scientific knowledge is validated and refined, including the role of publication and peer review AC9S10H01 | * examining how the work of Rosalind Franklin was critical to the discovery of the double helix structure of DNA and her publications validated the findings of James Watson and Francis Crick
* exploring the role of large data sets and statistical analysis in validating scientific findings, such as Gregor Mendel’s experiments with pea plants
* examining why there are different climate change models used by scientists when there is a climate change consensus among scientists
* exploring how astronomer Vera Rubin’s discovery of the existence of dark matter was validated
* examining how the discovery of gravity waves validated Einstein’s theory of general relativity and why this discovery did not occur until 100 years after the theory was proposed
* investigating how the development of the periodic table has been disputed and refined as science has progressed and new elements have been discovered
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| investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering AC9S10H02 | * examining karyotypes and applications of gene technologies, such as gene therapy and genetic engineering and biotechnologies used to produce therapeutic proteins
* 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, the Laser Interferometer Gravitational-Wave Observatory and the Square Kilometre Array
* considering how computer modelling has improved knowledge and predictability of phenomena such as climate change and atmospheric pollution
* investigating how satellites generate global data including ocean temperatures, sea levels and forest and ice cover and examining how that data is used to evaluate the effects of climate change
* researching how an understanding of the way DNA stores data has been applied to DNA bar coding to accelerate the pace of research in fields such as chemical engineering, materials science and nanotechnology
* examining how the recent use of female crash test dummies has shown women are at greater risk of injury in a car accident and considering implications for changing car safety features
* exploring how the development of new materials and thin films has led to better computer chips and solar cells
* investigating how the development of superstrong, lighter alloys has enabled engineers to improve structural components in building, transportation and industry and to design products such as improved protective armour for police and soldiers
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| **Sub-strand: Use and influence of science** |
| analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society AC9S10H03 | * 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
* discussing examples of the application of genetic screening and reasons for the adoption of the practice by groups in society
* examining why climate change models used by scientists are contested by some people in society
* discussing citizen science projects such as the GLOBE Project or others of local relevance and examining why people would choose to be involved
* considering how the traditional ecological knowledges of First Nations Australians are being reaffirmed by modern science and how these practices are being used by Traditional Owners in carbon farming initiatives
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| examine how the values and needs of society influence the focus of scientific research AC9S10H04 | * considering the use of genetic testing for decisions such as genetic counselling, embryo selection, identification of carriers of genetic mutations and the use of this information for personal use or by organisations such as insurance companies or medical facilities
* researching how the values of 19th and early 20th century Australian society, combined with scientific misconceptions about heredity and evolution, influenced policies and attitudes towards First Nations Australians
* recognising that financial backing from governments or commercial organisations is needed for scientific developments and that this can determine what research is carried out
* examining the link between scientific research and real-world applications such as space research and new material development
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| **Strand: Science inquiry**  | **Year 10** |
| **Sub-strand: Questioning and predicting** |
| **Content descriptions***Students learn to:* | **Content elaborations***This may involve students:* |
| develop investigable questions, reasoned predictions and hypotheses to test relationships and develop explanatory models AC9S10I01 | * discussing how a tested hypothesis may lead to further predictions and testing to determine if the prediction is supported
* developing hypotheses about the role of human activity in changes to climate and investigating these using secondary data
* observing a change in the frequency of extreme weather events and hypothesising causes from scientific models, such as: ‘If the El Niño weather pattern occurs more frequently then there will be more droughts due to decreased rainfall’
* asking questions about the relationship between crash impact force and speed and developing a hypothesis which can then be tested
* observing how changing the surface area, concentration and temperature affects the rate of a chemical reaction and developing reasoned predictions
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| **Sub-strand: Planning and conducting**  |
| plan and conduct valid, reproducible investigations to answer questions and test hypotheses, including identifying and controlling for possible sources of error and, as appropriate, developing and following risk assessments, considering ethical issues, and addressing key considerations regarding heritage sites and artefacts on Country/Place AC9S10I02 | * addressing possible sources of error through choice of equipment, variable control or further testing
* considering possible confounding variables or effects and ensuring these are controlled or accounted for in planned methods for data collection and analysis
* identifying safety risks and impacts on animal welfare and ensuring these are effectively managed within an investigation
* identifying the potential hazards of chemicals or biological materials and processes used in experimental investigations and how these should be addressed
* addressing ethical issues when collaborating with First Nations Australians to explore the development of a commercial product based on traditional ecological knowledges
* modelling how to report the discovery of unregistered First Nations Australians artefacts and heritage or any unauthorised disturbance
* considering the ethical and social issues and legal responsibilities involved in the care and use of animals for scientific purposes before starting an investigation involving animals
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| select and use equipment to generate and record data with precision to obtain useful sample sizes and replicable data, using digital tools as appropriate AC9S10I03 | * ensuring instruments are correctly calibrated before use and planning for recalibration as necessary between uses to improve reliability of results
* explaining how estimation affects precision and examining the inaccuracy introduced when reading between scale markings
* identifying how human error can affect replicability and reproducibility
* deciding how much data is needed to produce valid conclusions
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| **Sub-strand: Processing, modelling and analysing** |
| select and construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information AC9S10I04 | * using spreadsheet software to carry out mathematical analyses of data
* describing sample properties such as mean, median, range and large gaps visible on a graph to make generalisations, acknowledging uncertainties and the effects of outliers
* considering how data or information can be organised and represented to effectively communicate support for conclusions, including through visual or interactive models
* considering how the scales used for representing data affect interpretation of the data
* evaluating the merits and limitations of time-lapse visual representations of changes in polar ice coverage with a mathematical representation
* comparing merits and limitations of patterns as represented by the periodic table with graphical representations of patterns such as melting point or boiling point, and with consideration of anomalies
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| analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies AC9S10I05 | * identifying similar trends and patterns in data from different sources such as homologous structures and fossil evidence
* analysing data regarding the distribution of species in time and space to identify patterns and relationships between organisms
* exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics to make reasoned predictions about global climate change
* representing speed and acceleration data from investigations or simulations in tables and graphs and comparing how these facilitate the identification of relationships
* 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
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| **Sub-strand: Evaluating** |
| assess the validity and reproducibility of methods and evaluate the validity of conclusions and claims, including by identifying assumptions, conflicting evidence and areas of uncertainty AC9S10I06 | * 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
* judging the validity of science-related media reports and how these reports might be interpreted by the public
* identifying assumptions in methods then examining if further testing or extra variable control is needed
* considering how data variation can indicate uncertainty and might affect confidence in conclusions reached and claims made
* analysing conclusions and claims to identify facts or premises that are taken for granted to be true, and evaluating the reasonableness of those assumptions
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| construct arguments based on analysis of a variety of evidence to support conclusions or evaluate claims, and consider any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information AC9S10I07 | * constructing a scientific argument showing how a range of evidence supports a claim relating to the age of the universe
* engaging in evidence-based debates about the role of human activity in global climate change
* reasoning from a range of evidence to support or rebut claims made in news reports on scientific research
* examining secondary data to determine the credibility of the source and the validity and reproducibility of the data, and identifying the extent to which the data is consistent with data from other sources
* acknowledging the need to critically analyse scientific literature for potential cultural bias in relation to First Nations Australians
* considering the ethical issues of non-therapeutic genetic testing performed by commercial companies
* using primary or secondary scientific evidence to support or oppose a local action that may impact on global climate change
* preparing an argument for increased funding for a particular scientific research focus
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| **Sub-strand: Communicating** |
| write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate AC9S10I08 | * examining how scientific texts develop arguments; considering the structure of the text, the selection of content and the use of language and text features; and reflecting on how these might be modified for different audiences
* 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
* collaboratively designing a public performance about climate change to encourage people to take specific action
* creating a digital infographic to highlight the multiple lines of evidence from polar ice caps, ocean temperatures and extreme weather to explain how climate change is impacting Earth
* using animation or comic strip software to create an explanation of the Big Bang for an audience of their peers
* creating a campaign to lower speed limits in specific areas of the local community
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