Year 7 to 10

Science

September 2022

Scope and sequence

Revised to align with the Australian Curriculum V9.0 (2022)

V2.0

Government of South Australia
Department for Education

Science: Year 7 to 10

Contents

Context statement

The Australian Curriculum: Science is organised around 6 key ideas and 3 interrelated strands. The 6 key ideas are:

- patterns, order and organisation
- form and function
- stability and change
- scale and measurement
- matter and energy
- systems.

All units of work can be categorised into one or more of these key ideas to support students in constructing deep and coherent understandings of the scientific phenomena comprising their world.
An integrated approach should be used to interweave the 3 strands of:

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

Across these strands, the below science core concepts are developed:

- Form and function – the form and features of living things are related to the functions that their body systems perform.
- Diversity and evolution – a diverse range of living things have evolved on Earth over large timescales; that is still ongoing.
- Interdependence and ecosystems – biological systems are interdependent and interact with each other and their environment.
- Properties of matter – the chemical and physical properties of substances are determined by their structure at a range of scales.
- Changes in matter– substances change and new substances are produced by rearranging atoms; these changes involve energy transfer and transformation.
- Forces and motion – forces affect the motion and behaviour of objects.
- Energy – energy can be transferred and transformed from one form to another and is conserved within systems.
- Earth in space – Earth is part of an astronomical system; interactions between Earth and celestial bodies influence the Earth system.
- Earth's surface – the Earth system comprises dynamic and interdependent systems; interactions between these systems cause continuous change over a range of scales.
- Sustainability of the Earth system – all living things are connected through the Earth's systems and depend on sustainability of the Earth system.

Within this scope and sequence document, strands are used to structure the curriculum with the key ideas and core concepts highlighted to show how they develop in conceptual sophistication, from reception to year 10.
The South Australian Scope and sequence: Science reception to year 10 document provides the following:

- Achievement standards:
  - presented as dot points and separated into the 3 strands
  - detailing the criteria used to assess student achievement.
- Science understanding:
  - detailing the depth and breadth of the scientific knowledge to be taught at each year level
  - focusing on the scientific concepts which enables flexibility of how they are taught within different content and contexts
  - divided into 4 sub-strands – biological sciences, chemicals sciences, Earth and space sciences, and physical sciences.
- First Nations Australian knowledge and ways of knowing:
  - have been included from Australian Curriculum: Science elaborations
  - are highlighted up front and with purpose.
- Science as a human endeavour:
  - providing content examples of the nature of science and the ability to think and act scientifically, using a range of inquiry processes
  - detailing examples which are inclusive of South Australian scientists, occupations, developments and the use and influence of science locally, nationally and globally.
- Science inquiry:
  - providing range of activities including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations
  - detailing the essential practices of science and the skills that need to be taught at each year level.
- Science core concepts:
  - are included for each sub-strand to highlight conceptual progression at and across year levels.

Achievement standards

Together the 3 interrelated strands of Science understanding, Science as a human endeavour, and Science inquiry provide students with understanding, knowledge and skills through which they can develop a scientific view of the world. Students are challenged to explore science, its concepts, nature and uses through clearly described inquiry practices.

Year 7	Year 8	Year 9	Year 10
Science understanding By the end of year 7, students: • **explain** how biological diversity is ordered and organised • **represent** flows of matter and energy ecosystems • **predict** the effects of environmental changes • **model** cycles in the Earth-Sun-Moon system and **explain** the effects of cycles on Earth phenomena • **represent** and **explain** the effects of forces acting on objects • **explain** the physical properties of substances using the particle theory • **develop** processes that separate mixtures.	**Science understanding** By the end of year 8, students: • **explain** the role of specialised cell structures and organelles in cellular function • **analyse** the relationship between structure and function at organ and body system levels • **apply** an understanding of the theory of plate tectonics to **explain** patterns of change in the geosphere • **explain** how the properties of rocks relate to their formation and influence their use • **compare** different forms of energy and **represent** transfer and transformation of energy in simple systems • **classify** and **represent** different types of matter • **distinguish** between physical and chemical change.	**Science understanding** By the end of year 9, students: • **explain** how a body system provides a coordinated response to stimuli • **describe** how the processes of sexual and asexual reproduction enable survival of the species • **explain** how the interactions within and between Earth's spheres affect the carbon cycle • **analyse** energy conservation in simple systems and **apply** wave and particle models to **describe** energy transfer • **explain** observable chemical processes in terms of changes in atomic structure, atomic rearrangement and mass.	**Science understanding** By the end of year 10, students: • **explain** the processes that underpin heredity and genetic diversity • **describe** the evidence supporting the theory of evolution by natural selection • **sequence** key events in the origin and evolution of the universe and **describe** supporting evidence for the big bang theory • **describe** trends in patterns of global climate change and identify causal factors • **explain** how Newton's laws describe motion and **apply** them to predict motion of objects in a system • **explain** patterns and trends in the periodic table • **predict** products of reactions and the effect of changing reactant and reaction conditions.
Science as a human endeavour By the end of year 7, students: • **identify** the factors that can influence development of and lead to changes in scientific knowledge • **explain** how scientific responses are developed and can impact society • **explain** the role of science communication in shaping viewpoints, policies and regulations.	**Science as a human endeavour** By the end of year 8, students: • **analyse** how different factors influence development of and lead to changes in scientific knowledge • **analyse** the key considerations that inform scientific responses and how these responses impact society • **analyse** the importance of scientific communication in shaping viewpoints, policies and regulations.	**Science as a human endeavour** By the end of year 9, students: • **explain** the role of publication and peer review in the development of scientific knowledge • **explain** the relationship between science, technologies and engineering • **analyse** the different ways in which science and society are interconnected.	**Science as a human endeavour** By the end of year 10, students: • **analyse** the importance of publication and peer review in the development of scientific knowledge • **analyse** the relationship between science, technologies and engineering • **analyse** the key factors that influence interactions between science and society.

Science inquiry By the end of year 7, students:	**Science inquiry** By the end of year 8, students:	**Science inquiry** By the end of year 9, students:	**Science inquiry** By the end of year 10, students:
• **plan** and **conduct** safe, reproducible investigations • **test** relationships and aspects of scientific models • **identify** potential ethical issues and intercultural considerations for field locations or use of secondary data • **use** equipment to **generate** and record data with precision • **select** and **construct** appropriate representations • **organise** and **process** data and information • **analyse** data and information to **describe** patterns, trends and relationships • **identify** possible sources of error in methods and **identify** unanswered questions in conclusions and claims • **identify** evidence to support their conclusions • **construct** arguments to support or dispute claims • **select** and **use** language and text features appropriately for their purpose and audience when communicating their ideas and findings.	• **plan** and **conduct** safe, reproducible investigations • **test** relationships and explore models • **describe** potential ethical issues and intercultural considerations for field locations or use of secondary data • **select** and **use** equipment to **generate** and record data with precision • **select** and **construct** appropriate representations • **organise** and **process** data and information • **analyse** data and information to **describe** patterns, trends and relationships to **identify** anomalies • **identify** assumptions and sources of error in methods • **analyse** conclusions and claims with reference to conflicting evidence and unanswered questions • **construct** evidence-based arguments to support conclusions and **evaluate** claims • **select** and **use** language and text features appropriately for their purpose when communicating their ideas, findings and arguments to specific audiences.	• **plan** and **conduct** safe, reproducible investigations • **test** or **identify** relationships and explore models • **describe** how they have addressed any ethical and intercultural considerations when generating or using primary and secondary data • **select** and **use** equipment to **generate** and record replicable data with precision • **select** and **construct** appropriate representations • organise, process and summarise data and information • **analyse** and **connect** data and information to describe patterns, trends and relationships • **identify** and **explain** patterns, trends, relationships and anomalies • **analyse** the impact of assumptions and sources of error in methods and **evaluate** the validity of conclusions and claims • **construct** logical arguments based on evidence to support conclusions and **evaluate** claims • **select** and **use** content, language and text features appropriately for their purpose when communicating their ideas, findings and arguments to specific audiences.	• **plan** and **conduct** safe, valid and reproducible investigations • **test** relationships or **develop** explanatory models • **explain** how they have addressed any ethical and intercultural considerations when **generating** or using primary and secondary data • **select** and **use** equipment efficiently to **generate** and record appropriate sample sizes and replicable data with precision • **select** and **construct** effective representations • organise, process and summarise data and information • **analyse** and **connect** a variety of data and information • **identify** and **explain** patterns, trends, relationships and anomalies • **evaluate** the validity and reproducibility of methods, and the validity of conclusions and claims • **construct** logical arguments based on analysis of a variety of evidence to support conclusions and **evaluate** claims • **select** and **use** content, language and text features effectively for their purpose when communicating their ideas, findings and arguments to diverse audiences.

Scope and sequence

Strand: Science understanding

In this strand, students learn to select and integrate appropriate science knowledge to explain and predict phenomena and apply that knowledge to new situations. Science knowledge refers to facts, concepts, principles, laws, theories and models that have been established over time. Content for Science understanding is described by year level and is comprised of 4 sub-strands.

<table>
<tr><th>Sub-strands:</th><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
<tr><td rowspan="2">Biological sciences
Students develop an understanding of living things, including animals, plants and microorganisms, and their interdependence and interactions within ecosystems.
They explore life cycles, body systems, structural adaptations and behaviours, how these features aid survival, and how characteristics are inherited from one generation to the next. They consider the interdependence of biological systems at a range of scales, and identify how these systems respond to change.
In this sub-strand, the following core concepts are developed:
• Diversity and evolution – a diverse range of living things have evolved on Earth over hundreds of millions of years; this process is ongoing.
• Interdependence and ecosystems – biological systems are interdependent and interact with each other and their environment.
• Form and function – the form and features of living things are related to the functions that their body systems perform.</td>
<td>Key idea: Pattern, order and organisation
Similarities and differences in patterns can be used to sort and classify organisms.
Core concept: Diversity and evolution</td>
<td>Key idea: Scale and measurement
Cells can be observed using a microscope because most are too small to observe directly.
Key idea: Form and function
• The structure and composition of cells and cell organelles can be used to explain their function.
• Cells can be modelled to describe the relationships between organelles.
Core concept: Form and function</td>
<td>Key idea: Systems
Coordination of the systems within the human body responds to the changes in the environment to maintain balanced internal systems.
Key idea: Form and function
The relationships between the structure of the body systems, organs, tissues and cells determine how they function.
Core concept: Form and function</td>
<td>Key idea: Form and function
Cells contain genetic information in the form of DNA, which has the code with instructions to determine the specific functions of cells.
Genes are a mechanism for passing on characteristics of form and function from one generation to the next.
Core concepts: Diversity and evolution, Form and function</td></tr>
<tr>
<td>Science understanding: Investigate the role of classification that enables us to organise the diversity of life on Earth and use and develop classification tools including dichotomous keys:
• There is a wide diversity of living things on Earth.
• Living things can be grouped according to their physical differences.
• Scientists have an agreed classification system.
• There is a role for ordering and organising information.
• Classification uses a hierarchical taxonomic system and has scientific conventions for naming species.</td>
<td>Science understanding: Recognise cells as the basic units of living things, compare plant and animal cells, and describe the functions of specialised cell structures and organelles:
• Cells are microscopic structures.
• Microscopes magnify small objects and are used to observe at the cellular level.
• Features in the structures of cells can be identified with a light microscope.
• Scale bars on microscopic images allow for comparisons about the size and relationship of the objects seen under a microscope.
• Structures of organelles are connected to their function (cell membrane, cell wall, nucleus, chloroplasts, mitochondria, cytoplasm and vacuoles).</td>
<td>Science understanding: 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:
• The coordination of the nervous and endocrine systems regulate and coordinate the requirements of life (for example, oxygen, nutrients, water and removal of waste) in complex organisms.
• Models, flow diagrams and simulations can show how the body systems work together to maintain a functioning body.
• Negative feedback mechanisms maintain equilibrium in body systems.</td>
<td>Science understanding: Explain the role of meiosis and mitosis and the function of chromosomes, DNA and genes in heredity, and predict patterns of Mendelian inheritance:
• An organism’s genome is a complete set of genetic instructions.
• Genes, chromosomes and DNA are mechanisms for passing on adaptations of form and function from one generation to the next.
• Genetic information passed on to offspring through sexual reproduction is from both parents by meiosis and fertilisation.
• The role of cell division (mitosis) is for reproduction, repair and growth.</td></tr>
</table>

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	• There are more similarities at lower levels of genus and species. • Classification has a long and ongoing history, and has developed over time. • Methods to construct dichotomous keys are important for classification. • Interpretation and modification of dichotomous keys plays a role in developing scientific knowledge. **First Nations Australians science elaboration** Many living things are grouped by First Nations Australians based on their context and usage.	• Models can be drawn or constructed in 2D and 3D to represent the structure of a cell and its organelles. • There are differences between plant and animal cells.	• Electrical impulses along nerves in the body respond to external stimuli and are connected to the body's regulation response. • The endocrine system sends messages through hormones to allow the body to respond to stimuli.	• Due to meiosis, there is variation in a species. • The ratio of offspring genotypes and phenotypes can be predicted via Mendelian inheritance patterns and can involve dominant and recessive alleles or genes that are sex-linked. • Inheritance using pedigree diagrams show patterns of inheritance of simple dominant and recessive characteristic through multigenerational families. • Karyotyping and applications of gene technologies are used in areas such as gene therapy and genetic engineering. • Mutations are changes in DNA or chromosomes and there are several factors that cause mutations. • DNA plays a role in development of cancer and genetic disorders (haemochromatosis, sickle cell anaemia or Klinefelter syndrome). • Genetic testing is used to inform decisions such as genetic counselling, embryo selection and insurance. **First Nations Australians science elaboration** First Nations Australians have complex societal systems such as strict adherence to kinship and family structures. This includes marriage laws that dictate who can marry whom. The development of societal rules that impose regulations on marriage rests on the understanding that unions between individuals that are too closely related can lead to the inheritance of detrimental traits in their offspring.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	Key idea: Stability and change Models of food chains and food webs are used to understand and predict changes in interrelationships between living things. **Core concept: Interdependence and ecosystems**	**Key idea: Form and function** The relationships between structure of cells, tissues, organs and body systems determines their functions at the microscopic and macroscopic scale. **Key idea: Systems** The relationships of the components within body systems in terms of flows of matter between independent organs, tissues and cells. **Core concept: Form and function**	**Key idea: Form and function** The relationship between the form and function of specialised cells determines the survival of species. **Core concept: Form and function**	**Key idea: Stability and change** The process of change in organisms and generations over different periods of time result from natural diversity within a species. **Core concept: Diversity and evolution**
	Science understanding: Use models, including food chains and food webs, to represent matter and energy flow in ecosystems, and predict the impact of changing abiotic and biotic factors on populations: • Ecosystems are biological communities of interacting organisms and their physical environment. • Food chains and food webs are models that represent feeding relationships. • Energy and matter flow through ecosystems via the pathway of food webs. • Environmental changes affect feeding relationships. • Humans have a significant impact on food chains and food webs. • Microorganisms have a role within food chains and food webs. • Interactions between (biotic) organisms that affect population sizes include: ○ predator and prey ○ parasites	**Science understanding: Analyse the relationship between structure and function of cells, tissues and organs in a plant and an animal system and explain how these systems enable survival of the individual:** • Multi-cellular organisms are made up of many cells. • Specialised cells are cells designed to carry out a particular role in an organism. • There is a relationship between structure and function at cell, organ and body system levels in multi-cellular organisms. • Models constructed in 2D and 3D can be used to understand where organs are positioned within the body. • Body systems are organised in terms of flows of matter between interdependent organs.	**Science understanding: 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:** • The structure of gametes allows them to perform particular functions. • There are differences and similarities between internal and external fertilisation. • Reproductive strategies of multicellular and unicellular organisms have similarities and differences. • Plants can reproduce sexually (pollination and cross pollination) or asexually (propagation, budding, fragmentation, spore formation). • Humans reproduce sexually through internal fertilisation of the sperm and the ovum. • The human reproductive system has specific structures and functions.	**Science understanding: Use the theory of evolution by natural selection to explain past and present diversity and analyse the scientific evidence supporting the theory:** • Genetic characteristics relate to survival and reproductive rates. • There are processes involved in natural selection including variation, isolation and selection. • Changes caused by natural selection in a population can be the result of specified selection pressures, for example, artificial selection in breeding for desired characteristics. • The Theory of evolution explains the diversity of living things. • Biodiversity is the variety and variability of life on Earth and is an important ecological indicator. • Evidence for evolution includes: ○ the fossil record ○ chemical and anatomical similarities ○ geographical distribution of species.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	○ competitors ○ pollinators ○ introduced species ○ disease. • Abiotic factors that affect population sizes include: ○ seasonal changes ○ destruction of habitats (bushfires, droughts and flooding). **First Nations Australians science elaboration** Invasive species imported through human activity have an impact on important food webs of local ecosystems. This subsequently impacts First Nations Australian communities who depend on these ecosystems for cultural continuance, food and medicine.	• The coordination of the respiratory, circulatory and digestive systems enables the survival of an individual. • Plants and animals share analogous systems but may vary in their structure and function. • Advances in technology as enabled medical science to replace or repair organs.	• Male and female humans have different reproductive organ structures, but they work collectively as a system.	• Evidence from the past and present can predict possible futures of the diversity of life on Earth. **First Nations Australians science elaboration** Traits or characteristics that confer a reproductive advantage will, over many generations, become more frequent throughout the entire population. First Nations Australians long habitation in the diverse regions of Australia has led to the development of some of the structural and physiological adaptations that are favourable to living in those environments.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Chemical sciences Students develop an understanding of the composition and behaviour of substances. They classify substances based on their properties, such as solids, liquids and gases, or their composition, such as elements, compounds and mixtures. They explore physical changes, such as changes of state and dissolving, and investigate how chemical reactions result in the production of new substances. Students recognise that all substances consist of atoms, and that chemical reactions involve atoms in substances being rearranged and recombined to form new substances. They explore chemical systems at a range of scales, from sub-atomic to macroscopic, to examine relationships between atoms, properties of substances and energy. In this sub-strand, the following core concepts are developed: • Properties of matter: The chemical and physical properties of substances are determined by their structure at a range of scales. • Changes in matter: Substances change and new substances are produced by rearranging atoms; these changes involve energy transfer and transformation.	**Key idea: Form and function** Models showing the arrangement of particles are used to predict, understand and explain the behaviour and properties of matter. **Core concept: Properties of matter**	**Key idea: Form and function** Mixtures and compounds are combinations of elements and are essential to chemical processes. **Core concept: Properties of matter**	**Key idea: Matter and energy** Atomic models visualize the interior of atoms and molecules and support the prediction properties of matter. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons are conserved. **Key idea: Scale and measurement** The incredibly small size of atoms is critical to the development of science understanding to enable comparisons using formal units of measurement. **Core concept: Properties of matter**	**Key idea: Pattern, order and organisation** Elements can be organised based on the internal structure of their atoms and the patterns of chemical reactions they undergo. **Core concept: Properties of matter**
	Science understanding: Understand that the particle theory is used 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. • Models can be used to show the particles in the different states of matter such as solids, liquids, gases and plasma. • The energy of particles and temperature affect the properties and behaviour of the states of matter. • The properties and behaviour of the states of matter are explained through the motion and arrangement of particles (particle theory). • Diffusion can be explained through the motion and arrangement of particles. • There are situations where plasma and Bose condensate form and they have potential uses in those states.	**Science understanding: Classify matter as elements, compounds or mixtures and compare different representations of these, including 2-dimensional (2D) and 3-dimensional (3D) models, symbols for elements, and formulas for molecules and compounds:** • Elements are substances that cannot be broken down into simpler substances by chemical means. • Compounds are formed when 2 or more elements chemically combine in a fixed ratio. • Elements in the same group of the periodic table have similar properties. • There are trends in properties across rows and down groups of elements in the periodic table. • Locate elements on the periodic table. • The evidence that underpinned the different historical models and theories for the periodic table have been refined over time.	**Science understanding: 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:** • Matter is made up of atoms. • Atoms are made up of protons and neutrons in the nucleus, and electrons which orbit the nucleus. • Protons, neutrons and electrons each have a mass and charge. • The evidence that underpinned the different historical models and theories for the structure of the atom have been refined over time. • Outer shell electrons determine the reactivity of an atom and its role in a chemical reaction. • Ions are formed due to the loss or gain of one or more electrons. • Changes in the particles of the nucleus of unstable atoms can release alpha	**Science understanding: Explain how the structure and properties of atoms relate to the organisation of the elements in the periodic table:** • The periodic table organises the elements by their atomic structure. • The electronic structure of an atom determines its position in the periodic table and its properties. • There are trends in properties across rows and down groups of elements in the periodic table; the position can be used to predict their activity. • Electronic configuration is the arrangement of electrons in the shells of an atom and determine the formation of compounds. • Metals and non-metals can react differently depending on their atomic structure. • The reactivity series is a series of an arrangement of metals in decreasing

Sub-strands:	Year 7	Year 8	Year 9	Year 10
		• Models can be drawn or constructed in to in 2D and 3D to represent elements and compounds. • Elements and simple compounds have specific symbols and formulas.	and beta particles and gamma radiation. • In radioactivity, the interval of time required for one-half of the atomic nuclei of a radioactive sample to decay is referred to as half-life. • Applications of radioactivity can be found in medicine and industry. **First Nations Australians science elaboration** Radiocarbon dating procedures are used by archaeologists to study the migration patterns of early humans. They also look at the antiquity of the habitation of the Australian continent by First Nations Australians for more than 60,000 years.	order of their reactivity and can be used to predict product formation. • Ionic compounds consist of ions of opposite charges held together by strong electrostatic forces. • An ionic bond is a type of linkage formed from the electrostatic attraction between oppositely charged ions in a chemical compound. • Spectroscopes can be used to analyse the components of compounds and identify their properties.
	Key idea: Form and function Direct experience and observation of samples of substances that are pure; and a mixture can be separated based on the different physical properties of the substances that it contains. **Core concept: Properties of matter**	**Key idea: Matter and energy** When some substances are combined, they form new substances with properties that are different from the original ones. Other substances simply mix without changing permanently and can often be separated again. **Core concept: Changes in matter**	**Key idea: Matter and energy** The total amount of matter in closed systems is conserved. **Key idea: Stability and change** Matter can be rearranged through chemical change and these changes play an important role in many systems. **Core concept: Changes in matter**	**Key idea: Systems** The rate of a chemical reaction can be measured by the rate of formation of a product and predicted through models. The chemical system is in a state of dynamic equilibrium when the rate of the forwards and reverse reactions are at the same. **Core concept: Changes in matter**
	Science understanding: Understand that a particle model can be used to describe the differences between pure substances and mixtures, and apply understanding of properties of substances to separate mixtures: • There are differences between pure substances and a homogenous and heterogeneous mixture. • Characteristic properties of pure substances, such as density, boiling	**Science understanding: Compare physical and chemical changes and identify indicators of energy change in chemical reactions.** **Understand that new substances are formed when a chemical reaction occurs:** • Compounds can have a number of elements chemically bonded through chemical reactions.	**Science understanding: 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:** • Chemical reactions involve the rearrangement of atoms to form new substances.	**Science understanding: Identify patterns in synthesis, decomposition and displacement reactions and investigate the factors that affect reaction rates:** • Chemical reactions can be represented by word and balanced symbol equation. • Different types of chemical reactions are used to produce a range of products such as fuels, metals and pharmaceuticals.

<table>
<tr><th>Sub-strands:</th><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
<tr><td></td><td>point, and solubility, can be used to identify the substance.
• Selecting a separation technique is based on the physical properties of the substances that make up the mixture, for example:
○ filtration separates on particle size
○ decanting, panning and centrifuging on density.
• A mixture can be separated back into the original substances.
• A solution is composed of a solute and a solvent.
• There are several other types of separation techniques:
○ Crystallisation
○ Chromatography
○ Distillation
First Nations Australians science elaboration
First Nations Australians developed separation methods such as hand picking, sieving, winnowing, yandying, filtering, cold pressing and steam distilling. These enable the procurement and processing of resources necessary for everyday life and for survival in times of food and water shortages.</td><td>• There are differences that exist between elements, compounds and mixtures.
• There are differences between a physical and a chemical change.
• The chemical separation of compounds involves the breaking of chemical bonds, whereas the physical separation of mixtures does not.
• Various types of evidence can show that a chemical reaction has occurred.
• Energy change in chemical reactions can be identified by differences in temperature.
• The chemical properties of a substance affect its use.
First Nations Australians science elaboration
First Nations Australians have employed many chemical reactions such as:
• calcination, used to produce plaster (calcium sulphate) and pigments such as iron oxide
• pyrolysis, used in the production of charcoal, quicklime, pyroligneous acid and salts
• fermentation in the production of ethanol
• combustion in the production of heat and light.</td><td>• Chemical reactions consist of reactants and products.
• During a chemical reaction mass is not created or destroyed (Law of conservation of mass) and can be represented in balanced chemical equations.
• Models can be drawn or constructed in to in 2D and 3D to represent the rearrangement of atoms in chemical reactions.
• Word equations and simple symbolic equations are used to describe chemical reactions.
• There are different types and patterns of chemical reactions, such as combustion, precipitation and acids with metals, bases, and carbonates.
• There are differences between endothermic and exothermic reactions.
First Nations Australians science elaboration
Many chemical reactions require the input of energy to initiate them. Fire, the result of a combustion reaction, is important in ecosystems because it promotes the recycling of nutrients. This process is well known by First Nations Australians, as fire has been used for millennia to control the transfer of matter and energy through the ecosystem in a practice known as ‘firestick farming’.</td><td>• Synthesis reactions produce chemical compounds from simpler reactants.
• Displacement reactions occur when one reactant is displaced by another reactant.
• Decomposition reactions are characterised when one reactant breaks down into 2 or more products.
• Different factors such as temperature, light, size of particles, and adding a catalyst can influence the rate of reactions.
• Patterns of interactions with natural and processed materials can be used to classify and identify their properties and structures.
First Nations Australians science elaboration
The development of complex detoxification processes provides evidence of First Nations Australians extensive scientific knowledge of chemical and physical processes, and an acute ability to draw conclusions that are consistent with evidence.
The recognition of patterns in data, gathered from experiments that attempted to remove toxin, allowed this cultural group to modify and perfect the detoxification processes.</td></tr>
</table>

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Earth and space sciences Students develop an understanding of Earth's dynamic structure and its place in the cosmos. They learn to view Earth as part of a larger celestial system. They explore how changes on Earth such as day and night and the seasons relate to Earth's rotation and its revolution around the sun. Students explore the interactions and interdependencies of the systems that comprise the Earth system: the geosphere, biosphere, hydrosphere and atmosphere. They appreciate that living things depend on sustainability of the Earth system and investigate the influence of human activity on key processes, cycles and relationships. In this sub-strand, the following core concepts are developed: • Earth in space: Earth is part of an astronomical system; interactions between Earth and celestial bodies influence the Earth system. • Earth's surface: The Earth system comprises dynamic and interdependent systems; interactions between these systems cause continuous change over a range of scales. • Sustainability of the Earth system: All living things are connected through Earth's systems and depend on sustainability of the Earth system.	**Key idea: Pattern, order and organisation** Patterns of change can be used to make predictions for day and night, the seasons and eclipses. **Core concept: Earth in space**	**Key idea: Stability and change** Rock formation is cyclical in nature and occurs within the Earth over a variety of timescales. The Earth's surface changes slowly over time, with mountains being eroded by weather, and new ones produced when the Earth's crust is forced upwards. **Core concept: The Earth's surface**	**Key idea: Stability and change** The carbon cycle can appear to be stable at one point in time but at a larger or smaller scale can be changing. **Key idea: Systems** The carbon cycle can change due to key factors – such as the combustion of fossil fuels – that need to be in a steady balance or equilibrium. Earth's systems interact with one another within a closed system, making it vital that interactions between systems remain in equilibrium. **Core concepts: The Earth's surface, Changes in matter**	**Key idea: Scale and measurement** The significance of a phenomenon in the solar system, other galaxies or the universe is dependent on the scale, proportion and quantity at which it occurs, and can only be studied indirectly, as they are too large and at enormous distances to observe directly. Using the concept of 'orders of magnitude' aid understanding of how a model at one scale relates to a model at another scale. **Key idea: Systems** Systems can exist as components within larger systems, and one important part of thinking about systems is identifying boundaries, inputs and outputs. **Core concept: Earth in space**
	Science understanding: Model cyclic changes in the relative positions of the Earth, Sun and Moon and explain how these cycles causes eclipses and influence predictable phenomena on Earth, including seasons and tides: • Predictable patterns such as day and night are based on the relative positions between the Earth, Sun and Moon. • Seasons are caused through the combination of: ○ the tilt of the Earth's axis ○ the Earth's rotation on that axis ○ revolution of Earth around the Sun. • Seasonal variation is connected with the angle of the Sun, shadow length, and day length.	**Science understanding: Understand that sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales:** • The structure of the Earth is composed of layers comprising of varying materials. • Earth's crust is altered by 2 closely related dynamic processes: the rock cycle and plate tectonics. In combination, these processes continually recycle and remodel Earth's solid surface. • There are stages in the formation of igneous, metamorphic and sedimentary rocks, and varying timescales involved. • The mode of formation of rocks determines the texture and the minerals contained within the rock.	**Science understanding: 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):** • Respiration and photosynthesis are chemical processes and have a role in energy flow within an ecosystem. • Combustion, photosynthesis and respiration are all types of reactions that rely on the interactions between Earth's spheres. • Resources cycle through the environment at different rates, which determines how renewable they are. • The systems on the surface of the Earth result from interactions in the	**Science understanding: Describe how the Big Bang theory models the origin and evolution of the universe and analyse the supporting evidence for the theory:** • There is evidence that supports the Big Bang theory and calculations of the age of the universe. • Galaxies, stars and planetary systems have developed during the evolution of the universe. • Light is electromagnetic radiation and certain wavelengths categorise the type of light and can inform the composition of celestial objects. • Patterns of spectra can determine the elements within different light sources. • Redshift and blueshift describe the change in the frequency of a light wave

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	• Similarities and differences within contemporary models explain eclipses relative to the movements of the Earth, Moon and Sun. • There are different times for the rotation of Earth, the Sun and Moon, and the times for the orbits of Earth and the Moon. • The phases of the Moon (lunar cycles) impact ocean tides. • Changes on Earth such as day and night and seasons relate to the Earth's rotation and its orbit around the Sun. • The seasons on Earth have similarities and differences with the seasons on other planets. **First Nations Australians science elaboration** The traditional astronomical knowledge of First Nations Australian communities includes an intricate understanding of the relationship between the Moon and tides. This knowledge was acquired through empirical observation of how ocean tides relate to the positioning of the Moon and Sun relative to the Earth. While the seasonal calendar used in most western societies is based on specific dates to mark each season, First Nations Australians observe the position of stars in the sky and follow water, plant and animal cycles as ways of identifying seasonal phenomena.	• Common rock types are based on observable physical and chemical properties. • Igneous rocks are formed when molten material from inside the Earth cools. • There is a relationship between rate of cooling and crystal formation size. • The forces of contraction, expansion and freezing of water can lead to the weathering of rocks. • Sedimentary rocks are formed when other rocks are weathered into small pieces, deposited and cemented together. • Metamorphic rocks are formed when other types of rock are changed by heat or pressure. • Fossil evidence can be used to predict how and when a rock was formed. • Mining of ores and minerals has significant impact on local environments. **First Nations Australians science elaboration** Traditionally, the mineral quartz and fine-grained, quartz-rich rocks such as silcrete, chert and quartzite, as well as hard volcanic rocks such as basalt, are important resources for First Nations Australians. Traditional geological knowledge enables suitable rock types to be identified, quarried or mined, and worked into a variety of sophisticated tools.	atmosphere, hydrosphere, biosphere, hydrosphere and geosphere. • The carbon is cycled within a system and is in an unbalanced state of equilibrium. • Strategies to reduce carbon dioxide emissions can vary at local, state, national and international levels. • Carbon dioxide can be captured and stored naturally or through the use of technologies. **First Nations Australians science elaboration** Many chemical reactions require the input of energy to initiate them. Fire – the result of a combustion reaction – is important in ecosystems because it promotes the recycling of nutrients. This process is well-known by First Nations Australians, as fire has been used for millennia to control the transfer of matter and energy through the ecosystem in a practice known as 'firestick farming'.	depending on whether an object is moving towards or away from Earth. • The life cycle of stars can be modelled in sequential stages. • The Sun provides Earth with life-sustaining heat and light. • Activity on the Sun's surface creates a type of weather called space weather, phenomena that impact systems and technologies in orbit and on Earth. • Advances in scientific understanding of the origins of the universe rely on developments in technology, such as the Hubble and James Webb telescopes. **First Nations Australians science elaboration** The astronomical knowledge of First Nations Australians as evidenced in histories inscribed in bark, rock and sand painting set the context to study traditional and modern understandings about the structure and origin of the universe. The exceptional observation skills of First Nations Australians are embedded in histories and handed down through generations, and is used to aid navigation and to construct seasonal calendars.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
		Key idea: Stability and change Below the surface, heat from the Earth's interior causes movement in the molten rock. This in turn leads to movement of the plates over a long time period, which forms the Earth's crust, creating volcanoes and earthquakes. **Core concept: The Earth's surface**		**Key idea: Systems** The relationships between aspects of the living, physical and chemical world are applied to systems on a local and global scale, and this enables us to predict how changes will affect equilibrium within these systems. Earth's systems can exist as components within larger systems. Identify the inputs and outputs, and boundaries of systems to predict the cycles of elements through the systems. **Core concepts: The Earth's surface, Changes in matter**
		Science understanding: Understand that the theory of plate tectonics explains global patterns of geological activity and continental movement: • The Earth's crust is made of separate plates. • The Earth's plates move slowly and in different directions. • Continental drift describes one of the earliest ways geologists thought continents moved over time and was an important precursor to the development of the theory of plate tectonics. • Tectonic plate movement is caused by heat and pressure energy which drive convection currents in the molten rock of the mantle. • The theory of plate tectonics explains how the movement of geologic plates causes mountain building, volcanoes, and earthquakes.		**Science understanding: Use models of energy flow between the geosphere, biosphere, hydrosphere and atmosphere to explain patterns of global climate change:** • Radiation from the Sun and its interactions with the atmosphere, hydrosphere, biosphere and lithosphere are the foundations for Earth's climate system. • The greenhouse effect is a process that occurs when gases in Earth's atmosphere trap the Sun's heat. • An increase in the atmospheric concentrations of greenhouse gases produces a warming effect on the global climate. • Factors that drive the deep ocean currents have a role in regulating global climate and have an effect on marine life. • Climate change affects sea levels, sea ice, permafrost and biodiversity.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
		• The theory of seafloor spreading explains variations in magnetic fields on the seafloor and can be used to determine the age of rocks. • Models can be drawn or constructed in 2D and 3D to represent interactions present at plate boundaries. • The age and stability of a large part of the Australian continent is related to its plate tectonic history. • There are many technical advances associated with Earth science, such as ultrasound, laser, sonar, satellites and seismometers, and these are used by government and industry.		• There are long-term effects of loss of biodiversity. • Nitrogen and phosphorus cycle through the atmosphere, hydrosphere, biosphere and lithosphere. These cycles are predictable, but each element cycle has a different duration. • Human activity affects global systems. • Scientific models can be used to predict how a change in the environment affects the equilibrium of an ecosystem now and in the future. • Strategies designed to reduce climate change or mitigate its effects have varying levels of impact. **First Nations Australians science elaboration** First Nations Australians traditional fire management practices are recognised by contemporary science and are being used for bushfire management. Due to this management, greenhouse gas emissions are reduced effectively because of the interactions between the biosphere and the atmosphere.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Physical sciences Students develop an understanding of forces and motion, and matter and energy. They investigate how an object's motion is influenced by a range of forces, such as frictional, magnetic, gravitational and electrostatic, and learn how to represent and predict these interactions. They develop an increasingly rich concept of energy and how energy transfer is associated with phenomena involving motion, heat, sound, light and electricity. They appreciate that concepts of force, motion, matter and energy apply to systems ranging in scale from atoms to the universe itself. In this sub-strand, the following core concepts are developed: • Forces and motion – Forces affect the motion and behaviour of objects. • Energy – Energy can be transferred and transformed from one form to another and is conserved within systems.	**Key idea: Stability and change** Stability can be the result of competing but balanced forces. Consider the interaction between multiple forces when explaining changes in an object's motion and quantify change through measurements and analyse patterns of change represented in tables or graphs. **Core concept: Forces and motion**	**Key idea: Systems** Models can be used to represent energy flows within systems. **Key idea: Matter and energy** Energy may take different forms that can be transferred and transformed. **Core concept: Energy**	**Key idea: Matter and energy** The transfer of energy can be tracked as energy flows through a designed or natural system. Models of sound and light can be used to explain the transfer of energy through different media. **Key idea: Form and function** The properties of particles and waves determine the behaviour of light and sound. **Core concept: Energy**	**Key idea: Systems** Interactions between components can involve forces and changes acting in opposing directions; for a system to be in a steady state, these factors need to be in a state of balance or equilibrium. **Key idea: Stability and change** Stability can be the result of competing but balanced forces. Students become adept at quantifying change through measurement and looking for patterns of change by representing and analysing data in tables or graphs. **Core concept: Forces and motion**
	Science understanding: 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: • Constant motion is when an object is not changing its speed or direction. • Constant motion occurs when forces are balanced. If forces are unbalanced, there will be a change in speed (speeding up or slowing down), or direction of movement. • Force diagrams represent situations where balanced or unbalanced forces are being applied to objects. • Simple machines include levers, pulleys, wheels and axles, inclined planes, screws, and wedges.	**Science understanding: Understand that energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems:** • Kinetic, potential, heat, sound, light, electrical, and chemical are different forms of energy. • Potential energy is the energy that is stored within an object while kinetic energy is the energy that is in motion. • Energy transfer is the movement of energy from one location to another. • An energy transformation is the change of energy from one form to another. • Energy can be transferred from one system to another or from a system to its environment in different forms. • Flow diagrams illustrate how energy is transferred and transformed.	**Science understanding: Understand wave and particle models to describe energy transfer through different mediums, and examine the usefulness of each model for explaining phenomena:** • Models of sound and light can be used to explain the transfer of energy through different media. • A wave is a disturbance that moves from its source and carries energy. • Waves have characteristics such as speed, amplitude, period, frequency and energy. • Mechanical waves are categorized by their type of motion as transverse or longitudinal. • The features of wave and particle models explain the behaviour of sound and light. • Sound is energy transferred in the form of a pressure wave through matter.	**Science understanding: Investigate Newton's laws of motion and qualitatively analyse the relationship between force, mass and acceleration of objects:** • Motion energy is the sum of potential and kinetic energy in an object that is used to do work. • Kinetic energy is a property of a moving object or particle and depends not only on its motion but also on its mass. • Newton's first law of motion states that an object at rest will remain this way unless it is acted upon by a force. • An object that is moving will continue to move at the same speed and in the same direction, unless an unbalanced force acts upon it. This can be represented mathematically. • Acceleration is a vector quantity that is defined as the rate at which an object changes its velocity.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	• There are different types of forces, including friction, air resistance, upthrust and weight. • There is a difference between mass and weight. • Gravity affects objects on the surface of Earth and also keeps planets in orbit around the Sun. • Gravity affects objects in space including moons, planets, stars, galaxies and blackholes. **First Nations Australians science elaboration** Across Australia, First Nation peoples created a range of tools to increase the velocity and accuracy of projectiles. Various styles of spear-throwers were developed and refined on much of the mainland. Spear-throwers were effective as they provided an extension to the human thrower's arm.	• Heat energy is often a by-product of energy transfer and transformation. • Transformations and transfers of energy within a system usually result in some energy transferring into its surrounding environment. • Energy can be transformed into usable and unusable forms and this can impact on the efficiency of a system. • Energy efficiency of different systems can be calculated and used to assess efficiency. **First Nations Australians science elaboration** Various fire-starting techniques developed and used by First Nations Australians rely on the transformation of energy.	• Sound travels at a finite speed which depends on the transmission medium. • Light is a form of electromagnetic radiation (EMR). • A photon is the smallest amount of electromagnetic radiation. It is the basic unit of all light. • Visible light is a combination of colours and is usually defined as having wavelengths in the range of 400–700 nanometres (nm). • Refraction of light occurs when light passes from one medium to another. • Ray diagrams can assist in tracing the pathway light takes when reflecting off plane, convex and concave mirrors. • Waves are used in our technology to assist with communication, exploration of the universe and the transfer of energy. **First Nations Australians science elaboration** As in all cultures, Aboriginal and Torres Strait Islander peoples have many diverse technologies, knowledges and processes that involve the transfer of sound energy. Aboriginal peoples' knowledge of sound propagation through different mediums influences the design of technologies including sound instruments, herding and signalling devices.	• Velocity is the rate at which an object changes position in a certain direction. • Newton's second law of motion states that an object will accelerate in the direction of an unbalanced force acting upon it. The size of this acceleration depends upon the mass of the object and the size of the force acting upon it. • Newton's third law states that for every action force there is an equal (in size) and opposite (in direction) reaction force. • Forces always come in pairs, referred to as equal and opposite action/reaction force pairs. • Changes in either mass or force influence the acceleration, velocity and reach of a projectile. **First Nations Australians science elaboration** The laws of physics can be applied to explain the effectiveness of hunting tools used in Aboriginal cultures. First Nations Australians achieve an increase in velocity, acceleration, reach and subsequent impact force by using spear-throwers and bows.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
			Key idea: Matter and energy The total amount of energy and matter in closed systems is conserved. Energy cannot be created or destroyed. Energy can be transferred and transformed from one place and another place, between objects or fields, or between systems. **Core concept: Energy**	
			Science understanding: Apply the law of conservation of energy to analyse a system efficiency in terms of energy inputs, outputs, transfers and transformations: • The Law of conservation of energy explains that total energy is maintained in energy transfer and transformation and that energy cannot be created or destroyed. • Energy transfer and transformation in systems is not 100 percent efficient. • Models can be used to show how energy is transferred and transformed within systems. • Sankey diagrams can be used to represent energy changes, inputs and outputs. • Thermal energy refers to the energy contained within a system that is responsible for its temperature. Heat is the flow of thermal energy. • Temperature is the measure of the thermal energy or average heat of the molecules in a substance. • Heat can be transferred by radiation, convection and conduction.	

Sub-strands:	Year 7	Year 8	Year 9	Year 10
			• The particle model can be used to explain conduction and convection of heat. • Energy transfer through radiation differs from convection and conduction. • Materials that are poor conductors of thermal energy are called thermal insulators. • Materials that are good conductors of thermal energy are called thermal conductors. • Thermal properties of materials can be used to regulate heat transfer. **First Nations Australians science elaboration** First Nations peoples cultures provide a context for understanding thermal energy transfer mechanisms. First Nations peoples living in cool and temperate climatic regions of Australia developed effective clothing technologies using the thermal conductivity of various materials. These affect the rate at which energy is transferred as heat between bodies.	

Strand: Science as a human endeavour

In this strand, students learn about the nature of science, including the role of science inquiry in developing science knowledge, and the factors that affect the use and advancement of science. Students learn that through science, humans seek to improve their understanding of and explanations for the natural and physical world, and that science knowledge is refined and revised as new evidence becomes available. They appreciate that science influences society by posing and responding to ethical, environmental and social questions, and individual and collective scientific research is itself influenced by the needs and priorities of society. This strand highlights the development of science as a unique way of knowing and doing, and the role of science in contemporary decision making and problem solving.

Content for Science as a human endeavour is described in 2-year bands that comprise of 2 sub-strands.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Nature and development of science Students develop an appreciation of the unique nature of science and scientific knowledge, including that scientific knowledge is based on empirical evidence and can be modified in light of new or reinterpreted evidence. They explore historical and global contributions to scientific knowledge and appreciate that individual and collaborative scientific endeavours are influenced by cultural perspectives and world views. In this sub-strand, students develop the core concepts that: • science inquiry values curiosity, creativity, accuracy, objectivity, perseverance and scepticism • science knowledge is a result of individual and collaborative efforts, and advances reflect historical and global contributions • science knowledge is built on empirical evidence; however, all science knowledge can be changed in light of new or reinterpreted evidence.	**Explain how new evidence or different perspectives can lead to changes in scientific knowledge.**		**Explain how scientific knowledge is validated and refined, including the role of publication and peer review.**	
	Content examples: • Adelaide aerospace engineer Andy Thomas is a NASA astronaut who has advocated for the Australian Space Discovery Centre in Adelaide. The centre is research advances in: ○ space observation and travel ○ predicting climate patterns ○ improving the communication on Earth and in space. **First Nations Australians science elaboration** First Nations Australians' knowledge in the identification of medicinal and endemic plants contributes to current scientific knowledge.	**Content examples:** • Nanotechnology has changed how society develops and uses materials to design innovative products, for example, sunscreen, paint and medicine. • Changes in our understanding of matter has enabled us to use plasma technology. • One of the biggest scientific advancements from 2013 is the production of organoids. Organoids are tiny immature organs that enable scientists to study disease and treatments in a laboratory without using live animals. • The treatment for gastric ulcers changed in 2005 when Professor Barry Marshall and Adelaide-born scientist Robin Warren jointly won the Nobel Prize in Medicine. They won it for their discovery of the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease.	**Content examples:** • Historical development of models that show the structure of the atom have been refined over time and reviewed by the scientific community. • Theory of plate tectonics has been contested and changed over time. • Models and theories for the nature of light have been refined over time through questioning and experimentation. The new evidence forms the basis of explanations used by scientists. • Physicist Chien-Shiung Wu was the first scientist to confirm — and later refine — Enrico Fermi's theory of radioactive beta decay. • Neurophysiologist John Eccles won the 1963 Nobel Prize in Physiology or Medicine for his research on the synapse – the junction between 2 neurons or a neuron and a muscle. • Marie and Pierre Curie first discovered the radioactive elements polonium and radium. Marie continued to investigate their properties. In 1910, she successfully produced radium as a pure metal, which proved the new element's existence beyond a doubt.	**Content examples:** • Chemist Rosalind Franklin is known for her revolutionary work in discovering the double helix structure of DNA, which has been contested and refined overtime. Her male colleagues James Watson and Francis Crick were awarded the Nobel Prize in Physiology or Medicine in 1962. • The development of the periodic table has steadily evolved over time. It has been disputed, altered and improved as science has progressed and new elements have been discovered. • The Square Kilometre Array (SKA) in Australia has the capability to answer profound questions in cosmology and challenge current scientific theories of the universe. • The climate change model is used by scientists to make predictions about changes on Earth; however, it is contested by some people in society. • Adelaide father-and-son scientists William Lawrence Bragg and William Henry Bragg were winners of the Nobel prize in Physics. They successfully constructed the first x-ray spectroscope, revolutionizing the study of x-ray crystallography.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
			First Nations Australians science elaboration First Nations Australians' fire regimes have influenced fire management policy throughout Australia.	• Astronomer Vera Rubin discovered the existence of dark matter – the strange glue that holds our universe together. Her contribution is regarded as one of the most significant discoveries of the 20th century. • University of Adelaide physics researchers were part of a global team which detected the gravitational waves produced by the merger of 2 black holes. This discovery led to the team being awarded the Nobel Prize in Physics. **First Nations Australians science elaboration** Prior to germ theory, First Nations Australians used their scientific observations to develop traditional medicines to treat wounds and skin infections.
	Investigate how cultural perspectives and world views influence the development of scientific knowledge.		**Investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering.**	
	Content examples: • Dame Jane Goodall is a primatologist and anthropologist, and an expert in wild chimpanzees. She collaborated with people from a range of cultures. • Ngarrindjeri inventor David Unaipon was famous for inventions such as the improved mechanical sheep shearing hand tool. He applied for patents for as many as 19 inventions and conceptualized the helicopter 22 years before it became a reality. He is featured on the Australian $50 note in commemoration of his work. **First Nations Australians science elaboration**	**Content examples:** • Extraction of mineral resources relies on the collaboration of geologists, physicists and chemists from a range of cultural backgrounds. • Adelaide pharmacologist and pathologist Baron Howard Florey won a Nobel Prize in Medicine for the development of penicillin in collaboration with Sir Ernst Chain and Sir Alexander Fleming. • Rebecca Richards, an Adnyamathanha and Barngarla woman from the Northern Flinders Ranges, was the first First Nations person to win the Australian Rhodes Scholar award and	**Content examples:** • Advances in the scientific understanding of electromagnetic radiation used in radar, medicine, mobile phones and microwaves have improved with technological advances. • Advances in the scientific understanding of the functions of the human body have improved with advanced imaging technologies. For example, bone density scanners, ultrasounds and MRIs. • Advances in the scientific understanding of dental care and the longevity of fillings has improved with	**Content examples:** • An increase in the speed of computers has enabled us to sequence the human genome and enabled the sequencing of DNA in common and complex diseases. • The South Australian Health and Medical Research Institute (SAHMRI) has improved radiation therapy treatment for cancer patients. • The technological advances of the Large Hadron Collider have enabled scientists to understand Einstein's theory of relativity. • South Australia's Space Agency Centre and SmartSAT Cooperative Research Centre (CRC)'s technological advances

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	Land management practices of First Nations Australians informs contemporary management of the environment to protect biodiversity.	South Australia's 2012 Young Australian of the Year. Rebecca is an early career researcher in anthropology at the South Australian Museum, investigating the best use of the museum's materials to show the history of First Nations peoples. • Advances in aerosol-based delivery methods led to Fiona Woods developing spray-on skin for burn victims which evolved from her early work of using cultural epithelial autograph (CEA). **First Nations Australians science elaboration** First Nations Australians connect knowledge from the science disciplines in the development of material culture and pigments and dyes.	technological advances such as 3D-printed tooth fillings. • Australian doctor and researcher Graeme Clark helped develop the bionic ear. • Frances Arnold was the first woman to receive a Nobel Prize in Chemistry for the directed evolution of enzymes in 2018. She shared it with George Smith and Gregory Winter. • Advances in medical science, such as reproductive technologies, depend on the collaboration of a range of scientists.	will improve communication and travel in space, and may contribute to new scientific discoveries. • Technological advances have enabled biofuels to be used as alternative energy for a number of machines. Biofuels are fuels produced directly or indirectly from organic material biomass, including plant materials and animal waste. • Monitoring greenhouse gas emissions using advanced technologies and other environmental factors have contributed to the reinstatement of traditional fire management practices. • In 2018, physicist Donna Strickland received the Nobel Prize in Physics with Arthur Ashkin and Gerard Mourou for ground-breaking inventions in the field of laser physics. **First Nations Australians science elaboration** Technological advances in dating methods of First Nations Australians' material culture contribute to our understanding of the changing climatic conditions and human interaction with Australian megafauna.
Use and influence of science Students explore how scientific knowledge and applications affect individuals and communities, including informing their decisions and identifying responses to contemporary issues. They learn that in making decisions about science practices and applications, ethical, environmental and social implications must be taken into account. Students also	**Examine how proposed scientific responses to contemporary issues may impact on society and explore ethical, environmental, social and economic considerations.**		**Analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society.**	
	Content examples: • Science and technology provide solutions to road safety issues such as wearing seatbelts, but implementation depends on society's ethics and legal regulations.	**Content examples:** • Home batteries for storage of solar energy are being trialled in an investigation by SA Power. This scientific research will help find a solution to reach Australia's zero	**Content examples:** • New career opportunities and advances in science have led to augmented reality (AR) in medical training for surgeons.	**Content examples:** • New discoveries and scientific explanations through space exploration and the use of nanosatellites will advance the life of all societies.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
gain an appreciation for the ways in which science is influenced by the needs and priorities of society. In this sub-strand, students develop the core concepts that: • scientific knowledge, practices and products are influenced by ethical, environmental, social and economic factors • science, technology and engineering are interconnected; advances in one field can lead to advances in other fields • science knowledge, balanced with ethical and social considerations, contributes to understanding complex contemporary issues and identifying responses.	• Using biological control to decrease or exterminate introduced species can impact on other areas of society, for example, myxomatosis. Australian virologist Frank Fenner is known for his work on the prevention of smallpox and introducing the Myxoma virus to control rabbit numbers during a rabbit plague. • Flavia Tata Nardini is co-founder and CEO of Australia's Fleet Space Technologies, which is improving communication connectivity on Earth and in space through the development and refinement of nano-satellites. **First Nations Australians science elaboration** Intellectual property rights and bio-piracy must be considered with the development of commercial products that are founded on the traditional knowledge and practices of First Nations Australians.	emissions target by 2050 and take ethical considerations into account. • The future of energy generation must consider renewable energy technologies. It also needs to look at the effects on the sustainability of systems and the ethical issues surrounding society's energy-dependent lifestyle. • Australian ophthalmologist Fred Hollows is known for his extraordinary work that helped to restore the eyesight of thousands of people. • Ethical considerations are required for organ transplantation between humans and humans, and animals and humans. • Local councils and community groups require solutions on sustainability of coastline dune regeneration based on scientific knowledge. **First Nations Australians science elaboration** There are ethical considerations for the use of sustainable technologies in remote First Nations Australian communities.	• Scientific predictions and explanations are improved by using virtual reality. For example: ○ medicine in radiation therapy training ○ for biologists in determining the energy flows through ecosystems. • Xenobots are living machines which promote self-healing in patients. • New career opportunities have been generated through innovative scientific developments such as lifi (light waves), and funtenna (using sound and radio waves to hack the internet of things). **First Nations Australians science elaboration** First Nations Australians are at the forefront of the development of scientific measures to prevent the transfer of certain infectious diseases and pests to the Australian continent.	• Bioinformatics are helping scientists accept claims of uncertain knowledge. • Advances in sustainable transport based on scientific evidence can create entrepreneurial and start-up opportunities for South Australia and may even take people to Mars. • Adelaide nuclear physicist Sir Mark Oliphant was the winner of the Hughes Medal and the Faraday Medal for his work on nuclear fusion and fission, which has led to many new career opportunities and research. • Australian biologist Elizabeth Blackburn helped discover an enzyme called telomerase. **First Nations Australians science elaboration** Traditional ecological knowledge of First Nations Australians is being reaffirmed by modern science and is generating new career opportunities in the field of restorative ecology.
	Explore the role of science communication in informing individual viewpoints and community policies and regulations.		**Examine how the values and needs of society influence the focus of scientific research.**	
	Content examples: • Science has influenced developments in supporting people with disability to walk again. • Recycling industries and waste disposal practices have been developed using scientific understandings and skills.	**Content examples:** • People use science to improve farming through the development of precision agriculture. • Science understanding is used to influence the development of earthquake and tsunami prediction alarms.	**Content examples:** • Australian scientific research on artificial skin by Dr Fiona Wood and Dr Marie Stoner is valued by contemporary society. • Dr James Muecke won the Australian of the Year award in 2020 for his work and influence on diabetes-induced blindness in society.	**Content examples:** • Contemporary society values scientific knowledge on climate change and increasing atmospheric pollution. The scientific data is used to influence decisions which affect all our lives. Australian researcher David Karoly is known for his research on climate

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	• Medical separation techniques such as blood transfusions are based on science understandings. **First Nations Australians science elaboration** The knowledge and experience of First Nations Australians are being used to inform scientific decisions, such as the care of Country.	• Science understanding is used in disease treatment and to influence human activity during pandemics. • Australian doctor and pioneer Helen Mayo influenced the prevention of infant mortality. • Australian epidemiologist Professor Fiona Stanley is noted for her research into pregnant women taking folate to prevent defects such as spina bifida. **First Nations Australians science elaboration** First Nations Australians used scientific understandings of complex ecological relationships to develop specific fire-based agricultural practices.	• Australian physicist Joan Freeman became the first woman to be awarded the British Institute of Physics' Rutherford Medal for her work on atomic energy. • University of Adelaide's Professor Rachel Burton has undertaken molecular biological research on the efficacy of several biofuels, including agave. • World politics and societal influence has seen Australia plan to build nuclear submarines in Adelaide. • The Australian Bragg Centre for Proton Therapy and Research in Adelaide will deliver precise, non-invasive radiotherapy that can destroy cancer cells while minimising the damage to surrounding healthy tissue and vital organs. Patients will be able to receive this treatment in Australia rather than going overseas.	change and stratospheric ozone depletion. • Contemporary society values scientific knowledge on gene therapy and more funding is being provided to research further solutions. • South Australian agricultural scientist Andrew Barr has been researching the development of drought and pest-resistant crops. • Pharmaceutical nanotechnology research on toxicological assessment is influenced by contemporary society's issues with drug development. Advanced cancer detection using gold nanoparticles research is supported by society. • Flying cars are being marked for development and production at Australia's Space Park in Adelaide to lower emissions and free up city roads for pedestrians and cyclists. **First Nations Australians science elaboration** Disease outbreaks and the emergence of drug resistant infections have focused scientific research into First Nations Australians' traditional medicines. This is to identify effective therapeutic compounds for use in pharmaceuticals. 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.

Strand: Science inquiry

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

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. They can involve a range of activities including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The choice of the approach taken will depend on the context and aims of the investigation. Content for Science inquiry is described in 2-year bands comprising of 5 sub-strands.

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

When viewing the inquiry skills, it is important to note that students cumulatively develop the skills over years 7 to 10. By the end of year 10 students should have had an opportunity to develop all inquiry skills in a progressive manner, practicing and building on concepts in new and familiar contexts.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Questioning and predicting Students learn to identify and construct questions, propose hypotheses and predict possible outcomes. Students appreciate the important role of questions, predictions and hypotheses as critical and creative drivers of scientific inquiry. In this sub-strand, students develop the core concepts that: • science inquiry involves making observations and predictions, asking questions, and constructing and testing explanations for natural and physical phenomena • science inquiry may be done to describe a phenomenon, explore relationships, test a theory or model, or design solutions.	**Key idea: Patterns, order and organisation and systems** • Patterns can be used to identify cause and effect relationships and make predictions. • Models can be used to make predictions but are limited in that they only represent certain aspects of the system under study.		**Key idea: Patterns, order and organisation and systems** • Patterns in systems can be observed at different scales and can be represented mathematically. • Models can be used to predict the behaviour of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.	
	Develop investigable questions, reasoned predictions and hypotheses to explore scientific models, identify patterns and test relationships.		**Develop investigable questions, reasoned predictions and hypotheses to test relationships and develop explanatory models.**	
	• Notice observations, similarities and differences that may change over time or scale and may require equipment due to temporal and spatial scale. • Identify features of questions that can be scientifically investigable, and which are non-investigable questions. • Construct, discuss and choose a question to answer or a problem to solve through scientific practices. • Make testable predictions based on scientific knowledge related to the aim or the question and explain why. • When appropriate, develop a hypothesis based on observations and scientific principles.	• Notice detailed observations of phenomena, scientific models, or unexpected results, to investigate scientifically. • Ask questions to clarify or refine a model, an explanation or a problem, which can be firmly established over time while others can be tentative. • Make a reasoned prediction and use this to formulate a hypothesis. • Formulate alternative 'If…then…' hypotheses based on their questions and provide reason(s). • Identify patterns in observations and consider if the variables have a causal	• Notice observations to identify and clarify their investigable questions of phenomena or explanatory models. • Formulate questions that can be investigated scientifically using several inquiry practices and can be used to clarify evidence and the premises of an argument. • Evaluate the reliability of secondary data to develop investigable questions. • Develop a reasoned prediction and propose a hypothesis based on scientific knowledge to test relationships of a model or theory.	• Observe patterns and relationships in big data sets and notice unusual or unexpected results to investigate. • Formulate and evaluate questions to clarify and refine scientific and explanatory models, an explanation or problem. • Explore additional information and relationships to determine if the questions are testable and relevant. • Develop questions that challenge the premise of an argument, the interpretation of a data set or the suitability of the design. • Formulate hypotheses to test relationships of models and theories

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	• Use scientific models to identify patterns and test relationships (models can be physical or virtual).	relationship in physical or virtual models.	• Use explanatory models to identify patterns and test relationships (models can be physical or virtual).	and make further predictions with multiple outcomes. • Develop explanatory models to test relationships and abstract theories (models can be physical or virtual).
Planning and conducting Students learn to make decisions about how to investigate or solve a problem, carry out an investigation, and generate and record data safely. They consider ethical and cultural issues and protocols associated with the generation or use of data and recognise and manage risk and safety. Students appreciate the important considerations and practices involved in the design of scientific investigations. In this sub-strand, students develop the core concept that: • science inquiries should be designed to systematically generate or collect valid and reliable primary and secondary data in a safe, ethical and interculturally aware way.	**Key idea: Scale and measurement** • Phenomena that can be observed at one scale may not be observable at another scale. • Proportional relationships and the use of appropriate units provide information about the magnitude of properties and processes.		**Key idea: Scale and measurement** • Some systems can only be investigated indirectly as they are too small, too large, too fast or too slow to observe directly. • Orders of magnitude can show how a model at one scale relates to a model at another scale.	
	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. **Select and use equipment to generate and record data with precision, using digital tools as appropriate.**		**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.** **Select and use equipment to generate and record data with precision to obtain useful sample sizes and replicable data, using digital tools as appropriate.**	
	• Plan and conduct reproducible investigations; the results obtained should be achieved again when the investigation is repeated. • Identify which variable can be changed, which can be measured, and which variables will be kept constant for a fair test. • Select which equipment, apparatus and materials will be required to generate data accurately, using digital tools as appropriate. • Consider the limitations on the accuracy of the data (for example, number of trials, cost, risk, time) and adjust the design accordingly. • Collaboratively or individually plan a range of investigation types (field work	• Plan and conduct reproducible investigations to answer questions and test hypotheses. • Identify and select which variable can be changed (independent variable), which can be measured (dependent variable), and which ones will be controlled within an investigation to test a hypothesis. • Select and use digital technologies when appropriate to observe, measure, and record qualitative and quantitative data accurately. • Evaluate the accuracy of various methods for collecting data, including number of trials, which serves as the basis of evidence to answer a question scientifically.	• Plan and conduct reproducible and valid investigations to answer questions and test hypotheses. • Identify the independent variable, dependent variable and controlled variables with reference to the method to test a hypothesis. • Select which equipment, digital tools, apparatus and materials will be required to effectively generate data, with accuracy and precision. • Identify assumptions and examine if further testing or additional variable control is required to improve accuracy. • Plan and conduct an investigation or test a design solution in a safe and ethical manner, including considerations of environmental, social, and personal impacts.	• Plan and conduct reproducible and valid investigations to answer questions and test hypotheses. • Consider possible errors, their effects and evaluate the investigation's design to ensure they are controlled or minimised. • Explain how estimation affects precision and examine the inaccuracy introduced when reading between scale markings, and how human error can affect replicability and reproducibility. • Identify and address possible sources of error through choice of equipment, variable control or further testing. • Plan and conduct an investigation or test a design solution in a safe and ethical manner, including

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	and experiments) to answer questions or solve problems. • Describe how safety and ethical guidelines are followed and managed. • Collaborate with First Nations Australians when appropriate to ensure research is conducted in appropriate locations. Consult with local knowledge holders.	• Explain how safety and ethical guidelines are followed and managed. • Collaborate to ensure field work avoids and protects artefacts and heritage sites. Consult with First Nations Australians when planning fieldwork and experiments on Country/Place.	• Identify how potential hazards and processes in the investigation can be addressed when developing a risk assessment. • Acknowledge cultural heritage protection Acts and the obligations of scientists in planning field investigations.	considerations of environmental, social, and personal impacts. • Identify the potential hazards of chemicals or biological materials and processes used in experimental investigations, and how these should be addressed when developing and following a risk assessment. • Collaborate in accordance with United Nations Declaration on the Rights of Indigenous Peoples and intellectual property rights.
Processing, modelling and analysing Students learn to analyse and represent data in meaningful and useful ways and identify trends, patterns and relationships in data. Students engage in the key practices involved in generating scientific evidence. In this sub-strand, students develop the core concept that: • mathematical thinking underpins science practices of representing objects and events, analysing data and modelling relationships.	**Key idea: Scale and measurement** Proportional relationships and the use of appropriate units (such as speed) can provide information about the magnitude of properties and processes. **Key idea: Systems** Models can be used to represent systems and inputs, processes and outputs.		**Key idea: Patterns, order and organisation** Patterns can be represented mathematically (through the use of algebraic expressions and equations). **Key idea: Scale and measurement** Orders of magnitude allow understanding of how a model at one scale relates to a model at another scale. **Key idea: Stability and change** Change and rates of change can be quantified and modelled at different scales. **Key idea: Systems** Models can be used to simulate systems and interactions including the flow of energy, matter and interactions within and between systems at different scales	
	Select and construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information. **Analyse data and information to describe patterns, trends and relationships and identify anomalies.**		**Select and construct appropriate representations, including tables, graphs, Select and construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information.** **Analyse and connect a variety of data and information to identify and explain patterns, trends, relationships and anomalies.**	
	• Identify patterns (similarities and differences in findings) and connections in data, from their observations and secondary sources. • Construct and use a range of representations, including graphs,	• Identify patterns (similarities and differences in findings) and connections in data, from their observations and secondary sources and describe relationships.	• Compare and contrast data from several sources to analyse cause and effect relationships and develop scientific explanations of the data. • Construct and interpret a range of representations, including graphs,	• Compare and contrast data from several sources to analyse and explain cause and effect relationships and create supported scientific explanations of the data.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
	tables, charts, keys, and models, and use digital technologies as appropriate to represent and analyse patterns, trends or relationships in data. • Identify anomalies and state their effect on observed patterns or relationships. • Develop a model using an analogy to describe a scientific concept or event and explain how relative it is to real life. • Make inferences from observations gathered and identify correlational and causal relationships. • Describe mathematical concepts and processes such as ratio, percent, basic operations, statistics and proportional reasoning. • Use appropriate conventions and formats in their representations (for example, table headings, graph type, correct axis for variables, scales and units).	• Construct and use a range of representations, including graphs, tables, maps, charts, keys, and models, and use digital technologies as appropriate to represent and analyse patterns, trends or relationships in data. • Identify anomalies within primary data and describe their effect on observed patterns or relationships. • Develop a model to predict and describe a scientific concept and state how relative it is to real life in scale (temporal and spatial). • Make inference from observations and analyse and interpret graphical displays of data and large data sets to distinguish correlational and causal relationships. • Describe mathematical concepts and processes such as ratio, percent, basic operations, simple algebra, statistics and probability. • Use appropriate conventions and formats in their representations (for example, table headings, graph type, correct axis for independent and dependent variables, scales and units).	tables, maps, charts, keys and models, and use digital technologies as appropriate to represent and analyse patterns, trends or relationships in data. • Identify anomalies and outliers within primary and secondary data and describe their effect on observed patterns and relationships. • Develop a model based on evidence to illustrate the relationships within and between systems and state assumptions between the model and real life. • Explain the strengths and limitations of representations such as physical and virtual models, diagrams and simulations. • Make inferences from observations, analyse, and interpret graphical displays of data and large data sets to identify linear and nonlinear relationships. • Describe mathematical concepts and processes such as ratio, rate, percent, simple algebra, measures of central tendency (mean, mode and median), statistics and probability.	• Construct and interpret a range of representations, including graphs, tables, maps, charts, keys and models, and use digital technologies as appropriate to represent and analyse patterns, trends or relationships in data. • Identify and explain anomalies and outliers within primary and secondary data and explain their effect on observed patterns and relationships. • Develop and use a model (mathematical, physical or virtual) to generate data to support explanations and predict phenomena while analysing the assumptions, merits and limitations. • Make inferences from observations, analyse, and interpret graphical displays of data and large data sets to identify linear and nonlinear relationships. • Describe mathematical concepts and processes such as ratio, rate, percent, algebra, measures of central tendency (mean, mode and median), statistics, and probability. • Explain the strengths and limitations of representations such as physical, mathematical and virtual models, diagrams and simulations.
Evaluating Students learn to consider the quality of available evidence, and the merit or significance of a claim, proposition, explanation or argument with reference to that evidence. Students engage in the	**Key idea: Patterns, order and organisation** Patterns can be used to identify cause and effect relationships and be used in the development of explanations, decision-making and designed solutions.		**Key idea: Patterns, order and organisation** Patterns in systems can be observed at different scales and can be evaluated mathematically. **Key idea: Systems** Models can be used to analyse the behaviour of a system, but evidence may have limited precision and reliability due to the assumptions and approximations inherent in models affecting decision-making and designed solutions.	

Sub-strands:	Year 7	Year 8	Year 9	Year 10
practices involved in refining and revising scientific ideas. In this sub-strand, students develop the core concept that: • evaluating evidence enables development of explanations, decision-making and designed solutions.	**Analyse methods, conclusions and claims for assumptions, possible sources of error, conflicting evidence and unanswered questions.** **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.**		**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.** **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.**	
	• Consider the spread of repeated measurements and observations. • Identify assumptions and possible sources of error and suggest improvements to the method and quality of the results. • Use scientific understanding to identify intended relationships and draw on evidence to reach simple conclusions. • Construct an argument supported by evidence and logic, not on personal beliefs, to support a conclusion or claim. • Describe the process used to determined that a primary or secondary source was credible. • Investigate the cultural, historical and archaeological evidence used in the scientific debate about the role of early First Nations Australians.	• Evaluate the accuracy of the method for collecting data and consider the spread of repeated measurements and observations. • Identify assumptions and possible sources of error in the method, control of variables, and measurements recorded and describe how the method could be improved. • Use results and quantitative relationships in the data to draw conclusions related to scientific concepts and consider ethical implications to support their explanations. • Evaluate the quality of evidence of primary and secondary sources used when constructing an argument to support a conclusion or claim. • Demonstrate an awareness of assumptions and bias in their work and secondary sources. • Acknowledge and consider the ethical issues and cultural protocols when using or citing secondary data.	• Evaluate the validity and reproducibility of the method for collecting data and consider the sample size, the spread of repeated measurements and observations. • Identify assumptions and limitations of the method and the need for further controlled variables. • Identify sources of errors and suggest modifications to the method to improve the quality of data. • Use knowledge of science concepts and data as evidence to draw a conclusion and justify their explanation, considering ethical implications. • Construct a scientific argument using evidence that has been identified as valid and credible, using a range of reliable sources, to support a conclusion or claim. • Explain the reliability, credibility and bias in using secondary sources and the implications for science communications. • Acknowledge the need to critically analyse scientific literature for potential cultural bias in relation to First Nations Australians.	• Evaluate the validity and reproducibility of the method for collecting data and justify the sample size, the spread of repeated measurements and observations. • Identify assumptions and distinguish between random and systematic errors and uncertainty. • Evaluate the effectiveness of their method to achieve desired outcomes and suggest improvements, giving reasons to how these will increase the accuracy and precision of data. • Use knowledge of science concepts and consider a variety of evidence to draw a conclusion and consider ethical implications to generalise their explanation. • Present a scientific argument that has a range of evidence, including evidence of others, to support a conclusion or claim. • Explain the reliability, credibility and bias in using secondary sources and describe any social, ethical and environmental implications. • Acknowledge the need to critically analyse scientific literature for potential cultural bias in relation to First Nations Australians.

Sub-strands:	Year 7	Year 8	Year 9	Year 10
Communicating Students learn to convey information or ideas to others in ways appropriate to the purpose and audience. Students engage in the practices involved in effective and purposeful communication for a range of audiences. In this sub-strand, students develop the core concept that: • critiquing and communicating science ideas effectively is critical to advancing science and influencing environmental, social and economic futures.	**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.**		**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.**	
	• Read, listen and create scientific texts to communicate science ideas, methods, findings and explanations using scientific terms and language, symbols and science conventions. • Construct, use, and present an argument supported by evidence and scientific reasoning. • Create an informative, causal explanation using representations based on findings. Ensure multi-source research is used to effectively communicate reliable information. • Create persuasive and imaginative text for a specific audience to convey scientific knowledge. • Create an investigative report incorporating diagrams and graphical representations as appropriate and include examination of the accuracy and reproducibility of the data. • Use digital tools when appropriate to represent scientific ideas.	• Read, listen and create a variety of scientific texts to communicate science ideas, methods, findings and explanations using scientific terms and language, symbols and science conventions (including SI units). • Identify the role of active and passive voice in scientific writing. • Explain that acceptance of an idea depends on evidence and argument to support or refute an explanation, and that ideas are contestable. • Create an informative, causal explanation using representations based on findings. Ensure multi-source research is used to effectively communicate reliable information. • Create persuasive and imaginative text for a specific audience to convey scientific knowledge. • Create an investigative report using appropriate scientific conventions and representations, including a discussion of how assumptions and possible sources of error may have affected the results. • Use digital tools to communicate scientific ideas and explanations.	• Read, listen and create a variety of scientific texts to communicate science ideas, methods, findings and explanations using scientific terms and language, symbols and science conventions (including SI units and significant figures). • Selectively use active and passive voice in scientific writing and content. • Discuss both strengths and weaknesses of science applications in developing an argument to support or refute a model for a phenomenon or a solution to a problem. • Create an informative report based on primary or secondary evidence and data using representations, explanations and arguments. Consider bias, credibility and reliability of multi-source research. • Create persuasive text for a specific purpose and audience to communicate explanatory power of scientific ideas creatively, such as using analogies and metaphors. • Create an investigative report that includes an introductory paragraph explaining or referencing scientific theories, processes, or other related knowledge that provides background information on the investigation. • Using digital tools to create or present scientific explanations and solutions to problems.	• Read, listen and create a variety of scientific texts to communicate science ideas, methods, findings and explanations using scientific terms and language, symbols and science conventions (including SI units and significant figures). • Critique the appropriateness of content for an audience and the role of active and passive voice in scientific writing. • Construct evidence-based arguments or counter arguments and engage in debate about scientific ideas using several representations including mathematical and symbolic forms. • Create an informative report based on primary or secondary evidence and data, using representations, explanations and arguments. Consider bias, credibility and reliability of multi-source research. • Create persuasive text for a specific purpose and audience to communicate explanatory power of scientific ideas creatively, such as using analogies and metaphors. • Create an investigative report using relevant data and observations reported in the results and include 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. • Use digital tools to create or present scientific explanations, solutions to problems and comparisons and contrasts of different perspectives.