Science scope and sequence: Levels 7 to 10

| **Levels 7 and 8** | **Levels 9 and 10** |
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| **Achievement standard** |  |  |  |  |
| By the end of Level 8, students explain how new evidence can lead to changes in scientific knowledge. They discuss how people with different understandings, skills, perspectives and worldviews have worked in multidisciplinary teams to develop scientific knowledge. They discuss the relevant ethical, environmental, social and economic considerations associated with a proposed scientific response to a selected socio-scientific issue. They analyse the importance of science communication in shaping viewpoints, policies and regulations. Students explain how biological diversity is ordered and organised. They explain the role of specialised cell structures and organelles in cellular function, and distinguish between cells in selected examples of plants and animals, and unicellular and multicellular organisms. They analyse the relationship between structure and function at organ and body system levels for a selected plant and an animal, and explain how a disorder in the cells, tissues or organs of these systems affects the survival of each organism. They represent flows of matter and energy in ecosystems and use real and hypothetical scenarios and population data to interpret and predict the effects of environmental changes. They use the particle and kinetic theories of matter to explain the structure, properties and behaviour of substances. They distinguish between pure substances and mixtures, and design procedures to separate mixtures. They classify and represent matter as elements, compounds or mixtures, and distinguish between physical and chemical changes. They distinguish between renewable and non-renewable resources, evaluate the sustainable use of different resources, and compare the benefits and risks of resource extraction and energy production. They apply the theory of plate tectonics to explain geological phenomena including volcanoes, earthquakes, mountain formation and the distribution of earthquakes and volcanic zones around the globe. They explain how the properties of rocks relate to their formation and influence their use. They model the Earth–Sun–Moon system’s cyclic changes to explain the observable phenomena of seasons and tides. They demonstrate how simple machines can be used for a purpose. They represent and explain the effects of forces acting on objects. They compare different forms of energy and represent energy transfers and transformations in simple systems. They undertake a household energy audit and propose ways to decrease energy consumption. They design and construct series and parallel circuits, and observe and make predictions about voltage and current and about energy transfer in the circuits.Students develop hypotheses and make reasoned predictions to identify patterns, test relationships and analyse and evaluate scientific models when investigating phenomena at various scales. They plan a range of reproducible scientific investigations, document procedures and identify potential ethical issues and intercultural considerations required for fieldwork or use of secondary data. They select and use equipment to generate and record data with precision. They select and construct appropriate representations to organise and process data and information. They analyse and connect data and information to identify and explain patterns, trends, relationships and anomalies. They identify assumptions and sources of error in methods and analyse conclusions and claims with reference to conflicting evidence and unanswered questions. They provide science-based explanations for findings, and use evidence to support conclusions and evaluate claims. They select and use appropriate presentation formats, scientific vocabulary, models and other representations when communicating their ideas, findings and arguments for specific purposes to specific audiences. | By the end of Level 10, students analyse the importance of different scientific methods, critique, replication, publication and peer review in the development of scientific knowledge. They examine the relationship between science, engineering and technologies. They examine how different projected outcomes of the application of scientific knowledge to a selected socio-scientific issue may lead to varied support from individuals and groups in society. They discuss how scientific information and misinformation may inform personal and social decision-making and influence priorities for scientific research. Students describe how the processes of sexual and asexual reproduction enable survival of the species. They explain the processes that underpin heredity and genetic diversity, and predict the outcomes of monohybrid crosses. They explain how the nervous and endocrine systems use negative feedback to support homeostasis in the body’s internal environment. They distinguish between infectious and non-infectious disease, and compare different infectious disease control measures. They describe the evidence supporting the theory of evolution by natural selection. They explain how ideas about the structure of the atom have changed over time, and model natural radioactive decay to illustrate how stable atoms are formed. They describe patterns and trends in the periodic table. They demonstrate the Law of Conservation of Mass in chemical reactions, and write word and balanced chemical equations for these reactions. They classify energy changes in chemical reactions as exothermic or endothermic. They predict the products of reactions and the effect of changing reaction conditions. They explain how interactions within and between Earth’s interrelated systems affect the carbon cycle. They describe trends in patterns of global climate change and propose strategies to mitigate contributing factors. They discuss the advantages and disadvantages of space exploration. They distinguish between different features in the universe and sequence key events in the origin and evolution of the universe, including an outline of the supporting evidence for the big bang theory. They explain how wave and particle models describe energy transfer, and compare the properties, features and applications of waves. They analyse and represent energy conservation, including efficiency, in systems, and model how different forms of energy are transformed into electrical energy. They use Newton’s laws to describe and predict the motion of objects in a system. Students formulate and refine questions and hypotheses to make reasoned predictions, test relationships and develop explanatory models when investigating scientific questions, problems and claims. They plan a range of valid, reproducible and safe scientific investigations and explain how they have addressed any ethical and cultural considerations when generating or using primary and secondary data. They select and use equipment to generate and record data, ensuring the use of suitable sample sizes and assessing the precision of multiple measurement readings. They select and construct a range of appropriate representations to organise, process and summarise data and information. They analyse and compare a variety of data and information to identify and explain qualitative and quantitative patterns, trends, relationships, assumptions and anomalies. They evaluate the validity and reproducibility of investigation methods including ways to improve the quality of data, and the validity of conclusions and claims. They provide evidence-based explanations for findings and construct logical arguments based on the evaluation of multiple sources of evidence to justify conclusions and assess claims. They select and use appropriate presentation formats, scientific content, vocabulary, models, conventions, formulas and other representations to achieve their purpose when communicating and justifying their ideas, findings, arguments and proposals to diverse audiences. |
| Content descriptions |
| Strand: Science as a Human Endeavour  |
| Sub-strand: Nature and development of science |
| *Students learn that:* |
| scientific knowledge, including models and theories, can change because of new evidenceVC2S8H01 | scientific knowledge is contestable and is validated and refined over time through expanding scientific methods, replication, publication, peer review and consensusVC2S10H01 |
| multidisciplinary endeavours to advance scientific knowledge make use of people’s different perspectives and worldviewsVC2S8H02 | advances in technologies have enabled advances in science, while science has contributed to developments in technologies and engineeringVC2S10H02 |
| proposed scientific responses to socio-scientific issues impact on society and may involve ethical, environmental, social and economic considerationsVC2S8H03 | the use of scientific knowledge to address socio-scientific issues and shape a more sustainable future for humans and the environment may have diverse projected outcomes that affect the extent to which scientific knowledge and practices are adopted more broadly by societyVC2S10H03 |
| communication of scientific knowledge has a role in informing individual viewpoints, and community policies and regulationsVC2S8H04 | scientific knowledge may be interpreted in different ways by individuals and groups in society; the values and needs of society can influence the focus of scientific researchVC2S10H04 |
| Strand: Science Understanding |
| Sub-strand: Biological sciences |
| *Students learn that:* |
| there are similarities and differences within and between groups of organisms living on Earth; the development and use of classification tools, including dichotomous keys, help order and organise human understanding of the diversity of lifeVC2S8U01 |  |
| cell theory describes cells as the basic units of life; organisms may be unicellular or multicellular and have specialised structures and organelles (including cell walls, cell membranes, cytoplasm, nuclei containing DNA, mitochondria, ribosomes, chloroplasts and vacuoles) that perform specific functions VC2S8U02 | infectious and non-infectious diseases are caused by different organisms and agents; measures to control the transmission of infectious diseases include personal hygiene, quarantine protocols, medical treatment and public education programsVC2S10U03 |
| the structure of cells, tissues and organs in a plant and an animal organ system are related to their function; plant and animal organ systems enable survival of the organismVC2S8U03 | the nervous and endocrine systems work together to regulate and coordinate the body’s response to stimuli, ensuring homeostasis, including through negative feedback mechanismsVC2S10U02 |
|  | the structures of reproductive cells and organs in plants and animals are related to their functions; processes of sexual and asexual reproduction enable survival of a speciesVC2S10U01 |
| genetic inheritance involves the function of DNA, chromosomes, genes and alleles, and the roles of mitosis and meiosis in passing on genetic information to the next generation; the principles of Mendelian inheritance can be used to predict ratios of genotypes and phenotypes in monohybrid crosses involving dominant and recessive traitsVC2S10U04 |
|  | the theory of evolution by natural selection includes the processes of variation, isolation and adaptation and is supported by evidence including the fossil record, biogeography and comparative embryology; the theory explains past and present biodiversity and demonstrates how all organisms have some degree of relatedness to each otherVC2S10U05 |
| matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids; populations will be affected by changing biotic and abiotic factors in an ecosystem including habitat loss, climate change, seasonal migration and introduction or removal of speciesVC2S8U04 |  |
| Sub-strand: Chemical sciences |
| *Students learn that:* |
| the particle and kinetic theories of matter can be used to describe the arrangement and motion of particles in a substance, including the attraction between particles, and to explain the properties and behaviour of substances, including melting point, boiling point, density, compressibility, gas pressure, viscosity, diffusion, sublimation, and expansion and contractionVC2S8U05 | the organisation of the elements in the periodic table is related to the structure and properties of atoms; patterns and trends include the significance of rows and periods, metallic and non-metallic properties, atomic size and reactivity VC2S10U07 |
| matter can be classified as pure substances such as elements and compounds or impure substances such as mixtures (including solutions), and can be modelled using the particle model; mixtures may have a uniform (homogeneous) or non-uniform (heterogeneous) composition and can be separated based on the properties of their components using techniques including filtration, decantation, evaporation, crystallisation, magnetic separation, distillation and chromatographyVC2S8U06 |  |
| the atomic theory of matter can be used to model and explain the difference between elements, compounds and mixtures; elements, compounds and mixtures can be represented as two-dimensional and three-dimensional models, elements can be represented by symbols, and molecules and compounds can be represented by chemical formulasVC2S8U07 | the model of the atom changed following the discovery of electrons, protons and neutrons; natural radioactive decay results in a change from unstable to stable atomsVC2S10U06 |
| physical changes can be distinguished from chemical changes; a chemical change can be identified by a colour change, a temperature change, the production of a gas (including laboratory preparation and testing of oxygen, carbon dioxide and hydrogen gases) or the formation of a precipitate VC2S8U08 | chemical reactions are described by the Law of Conservation of Mass and involve the rearrangement of atoms; they can be modelled using a range of representations, including word and simple balanced chemical equationsVC2S10U08 |
| chemical reactions include synthesis, decomposition and displacement reactions and can be classified as exothermic or endothermic; reaction rates are affected by factors including temperature, concentration, surface area of solid reactants, and catalystsVC2S10U09 |
| Sub-strand: Earth and space sciences |
| *Students learn that:* |
| the sustainable use of Earth’s resources is influenced by whether the resources are renewable or non-renewable; the processes involved in resource extraction and energy production come with both benefits and risks to sustainabilityVC2S8U09 |  |
| key processes of the rock cycle occur over different timescales; the properties of sedimentary, igneous and metamorphic rocks not only reflect their formation but also impact their usefulness and determine the methods used when minedVC2S8U11 | carbon is cycled on Earth through key processes including photosynthesis, respiration, fire, weathering, vulcanism and the combustion of fossil fuels; these processes change the composition of Earth’s interrelated systems (atmosphere, biosphere, hydrosphere and lithosphere) over timeVC2S10U10 |
| Earth is a dynamic planet as demonstrated by tectonic activity, including the formation of geological features at divergent, convergent and transform plate boundaries; the theory of plate tectonics is supported by scientific evidenceVC2S8U10 |
|  | the dynamics of global climate change can be modelled and explained by examining the interactions between greenhouse gas emissions and energy exchanges within and between Earth’s systems; mitigating human-induced climate change requires addressing various activities including power generation, deforestation, manufacturing, transportation, food production and resource consumption VC2S10U11 |
| cyclic changes in the relative positions of Earth, the Sun and the Moon can be modelled to show how these cycles cause eclipses and influence predictable phenomena on Earth, including seasons and tidesVC2S8U12 | space exploration seeks to expand knowledge of the origins and structure of the universe and to resolve the challenges of humans travelling and living away from Earth’s surfaceVC2S10U12 |
| the universe contains features including galaxies, stars, solar systems and black holes; the big bang theory models the origin and evolution of the universe and is supported by evidenceVC2S10U13 |
| Sub-strand: Physical sciences |
| *Students learn that:* |
| simple machines, including the lever, inclined plane, wedge, pulley, screw, and wheel and axle, alter the direction and magnitude of forces VC2S8U13 |  |
| balanced and unbalanced forces acting on objects, including gravitational force, may be investigated and represented using force diagrams; changes in an object’s motion can be related to its mass and the magnitude and direction of the forces acting on itVC2S8U14 | Newton’s laws of motion can be used to quantitatively analyse the relationship between force, mass and acceleration of objects VC2S10U17 |
| energy exists in different forms, including thermal, chemical, gravitational and elastic, and may be classified as kinetic or potential; energy transfers (conduction, convection and radiation) and transformations occur in simple systems and can be analysed in terms of energy efficiency VC2S8U15 | wave and particle models can be used to describe energy transfer (conduction, convection and radiation) through different media; waves (electromagnetic and mechanical) have different properties, features (including amplitude, wavelength, frequency and speed) and applicationsVC2S10U14 |
| household energy consumption can be analysed using an energy audit and is affected by appliance choice, building design, season and climateVC2S8U16 | the Law of Conservation of Energy can be analysed in systems, including Earth systems, by assessing the efficiency of energy inputs, outputs, transfers and transformationsVC2S10U15 |
| electrical circuits transfer energy when current flows and can be designed for diverse purposes using different components; the operation of circuits can be explained using the concepts of voltage and currentVC2S8U17 | electricity can be generated as alternating current (AC) using magnets (via turbines turned by wind, water, tides or steam that is generated by the combustion of oil, gas or coal or by nuclear energy) or as direct current (DC) using photovoltaic cells or batteriesVC2S10U16 |
| Strand: Science Inquiry  |
| Sub-strand: Questioning and predicting |
| *Students learn that:* |
| investigable questions, reasoned predictions and hypotheses can be developed in guiding investigations to identify patterns, test relationships and analyse and evaluate scientific modelsVC2S8I01 | investigable questions, reasoned predictions and hypotheses can be used in guiding investigations to test and develop explanatory models and relationshipsVC2S10I01 |
| Sub-strand: Planning and conducting |
| *Students learn that:* |
| reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying independent, dependent and controlled variables where applicable, stating assumptions, recognising and managing risks, considering ethical issues and following protocols when accessing cultural sites and artefacts on Country and PlaceVC2S8I02 | valid, reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying and controlling for possible sources of error and bias in sampling or in making observations; safe, ethical investigations include undertaking risk assessments and following protocols when accessing cultural sites and artefacts on Country and PlaceVC2S10I02 |
| equipment can be selected and used to generate and record data with attention to precision, using digital tools as appropriate VC2S8I03 | equipment can be selected and used to generate and record data sets that show precision, including consideration of sample size and using digital tools as appropriate VC2S10I03 |
| Sub-strand: Processing, modelling and analysing |
| *Students learn that:* |
| data and information can be organised and processed by selecting and constructing representations including tables, graphs, keys, models and mathematical relationshipsVC2S8I04 | data and information can be organised, processed and summarised by selecting and constructing representations including tables, graphs, descriptive statistics, models, symbols, formulas and mathematical relationshipsVC2S10I04 |
| information and processed data can be analysed to show patterns, trends and relationships, and to identify anomaliesVC2S8I05 | information and processed data can be analysed and compared to identify and explain qualitative and quantitative patterns, trends, relationships and anomaliesVC2S10I05 |
| Sub-strand: Evaluating |
| *Students learn that:* |
| scientific methods, conclusions and claims can be analysed to identify assumptions, possible sources of error, conflicting evidence and unanswered questionsVC2S8I06 | the validity and reproducibility of investigation methods and the validity of conclusions and claims can be evaluated, including by identifying assumptions, conflicting evidence, biases that may influence observations and conclusions, sources of error and areas of uncertaintyVC2S10I06 |
| evidence-based arguments can be constructed to support conclusions or evaluate claims, including consideration of ethical issues and protocols associated with using or citing secondary data or informationVC2S8I07 | arguments based on a variety of evidence can be constructed to support conclusions or evaluate claims, including consideration of any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information VC2S10I07 |
| Sub-strand: Communicating |
| *Students learn that:* |
| communicating ideas, findings and arguments for specific purposes and audiences involves the selection and use of appropriate presentation formats, scientific vocabulary, models and other representations, and may include the use of digital toolsVC2S8I08 | communicating and justifying scientific ideas, findings and arguments for diverse audiences involves the selection of appropriate presentation formats, content, scientific vocabulary, conventions, models and other representations, and may include the use of digital tools VC2S10I08 |