The Australian
Curriculum

Learning areas	(Version 8.4)
Subjects	Earth and Environmental Science (Version 8.4), Geography (Version 8.4)
Year levels	Unit 1,Unit 2,Unit 3,Unit 4,Bridging Unit 1,Bridging Unit 2,Bridging Unit 3,Bridging Unit 4,Unit 1: Investigating the Ancient World,Unit 2: Ancient Societies,Unit 3: People, Power and Authority,Unit 4: Reconstructing the Ancient World,Unit 1: Natural and ecological hazards,Unit 2: Sustainable places,Unit 3: Land cover transformations,Unit 4: Global transformations,Unit 1: Understanding the Modern World,Unit 2: Movements for Change in the 20th century,Unit 3: Modern Nations in the 20th century,Unit 4: The Modern World since 1945

acara AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

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The Australian Curriculum

Science (Version 8.4)

Science - How the Learning Area works

Overview of senior secondary Australian Curriculum

ACARA has developed a senior secondary Australian Curriculum for English, Mathematics, Science and Humanities and Social Sciences.

The senior secondary Australian Curriculum specifies content and achievement standards for each senior secondary subject. Content refers to the knowledge, understanding and skills to be taught and learned within a given subject. Achievement standards refer to descriptions of the quality of learning (the depth of understanding, extent of knowledge and sophistication of skill) expected of students who have studied the content for the subject.

The senior secondary Australian Curriculum for each subject has been organised into four units. The last two units are cognitively more challenging than the first two units. Each unit is designed to be taught in about half a 'school year' of senior secondary studies (approximately 50–60 hours duration including assessment and examinations). However, the senior secondary units have also been designed so that they may be studied singly, in pairs (that is, year-long), or as four units over two years.

State and territory curriculum, assessment and certification authorities are responsible for the structure and organisation of their senior secondary courses and will determine how they will integrate the Australian Curriculum content and achievement standards into their courses. They will continue to be responsible for implementation of the senior secondary curriculum, including assessment, certification and the attendant quality assurance mechanisms. Each of these authorities acts in accordance with its respective legislation and the policy framework of its state government and Board. They will determine the assessment and certification specifications for their local courses that integrate the Australian Curriculum content and achievement standards and any additional information, guidelines and rules to satisfy local requirements including advice on entry and exit points and credit for completed study.

The senior secondary Australian Curriculum for each subject should not, therefore, be read as a course of study. Rather, it is presented as content and achievement standards for integration into state and territory courses.

Senior secondary Science subjects

The Australian Curriculum senior secondary Science subjects build on student learning in the Foundation to Year 10 Science curriculum and include:

- Biology
- Chemistry
- Earth and Environmental Science
- Physics.

Representation of General capabilities

Literacy is important in students’ development of *Science Inquiry Skills* and their understanding of content presented through the *Science Understanding* and *Science as a Human Endeavour* strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy is key to students' ability to apply a wide range of *Science Inquiry Skills*, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which Earth systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and Communication Technology (ICT) capability is a key part of *Science Inquiry Skills*. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of *Science as a Human Endeavour* concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop *Science Understanding* and *Science Inquiry Skills.* They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and social capability is integral to a wide range of activities in Earth and Environmental Science, as students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of *Science as a Human Endeavour,* students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people's lives.

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural understanding is fundamental to understanding aspects of *Science as a Human Endeavour*, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011*, in addition to relevant state or territory health and safety guidelines.

When state and territory curriculum authorities integrate the Australian Curriculum into local courses, they will include more specific advice on safety.

For further information about relevant guidelines, contact your state or territory curriculum authority.

Animal ethics

Through a consideration of research ethics as part of Science Inquiry Skills, students will examine their own ethical position, draw on ethical perspectives when designing investigation methods, and ensure that any activities that impact on living organisms comply with the *Australian code of practice for the care and use of animals for scientific purposes 7th edition* (2004) (http://www.nhmrc.gov.au/guidelines/publications/ea16).

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes 7th edition*, in addition to relevant state or territory guidelines.

When state and territory curriculum authorities integrate the Australian Curriculum into local courses, they will include more specific advice on the care and use of, or interaction with, animals.

For further information about relevant guidelines or to access your local Animal Ethics Committee, contact your state or territory curriculum authority.

Glossary

Accuracy

The extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty.

Animal ethics

Animal ethics involves consideration of respectful, fair and just treatment of animals. The use of animals in science involves consideration of replacement (substitution of insentient materials for conscious living animals), reduction (using only the minimum number of animals to satisfy research statistical requirements) and refinement (decrease in the incidence or severity of ‘inhumane’ procedures applied to those animals that still have to be used).

Biogeochemical cycles

Pathways by which chemical substances move through the biosphere, lithosphere, atmosphere, and hydrosphere.

Biosecurity

Policy and regulatory frameworks designed to safeguard against biological threats to environments, organisms and human health; biosecurity measures aim to restrict entry of disease causing agents, genetically modified species, or invasive alien species or genotypes.

Biotechnology

The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for human purposes.

Comparative genomics

The study and comparison of the genome sequences of different species; comparative genomics enables identification of genes that are conserved or common among species, as well as genes that give each organism its unique characteristics.

Data

The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.

Ecological survey techniques

Techniques used to survey, measure, quantify, assess and monitor biodiversity and ecosystems in the field; techniques used depend on the subject and purpose of the study. Techniques may include random quadrats, transects, capture - recapture, nest survey, netting, trapping, flight interception, beating trays, dry extraction from leaf litter samples, 3-minute habitat-proportional sampling of aquatic habitats, aerial surveys and soil, air and water sampling.

Evidence

In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.

Field work

Observational research undertaken in the normal environment of the subject of the study.

Genre

The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).

Hypothesis

A tentative explanation for an observed phenomenon, expressed as a precise and unambiguous statement that can be supported or refuted by experiment.

Investigation

A scientific process of answering a question, exploring an idea or solving a problem that requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.

Law

A statement describing invariable relationships between phenomena in specified conditions, frequently expressed mathematically.

Measurement error

The difference between the measurement result and a currently accepted or standard value of a quantity.

Media texts

Spoken, print, graphic or electronic communications with a public audience. Media texts can be found in newspapers, magazines and on television, film, radio, computer software and the internet.

Mode

The various processes of communication – listening, speaking, reading/viewing and writing/creating.

Model

A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.

Population

A group of organisms of one species that interbreed and live in the same place at the same time.

Primary data

Data collected directly by a person or group.

Primary source

Report of data created by the person or persons directly involved in observations of one or more events, experiments, investigations or projects.

Reliability

The degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results for the same population.

Reliable data

Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results for the same population.

Representation

A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.

Research

To locate, gather, record, attribute and analyse information in order to develop understanding.

Research ethics

Norms of conduct that determine ethical research behaviour; research ethics are governed by principles such as honesty, objectivity, integrity, openness and respect for intellectual property and include consideration of animal ethics.

Risk assessment

Evaluations performed to identify, assess and control hazards in a systematic way that is consistent, relevant and applicable to all school activities. Requirements for risk assessments related to particular activities will be determined by jurisdictions, schools or teachers as appropriate.

Secondary data

Data collected by a person or group other than the person or group using the data.

Secondary source

Information that has been compiled from records of primary sources by a person or persons not directly involved in the primary event.

Simulation

A representation of a process, event or system which imitates a real or idealised situation.

System

A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.

Theory

A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.

Uncertainty

Range of values for a measurement result, taking account of the likely values that could be attributed to the measurement result given the measurement equipment, procedure and environment.

Validity

The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.

Algebraic representation

A set of symbols linked by mathematical operations; the set of symbols summarise relationships between variables.

Anomalous data

Data that does not fit a pattern; outlier.

Green chemistry

Chemistry that aims to design products and processes that minimise the use and generation of hazardous substances and wastes. Principles of green chemistry include prevention of waste; atom economy; design of less toxic chemicals and synthesis methods; use of safer solvents and auxiliaries; design for energy efficiency; use of renewable feedstocks; reduction of unnecessary derivatives; use of catalytic reagents rather than stoichiometric reagents; design for degradation; design of in-process analysis for pollution prevention; and safer chemistry for accident prevention.

Random error

Uncontrollable effects of the measurement equipment, procedure and environment on a measurement result; the magnitude of random error for a measurement result can be estimated by finding the spread of values around the average of independent, repeated measurements of the quantity.

Significant figures

The use of place value to represent a measurement result accurately and precisely.

Systematic error

The contribution to the uncertainty in a measurement result that is identifiable and quantifiable, for example, imperfect calibration of measurement instruments.

Biomass

The mass of living matter (microbial, plant and animal) in a given environmental area.

Biomass pyramid

A representation of the total biomass at each trophic level within a system.

Biophysical interactions

Interaction between the biotic and abiotic elements of the atmosphere, hydrosphere, lithosphere and biosphere.

Carrying capacity

The largest number of individuals (within populations) that can be supported by the ecosystem.

Environmental sampling techniques

Techniques used to survey, measure, quantify, assess and monitor biotic and abiotic components of the environment and their interactions; techniques used depend on the subject and purpose of the study and may include: random quadrats, transects, grid arrays, netting, trapping, aerial surveys and rock, soil, air and water sampling.

Field metering equipment

Tools used in the field to measure and record environmental parameters including light meters, weather stations, electromagnetic induction (EMI) meters, magnetometers and radioactivity sensors.

Mapping and field location techniques

Techniques used in the field to describe the field location and to measure and record data and field observations, including use of maps, global positioning system (GPS), magnetic compasses and electronic devices with geopositioning capacity (for example, cameras).

Spatial analysis

The range of techniques used to examine imagery and datasets covering large spatial areas and commonly compiled in geographical information systems (GIS) including maps, satellite imagery, aerial photographs, geophysical data sets, water or rock samples and other directly sensed data.

Stratigraphy

Study of rock layers and layering of materials such as sediments including ash, meteoritic impact ejecta layers, and soils.

Tectonic plate supercycle

The cycling of Earth over a period of 400 to 600 million years from a single continent and ocean with an inferred icehouse climate to many continents and oceans with a moderate to warm climate.

Absolute uncertainty

Estimate of the dispersion of the measurement result; the range of values around the measurement result that is most likely to include the true value.

Fundamental forces

Four fundamental forces have been identified. They are, in order from strongest to weakest, the strong, electromagnetic, weak and gravity forces.

Measurement discrepancy

The difference between the measurement result and a currently accepted or standard value of a quantity.

Simple reaction diagrams

A visual representation of reactions between subatomic particles. In the diagram, time runs from left to right. The lines represent particles and the circle represents the reaction process. Antiparticles have the time arrow reversed.

Abstract

Abstract scenario: a scenario for which there is no concrete referent provided.

Account

Account for: provide reasons for (something).
Give an account of: report or describe an event or experience.
Taking into account: considering other information or aspects

Analyse

Consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.

Apply

Use, utilise or employ in a particular situation.

Assess

Determine the value, significance or extent of (something).

Coherent

Orderly, logical, and internally consistent relation of parts.

Communicates

Conveys knowledge and/or understandings to others.

Compare

Estimate, measure or note how things are similar or dissimilar.

Complex

Consisting of multiple interconnected parts or factors.

Considered

Formed after careful thought.

Critically analyse

Examine the component parts of an issue or information, for example the premise of an argument and its plausibility, illogical reasoning or faulty conclusions.

Critically evaluate

Evaluation of an issue or information that includes considering important factors and available evidence in making critical judgement that can be justified.

Deduce

Arrive at a conclusion by reasoning.

Demonstrate

Give a practical exhibition as an explanation.

Describe

Give an account of characteristics or features.

Design

Plan and evaluate the construction of a product or process.

Develop

In history: to construct, elaborate or expand.
In English: begin to build an opinion or idea.

Discuss

Talk or write about a topic, taking into account different issues and ideas.

Distinguish

Recognise point/s of difference.

Evaluate

Provide a detailed examination and substantiated judgement concerning the merit, significance or value of something.
In mathematics: calculate the value of a function at a particular value of its independent variables.

Explain

Provide additional information that demonstrates understanding of reasoning and/or application.

Familiar

Previously encountered in prior learning activities.

Identify

Establish or indicate who or what someone or something is.

Integrate

Combine elements.

Investigate

Plan, collect and interpret data/information and draw conclusions about.

Justify

Show how an argument or conclusion is right or reasonable.

Locate

Identify where something is found.

Manipulate

Adapt or change.

Non-routine

Non-routine problems: Problems solved using procedures not previously encountered in prior learning activities.

Reasonableness

Reasonableness of conclusions or judgements: the extent to which a conclusion or judgement is sound and makes sense.

Reasoned

Reasoned argument/conclusion: one that is sound, well-grounded, considered and thought out.

Recognise

Be aware of or acknowledge.

Relate

Tell or report about happenings, events or circumstances.

Represent

Use words, images, symbols or signs to convey meaning.

Reproduce

Copy or make close imitation.

Responding

In English: When students listen to, read or view texts they interact with those texts to make meaning. Responding involves students identifying, selecting, describing, comprehending, imagining, interpreting, analysing and evaluating.

Routine problems

Routine problems: Problems solved using procedures encountered in prior learning activities.

Select

Choose in preference to another or others.

Sequence

Arrange in order.

Solve

Work out a correct solution to a problem.

Structured

Arranged in a given organised sequence.
In Mathematics: When students provide a structured solution, the solution follows an organised sequence provided by a third party.

Substantiate

Establish proof using evidence.

Succinct

Written briefly and clearly expressed.

Sustained

Consistency maintained throughout.

Synthesise

Combine elements (information/ideas/components) into a coherent whole.

Understand

Perceive what is meant, grasp an idea, and to be thoroughly familiar with.

Unfamiliar

Not previously encountered in prior learning activities.

Earth and Environmental Science - How the Subject works

Rationale/Aims

Rationale

Earth and Environmental Science is a multifaceted field of inquiry that focuses on interactions between the solid Earth, its water, its air and its living organisms, and on dynamic, interdependent relationships that have developed between these four components. Earth and environmental scientists consider how these interrelationships produce environmental change at a variety of timescales. To do this, they integrate knowledge, concepts, models and methods drawn from geology, biology, physics and chemistry in the study of Earth's ancient and modern environments. Earth and environmental scientists strive to understand past and present processes so that reliable and scientifically-defensible predictions can be made about the future.

Earth and Environmental Science builds on the content in the Biological and Earth and Space Sciences sub-strands of the Foundation to Year 10 Australian Curriculum: Science. In particular, the subject provides students with opportunities to explore the theories and evidence that frame our understanding of Earth's origins and history; the dynamic and interdependent nature of Earth's processes, environments and resources; and the ways in which these processes, environments and resources respond to change across a range of temporal and spatial scales.

In this subject, the term 'environment' encompasses terrestrial, marine and atmospheric settings and includes Earth's interior. Environments are described and characterised with a focus on systems thinking and multidisciplinarity rather than with a particular ecological, biological, physical or chemical focus. This subject emphasises the way Earth materials and processes generate environments including habitats where organisms live; the natural processes and human influences which induce changes in physical environments; and the ways in which organisms respond to those changes.

Studying senior secondary Science provides students with a suite of skills and understandings that are valuable to a wide range of further study pathways and careers. In this subject, students develop their investigative, analytical and communication skills and apply these to their understanding of science issues in order to engage in public debate, solve problems and make evidence-based decisions about contemporary issues. The knowledge, understanding and skills introduced in this subject will encourage students to become confident, active citizens who can competently use diverse methods of inquiry, and will provide a foundation for further studies or employment in Earth and environmental science-related fields.

Aims

Earth and Environmental Science aims to develop students':

- interest in Earth and environmental science and their appreciation of how this multidisciplinary knowledge can be used to understand contemporary issues
- understanding of Earth as a dynamic planet consisting of four interacting systems: the geosphere, atmosphere, hydrosphere and lithosphere
- appreciation of the complex interactions, involving multiple parallel processes, that continually change Earth systems over a range of timescales
- understanding that Earth and environmental science knowledge has developed over time; is used in a variety of contexts; and influences, and is influenced by, social, economic, cultural and ethical

considerations
- ability to conduct a variety of field, research and laboratory investigations involving collection and analysis of qualitative and quantitative data, and interpretation of evidence
- ability to critically evaluate Earth and environmental science concepts, interpretations, claims and conclusions with reference to evidence
- ability to communicate Earth and environmental understanding, findings, arguments and conclusions using appropriate representations, modes and genres.

Structure of Earth and Environmental Science

Units

In Earth and Environmental Science, students develop their understanding of the ways in which interactions between Earth systems influence Earth processes, environments and resources. There are four units:

- Unit 1: Introduction to Earth systems
- Unit 2: Earth processes - energy transfers and transformations
- Unit 3: Living on Earth - extracting, using and managing Earth resources
- Unit 4: The changing Earth - the cause and impact of Earth hazards.

In Units 1 and 2, students are introduced to the Earth system model and to the ways in which the Earth spheres interact and are related by transfers and transformations of energy. In Unit 1, students examine the evidence underpinning theories of the development of the Earth systems, their interactions and their components. In Unit 2, students investigate how Earth processes involve interactions of Earth systems and are inter-related through transfers and transformations of energy.

In Units 3 and 4, students use the Earth system model and an understanding of Earth processes, to examine Earth resources and environments, as well as the factors that impact the Earth system at a range of spatial and temporal scales. In Unit 3, students examine renewable and non-renewable resources, the implications of extracting, using and consuming these resources, and associated management approaches. In Unit 4, students consider how Earth processes and human activity can contribute to Earth hazards, and the ways in which these hazards can be predicted, managed and mitigated to reduce their impact on Earth environments.

Each unit includes:

- Unit descriptions – short descriptions of the purpose of and rationale for each unit
- Learning outcomes – six to eight statements describing the learning expected as a result of studying the unit
- Content descriptions – descriptions of the core content to be taught and learned, organised into three strands:
    - *Science Inquiry Skills*
    - *Science as a Human Endeavour*
    - *Science Understanding (organised in sub-units).*

Organisation of content

Science strand descriptions

The Australian Curriculum: Science has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding. These strands are used to organise the Science learning area from Foundation to Year 12. In the senior secondary Science subjects, the three strands build on students' learning in the F-10 Australian Curriculum: Science.

In the practice of science, the three strands are closely integrated: the work of scientists reflects the nature and development of science, is built around scientific inquiry, and seeks to respond to and influence society. Students' experiences of school science should mirror this multifaceted view of science. To achieve this, the three strands of the Australian Curriculum: Science should be taught in an integrated way. The content descriptions for *Science Inquiry Skills, Science as a Human Endeavour* and *Science Understanding* have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.

In science investigations, the collection and analysis of data to provide evidence plays a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, prose, keys, spreadsheets and databases. The analysis of data to identify and select evidence, and the communication of findings, involve the selection, construction and use of specific representations, including mathematical relationships, symbols and diagrams.

Through the senior secondary Science subjects, students will continue to develop generic science inquiry skills, building on the skills acquired in the F-10 Australian Curriculum: Science. These generic skills are described below and will be explicitly taught and assessed in each unit. In addition, each unit provides more specific skills to be taught within the generic science inquiry skills; these specific skills align with the *Science Understanding* and *Science as a Human Endeavour* content of the unit.

The generic science inquiry skills are:

- Identifying, researching and constructing questions for investigation; proposing hypotheses; and predicting possible outcomes
- Designing investigations, including the procedure/s to be followed, the materials required and the type and amount of primary and/or secondary data to be collected; conducting risk assessments; and considering ethical research
- Conducting investigations, including using equipment and techniques safely, competently and methodically for the collection of valid and reliable data
- Representing data in meaningful and useful ways; organising and analysing data to identify trends, patterns and relationships; recognising error, uncertainty and limitations in data; and selecting, synthesising and using evidence to construct and justify conclusions
- Interpreting scientific and media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and using reasoning to construct scientific arguments
- Selecting, constructing and using appropriate representations to communicate understanding, solve problems and make predictions
- Communicating to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes.

The senior secondary Science subjects have been designed to accommodate, if appropriate, an extended scientific investigation within each pair of units. States and territories will determine whether there are any requirements related to an extended scientific investigation as part of their course materials.

Science as a Human Endeavour

Through science, we seek to improve our understanding and explanations of the natural world. The *Science as a Human Endeavour* strand highlights the development of science as a unique way of knowing and doing, and explores the use and influence of science in society.

As science involves the construction of explanations based on evidence, the development of science concepts, models and theories is dynamic and involves critique and uncertainty. Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice and can involve the use of international conventions and activities such as peer review.

The use and influence of science are shaped by interactions between science and a wide range of social, economic, ethical and cultural factors. The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As a result, decision making about socio-scientific issues often involves consideration of multiple lines of evidence and a range of stakeholder needs and values. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Across the senior secondary Science subjects, the same set of Science as a Human Endeavour content descriptions is used for Units 1 and 2 of the subjects; and another set for Units 3 and 4. This consistent approach enables students to develop a rich appreciation of the complex ways in which science interacts with society, through the exploration of Science as a Human Endeavour concepts across the subjects and in multiple contexts.

'Examples in context' will be developed to illustrate possible contexts related to *Science Understanding* content, in which students could explore *Science as a Human Endeavour* concepts. These will be made available to complement the final online curriculum. Each Example in context will be aligned to the relevant sub-unit in *Science Understanding* and will include links to the relevant Science as a Human Endeavour content descriptions.

Science Understanding

Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations. Models in science can include diagrams, physical replicas, mathematical representations, word-based analogies (including laws and principles) and computer simulations. Development of models involves selection of the aspects of the system/s to be included in the model, and thus models have inherent approximations, assumptions and limitations.

The *Science Understanding* content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Science understanding can be developed through the selection of contexts that have relevance to and are engaging for students. The Australian Curriculum: Science has been designed to provide jurisdictions, schools and teachers with the flexibility to select contexts that meet the social, geographic and learning needs of their students.

Organisation of achievement standards

The Earth and Environmental Science achievement standards are organised by two dimensions: 'Earth and

Environmental Science Concepts, Models and Applications’ and ‘Earth and Environmental Science Inquiry Skills’. They describe five levels of student achievement.

‘Earth and Environmental Science Concepts, Models and Applications’ describes the knowledge and understanding students demonstrate with reference to the content of the *Science Understanding* and *Science as a Human Endeavour* strands of the curriculum. ‘Earth and Environmental Science Inquiry Skills’ describes the skills students demonstrate when investigating the content developed through the strands of *Science Understanding* and Science as a *Human Endeavour.*

Senior secondary achievement standards have been written for each Australian Curriculum senior secondary subject. The achievement standards provide an indication of typical performance at five different levels (corresponding to grades A to E) following the completion of study of senior secondary Australian Curriculum content for a pair of units. They are broad statements of understanding and skills that are best read and understood in conjunction with the relevant unit content. They are structured to reflect key dimensions of the content of the relevant learning area. They will be eventually accompanied by illustrative and annotated samples of student work/ performance/ responses.

The achievement standards will be refined empirically through an analysis of samples of student work and responses to assessment tasks: they cannot be maintained a priori without reference to actual student performance. Inferences can be drawn about the quality of student learning on the basis of observable differences in the extent, complexity, sophistication and generality of the understanding and skills typically demonstrated by students in response to well-designed assessment activities and tasks.

In the short term, achievement standards will inform assessment processes used by curriculum, assessment and certifying authorities for course offerings based on senior secondary Australian Curriculum content.

ACARA has made reference to a common syntax (as a guide, not a rule) in constructing the achievement standards across the learning areas. The common syntax that has guided development is as follows:

1. Given a specified context (as described in the curriculum content)
2. With a defined level of consistency/accuracy (the assumption that each level describes what the student does well, competently, independently, consistently)
3. Students perform a specified action (described through a verb)
4. In relation to what is valued in the curriculum (specified as the object or subject)
5. With a defined degree of sophistication, difficulty, complexity (described as an indication of quality)

Terms such as ‘analyse’ and ‘describe’ have been used to specify particular action but these can have everyday meanings that are quite general. ACARA has therefore associated these terms with specific meanings that are defined in the senior secondary achievement standards glossary and used precisely and consistently across subject areas.

Links to Foundation to Year 10

Progression from the F-10 Australian Curriculum: Science

The Earth and Environmental Science curriculum continues to develop student understanding and skills from across the three strands of the F-10 Australian Curriculum: Science.

In the Science Understanding strand, the Earth and Environmental Science curriculum draws on knowledge and understanding from across the four sub-strands of Biological, Physical, Chemical and Earth and Space Sciences. In particular, the Earth and Environmental Science curriculum continues to develop the key concepts introduced in the Biological Sciences and Earth and Space Sciences sub-strands, that is, that a diverse range of living things have evolved on Earth over hundreds of millions of years; that living things are interdependent and interact with each other and with their environment; and that the Earth is subject to change within and on its surface, over a range of timescales as a result of natural processes and human use of resources.

Mathematical skills expected of students studying Earth and Environmental Science

The Earth and Environmental Science curriculum requires students to use the mathematical skills they have developed through the F-10 Australian Curriculum: Mathematics, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Australian Curriculum: Science.

Within the Science Inquiry Skills strand, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of their scientific arguments, claims or conclusions.. In gathering and recording numerical data, students are required to make measurements with an appropriate degree of accuracy and to represent measurements using appropriate units.

Students may need to be taught to recognise when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

It is assumed that students will be able to competently:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- transform decimal notation to power of ten notation
- substitute physical quantities into an equation using consistent units so as to calculate one quantity and check the dimensional consistency of such calculations
- solve simple algebraic equations
- comprehend and use the symbols/notations $<$,$>$, Δ, $\approx$
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data and then select appropriate forms, variables and scales for constructing graphs
- construct and interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean, median and inter-quartile range
- interpret the slope of a linear graph.

Representation of Cross-curriculum priorities

While the significance of the cross-curriculum priorities for Earth and Environmental Science varies, there are opportunities for teachers to select contexts that incorporate the key concepts from each priority.

The Earth and Environmental Science curriculum provides an opportunity for students to engage with *Aboriginal and Torres Strait Islander histories and cultures*. It acknowledges that Aboriginal and Torres Strait Islander people have longstanding scientific knowledge traditions that inform understanding of the Australian environment and the ways in which it has changed over time. In exploring scientific knowledge and decision making about Earth processes, environments and resources, students could develop an understanding that Aboriginal and Torres Strait Islander people have particular ways of knowing the world and continue to be innovative in providing significant contributions to development in science. Students could investigate examples of Aboriginal and Torres Strait Islander science and the ways traditional knowledge and Western scientific knowledge can be complementary.

Students could investigate a wide range of contexts that draw *on Asia and Australia's engagement with Asia* through Earth and Environmental Science. Students could explore the diverse environments of the Asia region and develop an appreciation that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world. Through an examination of developments in Earth and Environmental Science, students could appreciate that the Asia region plays an important role in scientific research and development, including through collaboration with Australian scientists, in such areas as natural hazard prediction and management, natural resource management, energy security and food security.

The *Sustainability* priority is explicitly addressed in Earth and Environmental Science. The Earth system model that frames the curriculum requires students to understand the interconnectedness of Earth's biosphere, geosphere, hydrosphere and atmosphere and how these systems operate and interact across a range of spatial and temporal scales. Relationships including cycles and cause and effect are explored, and students develop skills of observation and analysis to examine these relationships in the world around them now and into the future.

In Earth and Environmental Science, students appreciate that Earth and environmental science provides the basis for decision making in many areas of society and that these decisions can impact the Earth system, its environments and its resources. They understand the importance of using science to predict possible effects of human and other activity, and to develop management plans or alternative technologies that minimise these effects and provide for a more sustainable future.

Unit 1: Introduction to Earth systems

Unit 1: Introduction to Earth systems Description

The Earth system involves four interacting systems: the geosphere, atmosphere, hydrosphere and biosphere. A change in any one ‘sphere’ can impact others at a range of temporal and spatial scales. In this unit, students build on their existing knowledge of Earth by exploring the development of understanding of Earth's formation and its internal and surface structure. Students study the processes that formed the oceans and atmosphere. They review the origin and significance of water at Earth’s surface, how water moves through the hydrological cycle, and the environments influenced by water, in particular the oceans, the cryosphere and groundwater. Students will examine the formation of soils at Earth’s surface (the pedosphere) as a process that involves the interaction of all Earth systems.

Students critically examine the scientific evidence for the origin of life, linking this with their understanding of the evolution of Earth’s hydrosphere and atmosphere. They review evidence from the fossil record that demonstrates the interrelationships between major changes in Earth’s systems and the evolution and extinction of organisms. They investigate how the distribution and viability of life on Earth influences, and is influenced by, Earth systems.

Through the investigation of appropriate contexts, students explore how international collaboration, evidence from multiple disciplines and individuals and the development of ICT and other technologies have contributed to developing understanding of Earth systems. They investigate how scientific knowledge is used to offer valid explanations and reliable predictions, and the ways in which it interacts with social, economic and cultural factors.

Students use science inquiry skills that mirror the types of inquiry conducted to establish our contemporary understanding of Earth systems: they engage in a range of investigations that help them develop the field and research skills used by geoscientists, soil scientists, atmospheric scientists, hydrologists, ecologists and environmental chemists to interpret geological, historical and real-time scientific information.

Unit 1: Introduction to Earth systems Learning Outcomes

By the end of this unit, students:

- understand the key features of Earth systems, how they are interrelated, and their collective 4.5 billion year history
- understand scientific models and evidence for the structure and development of the solid Earth, the hydrosphere, the atmosphere and the biosphere
- understand how theories and models have developed based on evidence from multiple disciplines; and the uses and limitations of Earth and environmental science knowledge in a range of contexts
- use science inquiry skills to collect, analyse and communicate primary and secondary data on Earth and environmental phenomena; and use these as analogues to deduce and analyse events that occurred in the past
- evaluate, with reference to empirical evidence, claims about the structure, interactions and evolution of Earth systems
- communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.

Unit 1: Introduction to Earth systems Content Descriptions

Science Inquiry Skills (Earth and Environmental Science Unit 1)

Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes (ACSES001)

Design investigations including the procedure/s to be followed, the information required and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics (ACSES002)

Conduct investigations, including using map and field location techniques and rock and soil sampling and identification procedures, safely, competently and methodically for the collection of valid and reliable data (ACSES003)

Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSES004)

Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence; use reasoning to construct scientific arguments (ACSES005)

Select, construct and use appropriate representations, including maps and cross sections to describe and analyse spatial relationships, and stratigraphy and isotopic half-life data to infer the age of rocks and fossils, to communicate conceptual understanding, solve problems and make predictions (ACSES006)

Communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports (ACSES007)

Science as a Human Endeavour (Units 1 & 2)

Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility (ACSES008)

Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSES009)

Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSES010)

The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSES011)

The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSES012)

Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSES013)

Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSES014)

Science Understanding

Development of the geosphere

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Changing views on the age of Earth

In the seventeenth century, Bishop James Ussher analysed historical accounts and the chronology of the Bible to deduce that the creation of Earth commenced at nightfall preceding the 23 October, 4004 BC (BCE). In the eighteenth century, the Comte du Buffon was one of the first to propose an age based on empirical evidence, suggesting that Earth was 75 000 years old, based on the rate it was cooling. In the following centuries, many scientists from many different disciplines proposed ages of Earth based on their experiments and calculations (ACSES009). The current agreed age of Earth is around 4.54 billion years. This age has been calculated from radiometric dating of meteorites and is consistent with various younger ages obtained from Earth and Moon rocks (ACSES010).

Modern processes as analogues for ancient processes

The principle of uniformitarianism, first formulated by James Hutton and later developed by Charles Lyell, suggests that change is constant and uniform. Therefore knowledge of a modern process can be used to explain similar past events or predict similar future events. For example, as part of studying the enhanced greenhouse effect, scientists have searched for possible previous geological analogues which would help them to make predictions about how the climate might change in the future (ACSES013). To achieve this, the geologic and paleoclimate scientific communities have been studying the collated data on glaciations, inter-glacial periods and atmospheric parameters to find a period in Earth's history that can be used as an analogue for a future with an enhanced greenhouse effect (ACSES008).

Understanding the interior of Earth

As technology has not yet developed to enable direct study of Earth below a depth of about 10 km, science relies on secondary sources of data to develop models of the interior based on inference. This includes studying the propagation of seismic waves, using gravity maps developed via satellite technology, studying the composition of material ejected from volcanic eruptions and meteorites, analysing the density of rocks, and studying Earth's magnetic field (ACSES009). The development of supercomputing has enabled the design of complex models of Earth's interior, demonstrating, for example, the way in which changes in the dynamics of the inner and outer core cause changes in Earth's magnetic field (ACSES010).

Observation of present day processes can be used to infer past events and processes by applying the Principle of Uniformitarianism (ACSES015)

A relative geological time scale can be constructed using stratigraphic principles including superposition, cross cutting relationships, inclusions and correlation (ACSES016)

Precise dates can be assigned to points on the relative geological time scale using data derived from the decay of radioisotopes in rocks and minerals; this establishes an absolute time scale and places the age of the Earth at 4.5 billion years (ACSES017)

Earth has internally differentiated into a layered structure: a solid metallic inner core, a liquid metallic outer core and a silicate mantle and crust; the study of seismic waves and meteorites provides evidence for this structure (ACSES018)

Rocks are composed of characteristic assemblages of mineral crystals or grains that are formed through igneous, sedimentary and metamorphic processes, as part of the rock cycle (ACSES019)

Soil formation requires interaction between atmospheric, geologic, hydrologic and biotic processes; soil is composed of rock and mineral particles, organic material, water, gases and living organisms (ACSES020)

Development of the atmosphere and hydrosphere

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Monitoring Earth's atmosphere

Study of contemporary atmospheric changes includes analysis of materials and chemicals present in the atmosphere, as well as properties such as air quality, surface pressure, surface temperature and humidity. Since the 1980s, the Global Atmosphere Watch, established by the World Meteorological Organisation, a United Nations agency, has been monitoring trends in Earth's atmosphere. The program seeks to identify and understand changes in the atmosphere in order to be able to predict future change and provide advice about ways to mitigate the effect of human-induced atmospheric change (ACSES014). A number of environmental conventions have been ratified as a consequence of information derived from the global monitoring of the atmosphere (ACSES012).

Water and the search for life on other planets

The search for evidence of life on other planets is often initially focused on identification of extraterrestrial liquid water. Based on models of Earth, scientists theorise that planets with surface water will occur within a 'Goldilocks zone' of distance from their sun, where surface temperatures are not too hot and not too cold (ACSES009). However new theories suggest that if a planet outside the 'Goldilocks zone' is large enough, and produces enough internal heat, it could still contain deep reservoirs of liquid water capable of supporting life. Development of satellite and probe technologies has enabled identification of natural satellites and dwarf planets in our solar system that have evidence of liquids below the surface, and both Venus and Mars are thought to have had large areas of surface water in their past. The Hubble space telescope has enabled identification of the atmosphere of planets outside our solar system (ACSES010).

The atmosphere was derived from volcanic outgassing during cooling and differentiation of Earth and its composition has been significantly modified by the actions of photosynthesising organisms (ACSES021)

The modern atmosphere has a layered structure characterised by changes in temperature: the troposphere, mesosphere, stratosphere and thermosphere (ACSES022)

Water is present on the surface of Earth as a result of volcanic outgassing and impact by icy bodies from space; water occurs in three phases (solid, liquid, gas) on Earth's surface (ACSES023)

Water's unique properties, including its boiling point, density in solid and liquid phase, surface tension and its ability to act a solvent, and its abundance at the surface of Earth make it an important component of Earth system processes (for example, precipitation, ice sheet formation, evapotranspiration, solution of salts) (ACSES024)

Development of the biosphere

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Evidence for the origin of life

Theories of the origin of living organisms from inanimate materials (abiogenesis) in a ‘primordial soup’ were first published in the 1920s, but received little attention. However in the 1950s, experimentation by Urey and Miller indicated that by introducing a spark to an aqueous mixture of compounds likely to have been present on early Earth, organic molecules could form. This is an example of how scientists can theorise about the early conditions on Earth that may have led to the origin of life and then use an experimental design as a ‘proof of concept’ (ACSES013). A wide range of other evidence supports the theory of abiogenesis, however many people also reject this theory in favour of a religious view of creation (ACSES011).

Evidence for a ‘sixth extinction’

Analysis of past mass extinction events, based on evidence in sedimentary rocks and the fossil record, identifies the cause of these events as physical change. Current data on global species loss indicates that a ‘sixth extinction’ of greater severity than previous events may be imminent. Research indicates that this extinction will be caused by biotic rather than physical events, including human transformation of the landscape, overharvesting of species, pollution and introduction of alien species. The fossil record provides evidence for significant ecosystem change and loss of species associated with human activity. Contemporary evidence of human population increase, increase in land clearing, pollution and alien species introduction is theorised to align with evidence of species loss around the globe (ACSES013). Actions to halt the loss of species require social, economic and cultural support and a commitment to global action for sustainability (ACSES014).

Evidence for changes to the Australian environment over time

The fossil record and sedimentary rock evidence, in addition to the oral histories and art sites of Aboriginal and Torres Strait Islander peoples, suggest that Australia’s environments have changed in significant ways since it separated from Antarctica approximately 45 million years ago, including becoming much drier (ACSES009). Evidence indicates that the landscape changed from cool temperate rainforest to deserts, open grasslands and open forests over the last few million years, and that fire stick farming played a significant role in the last 50 000 years. Some aspects of Australia’s past are debated, including the relationship between the extinction of the megafauna and hunting by Aboriginal people. However there is a wide body of evidence that suggests climate change was more likely to have been the cause of megafauna extinction than overhunting (ACSES013).

Fossil evidence indicates that life first appeared on Earth approximately 4 billion years ago (ACSES025)

Laboratory experimentation has informed theories that life emerged under anoxic atmospheric conditions in an aqueous mixture of inorganic compounds, either in a shallow water setting as a result of lightning strike or in an ocean floor setting due to hydrothermal activity (ACSES026)

In any one location, the characteristics (for example, temperature, surface water, substrate, organisms, available light) and interactions of the atmosphere, geosphere, hydrosphere and biosphere give rise to unique and dynamic communities (ACSES027)

The characteristics of past environments and communities (for example, presence of water, nature of the substrate, organism assemblages) can be inferred from the sequence and internal textures of sedimentary rocks and enclosed fossils (ACSES028)

The diversification and proliferation of living organisms over time (for example, increases in marine animals in the Cambrian), and the catastrophic collapse of ecosystems (for example, the mass extinction event at the end of the Cretaceous) can be inferred from the fossil record (ACSES029)

Unit 2: Earth processes – energy transfers and transformations

Unit 2: Earth processes – energy transfers and transformations Description

Earth system processes require energy. In this unit, students explore how the transfer and transformation of energy from the sun and Earth's interior enable and control processes within and between the geosphere, atmosphere, hydrosphere and biosphere. Students examine how the transfer and transformation of heat and gravitational energy in Earth's interior drive movements of Earth's tectonic plates. They analyse how the transfer of solar energy to Earth is influenced by the structure of the atmosphere; how air masses and ocean water move as a result of solar energy transfer and transformation to cause global weather patterns; and how changes in these atmospheric and oceanic processes can result in anomalous weather patterns.

Students use their knowledge of the photosynthetic process to understand the transformation of sunlight into other energy forms that are useful for living things. They study how energy transfer and transformation in ecosystems are modelled and they review how biogeochemical cycling of matter in environmental systems involves energy use and energy storage.

Through the investigation of appropriate contexts, students explore how international collaboration, evidence from multiple disciplines and individuals and the development of ICT and other technologies have contributed to developing understanding of the energy transfers and transformations within and between Earth systems. They investigate how scientific knowledge is used to offer valid explanations and reliable predictions, and the ways in which it interacts with social, economic and cultural factors, including the design of action for sustainability.

Students use inquiry skills to collect, analyse and interpret data relating to energy transfers and transformations and cycling of matter and make inferences about the factors causing changes to movements of energy and matter in Earth systems.

Unit 2: Earth processes – energy transfers and transformations Learning Outcomes

By the end of this unit, students:

- understand how energy is transferred and transformed in Earth systems, the factors that influence these processes, and the dynamics of energy loss and gain
- understand how energy transfers and transformations influence oceanic, atmospheric and biogeochemical cycling
- understand how theories and models have developed based on evidence from multiple disciplines; and the uses and limitations of Earth and environmental science knowledge in a range of contexts
- use science inquiry skills to collect, analyse and communicate primary and secondary data on energy transfers and transformations between and within Earth systems
- evaluate, with reference to empirical evidence, claims about energy transfers and transformations between and within Earth systems
- communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.

Unit 2: Earth processes – energy transfers and transformations Content Descriptions

Science Inquiry Skills (Earth and Environmental Science Unit 2)

Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes (ACSES030)

Design investigations including the procedure/s to be followed, the information required and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics (ACSES031)

Conduct investigations, including using map and field location techniques and environmental sampling procedures, safely, competently and methodically for the collection of valid and reliable data (ACSES032)

Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSES033)

Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence; use reasoning to construct scientific arguments (ACSES034)

Select, construct and use appropriate representations, including maps and other spatial representations, diagrams and flow charts, to communicate conceptual understanding, solve problems and make predictions (ACSES035)

Communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports (ACSES036)

Science as a Human Endeavour (Units 1 & 2)

Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility (ACSES037)

Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSES038)

Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSES039)

The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSES040)

The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSES041)

Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSES042)

Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSES043)

Science Understanding

Energy for Earth processes

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Development of plate tectonic theory

Alfred Wegener, a meteorologist, first proposed a theory of continental drift in 1912 and followed this with publication of an expanded theory in 1915. His theory provoked much debate in scientific circles, because although there was some evidence of continental movement, there was no clear mechanism to drive plate movement. It took more than 50 years and the collection of a large body of evidence for broad acceptance of what we now refer to as plate tectonics theory (ACSES037). Patterns in the distribution of rock types and fossil fragments occurring across various continents were provided as early evidence for the theory, and scientists working with palaeomagnetism found further evidence that the continents had different configurations in the past by comparing the magnetic fields recorded by rocks of similar age across different continents. Marine geology conducted in the late 1950s and early 1960s also provided evidence for sea floor spreading along plate boundaries (ACSES038). By the late 1960s the explanatory and predictive power of the theory of plate tectonics became more broadly accepted, with numerous scientists presenting papers elaborating the concepts involved (ACSES037).

Measuring plate movement

Heat energy stored and generated in Earth's interior creates convection currents on a massive, continental scale that result in the movement of very large sections of Earth's rigid crust and uppermost mantle. Development of satellite measurement techniques, particularly global positioning system (GPS) technologies, enables accurate measurement of plate movement (ACSES039). Plate movement is tracked directly by means of GPS data; repeated measurements of carefully selected points on Earth's surface are taken and plate movement is inferred through determination of how the distance between them changes. Measurement of plate movements enables scientists to predict the direction and rate of plate movement and to develop better understandings of processes such as mountain building and mantle convection (ACSES042).

Geothermal energy

Geothermal heat from Earth's interior provides a low carbon emission energy source, and can be accessed via hot rock, hot sedimentary aquifer and direct heat technologies. Geothermal systems involve a heat source, permeable rock and a fluid to transport heat to the surface; of these the permeable rock and fluid reservoirs can be artificially created. Proponents of geothermal power generation point to its high baseload capacity, low carbon dioxide emissions, low environmental impacts and potential to provide increased energy security (ACSES043). In areas of Europe, heat from geothermal sources has been brought to the surface using both simple conductive and convective processes to heat homes and large greenhouses for horticulture (ACSES041). However in countries that are less geologically active, such as Australia, sourcing geothermal energy requires significant infrastructure and investment and it remains a challenge to make geothermal energy production economically viable.

Energy is neither created nor destroyed, but can be transformed from one form to another (for example, kinetic, gravitational, thermal, light) and transferred between objects (ACSES044)

Processes within and between Earth systems require energy that originates either from the sun or the interior of Earth (ACSES045)

Thermal and light energy from the Sun drives important Earth processes including evaporation and photosynthesis (ACSES046)

Transfers and transformations of heat and gravitational energy in Earth's interior drives the movement of tectonic plates through processes including mantle convection, plume formation and slab sinking (ACSES047)

Energy for atmospheric and hydrologic processes

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Predicting the weather

Formal weather prediction has been practised since the nineteenth century. Accurate weather forecasting is vital to the public and private sectors, for example to provide severe weather warnings and to inform decision making in aviation and marine industries, agriculture and forestry. There is a huge demand from commercial and industrial sectors to increase the accuracy and reliability of weather forecasting over longer periods of time (ACSES040). Weather predictions are based on interpretation of changes in factors such as air and water temperature, the direction and speed of air and water currents, humidity and atmospheric pressure. Contemporary weather predictions are informed by computer models that take into account a range of atmospheric factors, but still rely on human input to determine the best forecast model and to interpret the model data into weather forecasts that are understandable to the end user (ACSES042).

Climate change and the global ocean conveyor

The global ocean conveyor is important in regulating global climate. Advances in remote sensing with satellites have enabled scientists to develop models of the complex pathways involved and measure their characteristics (ACSES039).The global ocean conveyor is partly driven by thermohaline circulation, the movement of water due to density changes resulting from temperature or salinity. The places where these deepwater currents are created are believed to compose less than 1% of the ocean’s surface area. Analysis of geological evidence indicates that when these vulnerable areas are disrupted, the global ocean conveyor can be “shut down” and the world’s climate can be drastically altered in just a few years. Some scientists predict that melting of the Greenland ice sheet could influence the global ocean conveyor, causing changes in global climate (ACSES043).

The net transfer of solar energy to Earth’s surface is influenced by its passage through the atmosphere, including impeded transfer of ultraviolet radiation to Earth’s surface due to its interaction with atmospheric ozone, and by the physical characteristics of Earth’s surface, including albedo (ACSES048)

Most of the thermal radiation emitted from Earth’s surface passes back out into space but some is reflected or scattered by greenhouse gases back toward Earth; this additional surface warming produces a phenomenon known as the greenhouse effect (ACSES049)

The movement of atmospheric air masses due to heating and cooling, and Earth’s rotation and revolution, cause systematic atmospheric circulation; this is the dominant mechanism for the transfer of thermal energy around Earth’s surface (ACSES050)

The behaviour of the global oceans as a heat sink, and Earth’s rotation and revolution, cause systematic ocean currents; these are described by the global ocean conveyer model (ACSES051)

The interaction between Earth’s atmosphere and oceans changes over time and can result in anomalous global weather patterns, including El Nino and La Nina (ACSES052)

Energy for biogeochemical processes

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Biological soil crusts and nutrient cycling in Australian rangelands

Biological soil crusts are formed by living organisms such as cyanobacteria, lichen or algae and their byproducts, creating a crust of soil particles bound together by organic materials. Biological soil crusts are found globally in arid and semiarid environments, and are common in Australia. They play an important role in soil fertility and protect the soil surface from erosion and evaporation. The cyanobacteria in soil crusts are photosynthetic and research indicates that they are important for fixing and storing soil carbon; they also secrete compounds that increase the bio-availability of phosphorus and nitrogen (ACSES038). However crusts are easily disrupted by domestic livestock grazing, leading to nutrient leaching and a significant rundown in the productivity of the pasture, especially in Australian environments where hooved animals have been introduced relatively recently. Some ecologists believe that a switch to harvesting kangaroo rather than sheep or cattle would have a significant impact on rangeland productivity and ecosystem health, but kangaroo meat is not currently as highly valued by consumers (ACSES040).

Closed ecosystem models

Artificial ecosystems (closed to materials import and export) have been developed to aid research in ecosystem function and to assess their potential as life support systems in space stations or for space colonisation. One of the most significant experiments of this type was Biosphere 2, constructed in Arizona in the late 1980s. The Biosphere dome is a large terrarium in which water and nutrients are recycled, with solar radiation entering via the vast glass surfaces of the dome. The first ‘mission’ involved eight people being sealed inside the closed system for two years. The system was designed to enable biogeochemical cycling of matter and particularly provided insight into carbon and oxygen cycling in carbon dioxide rich environments (ACSES041). The $200 million experiment has been criticised for contamination of the system when an ill crew member was removed and reinstated, bringing in some new materials, but other members of the science community consider its contribution to closed system ecological studies to be invaluable (ACSES037).

Marine primary production

The majority of primary production in marine environments occurs via phytoplankton floating near the surface of the ocean. The zone in which sufficient sunlight is available for photosynthesis to occur is called the photic zone and almost 90% of marine organisms live in this zone. Water turbidity has a significant effect on the depth of the photic zone; pollution of marine ecosystems via erosion from mining, forestry, farming or coastal dredging can cause high turbidity that impedes photosynthesis (ACSES043). However recent studies have shown that phytoplankton populations appear to be rising in a number of locations across the globe as they absorb more carbon dioxide from the atmosphere. Some scientists predict an increase in the primary productivity of the oceans of between 0.7% and 8.1% as atmospheric carbon dioxide increases, but this predicted increase is likely to vary significantly with location, and may be offset by large predicted losses in productivity around the polar regions due to ice cap contraction (ACSES042).

Photosynthesis is the principal mechanism for the transformation of energy from the sun into energy forms that are useful for living things; net primary production is a description of the rate at which new biomass is generated, mainly through photosynthesis (ACSES053)

The availability of energy and matter are one of the main determinants of ecosystem carrying capacity; that is, the number of organisms that can be supported in an ecosystem (ACSES054)

Biogeochemical cycling of matter, including nitrogen and phosphorus, involves the transfer and transformation of energy between the biosphere, geosphere, atmosphere and hydrosphere (ACSES055)

Energy is stored, transferred and transformed in the carbon cycle; biological elements, including living and dead organisms, store energy over relatively short timescales, and geological elements (for example, hydrocarbons, coal and kerogens) store energy for extended periods (ACSES056)

Unit 3: Living on Earth - extracting, using and managing Earth resources

Unit 3: Living on Earth - extracting, using and managing Earth resources Description

Earth resources are required to sustain life and provide infrastructure for living (for example, food, shelter, medicines, transport, and communication), driving ongoing demand for biotic, mineral and energy resources. In this unit, students explore renewable and non-renewable resources and analyse the effects that resource extraction, use and consumption and associated waste removal have on Earth systems and human communities.

Students examine the occurrence of non-renewable mineral and energy resources and review how an understanding of Earth and environmental science processes guides resource exploration and extraction. They investigate how the rate of extraction and other environmental factors impact on the quality and availability of renewable resources, including water, energy resources and biota, and the importance of monitoring and modelling to manage these resources at local, regional and global scales. Students learn about ecosystem services and how natural and human-mediated changes of the biosphere, hydrosphere, atmosphere and geosphere, including the pedosphere, influence resource availability and sustainable management.

Through the investigation of appropriate contexts, students explore the ways in which models and theories related to resource extraction, use and management have developed over time and through interactions with social, economic, cultural and ethical considerations. They investigate the ways in which science contributes to contemporary debate regarding local, regional and international resource use, evaluation of risk and action for sustainability, and recognise the limitations of science in providing definitive answers in different contexts.

Students use science inquiry skills to collect, analyse and interpret data relating to the extraction, use, consumption and waste management of renewable and non-renewable resources. They critically analyse the range of factors that determine management of renewable and non-renewable resources.

Unit 3: Living on Earth - extracting, using and managing Earth resources Learning Outcomes

By the end of this unit, students:

- understand the difference between renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal impact Earth systems
- understand how renewable resources can be sustainably extracted, used and consumed at local, regional and global scales
- understand how models and theories have developed over time; and the ways in which Earth and environmental science knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
- use science inquiry skills to collect, analyse and communicate primary and secondary data on resource extraction and related impacts on Earth systems
- evaluate, with reference to empirical evidence, claims about resource extraction and related impacts on Earth systems and justify evaluations
- communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.

Unit 3: Living on Earth - extracting, using and managing Earth resources Content Descriptions

Science Inquiry Skills (Earth and Environmental Science Unit 3)

Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes (ACSES057)

Design investigations including the procedure/s to be followed, the information required and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics (ACSES058)

Conduct investigations, including using spatial analysis to complement map and field location techniques and environmental sampling procedures, safely, competently and methodically for the collection of valid and reliable data (ACSES059)

Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error and instrumental accuracy and the nature of the procedure and sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSES060)

Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; use reasoning to construct scientific arguments (ACSES061)

Select, construct and use appropriate representations, including maps and other spatial representations, to communicate conceptual understanding, solve problems and make predictions (ACSES062)

Communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports (ACSES063)

Science as a Human Endeavour (Units 3 & 4)

ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work (ACSES064)

Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power (ACSES065)

The acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered (ACSES066)

People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk (ACSES067)

Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question (ACSES068)

International collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region (ACSES069)

Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSES070)

Science Understanding

Use of non-renewable Earth resources

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Locating and assessing resources for extraction

The location and assessment of resources for extraction can be an expensive and time consuming process. However it is critical that it be done accurately if resources are to be extracted in a sustainable and profitable manner. Modern technologies have had a large impact on improving the efficiency and effectiveness of this process, including the use of aerial and satellite imagery to map resource location, use of software packages to model resource distribution, and validation of the model using technologies such as seismic surveys (ACSES064). A feasibility study is then conducted to determine whether the resource can be extracted effectively and profitably. This includes not only an estimate of the size and value of the resource, but also a detailed analysis of suitable extraction methods and any processing techniques needed to refine the commodity, the capital and operating costs of the operation, and its environmental impacts (ACSES070). Other key parameters such as availability of support facilities and infrastructure, site access and social impacts are also investigated and evaluated.

Coal seam gas extraction in Australia

Australia has relatively large coal seam gas reserves (CSG) and the CSG industry is rapidly expanding. Proponents of the CSG industry argue it will deliver economic benefits for regional towns and cities, and represents a cleaner energy source than coal. However there is also significant resistance to the rapid development of the industry, including competition issues with relation to agricultural and reserve land, and environmental impacts on landscapes and aquifers (ACSES066). A CSG plant, while causing much less physical damage to the land surface than conventional mining, fragments pasture or habitat with a large number of pipes, compressor stations and access roads. These are typically set up on a 200 to 750 metre grid pattern, depending on the nature of the coal seam. Environmental concerns include the emissions produced from extracting the gas and condensing it into a liquid form, and the extraction of water in order to access the CSG. Community concern over CSG industry development also reflects the limited information available on the long-term impacts of CSG industries (ACSES067).

Carbon pricing

One of the main concerns associated with resource extraction is greenhouse gas pollution in the form of carbon dioxide, methane, nitrous oxide and perfluorocarbon emissions. The Kyoto Protocol adopted by the United Nations in 1997 sets obligations for industrialised countries to reduce emissions of greenhouse gases (ACSES069). One approach to reduce the level of carbon dioxide emissions adopted by the European Union, some American states and Australia has been to introduce carbon pricing. Carbon pricing can provide funds for investment in cleaner energy, and aims to act as an incentive for businesses to reduce their pollution. There is debate about the effectiveness of carbon pricing in reducing greenhouse gas emissions, partly because there are a number of factors that contribute to a reduction in emissions, including a decrease in economic activity, and these make it difficult to attribute significance to a single factor (ACSES068).

Non-renewable mineral and energy resources are formed over geological time scales so are not readily replenished (ACSES071)

The location of non-renewable mineral and energy resources, including fossil fuels, iron ore and gold, is related to their geological setting (for example, sedimentary basins, igneous terrains) (ACSES072)

Mineral and energy resources are discovered using a variety of remote sensing techniques (for example, satellite images, aerial photographs and geophysical datasets) and direct sampling techniques (for example, drilling, core sampling, soil and rock sampling) to identify the spatial extent of the deposit and quality of the resource (ACSES073)

The type, volume and location of mineral and energy resources influences the methods of extraction (for example, underground, open pit, onshore and offshore drilling and completion) (ACSES074)

Extraction of mineral and energy resources influences interactions between the abiotic and biotic components of ecosystems, including hydrologic systems (ACSES075)

Use of renewable Earth resources

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Maximum sustainable yield models and fisheries

Overfishing has been a concern since the late nineteenth century, and government approaches to manage fish stocks have been in place since the early twentieth century. Maximum sustainable yield (MSY) has been one of the most influential concepts to inform fish stock management and has been applied since the 1950s. However, MSY models have been criticised as they ignore the size and age of the animal being harvested, its reproductive status and the effects of fishing on the ecosystem more broadly (ACSES065). For example, application of an MSY model to fishing for orange roughy in New Zealand almost resulted in depletion of natural stocks because this species has a slow maturation and low resilience to harvesting. However overfishing continues to be a problem that requires management policies; use of fishing quotas has been shown to be successful, but calculation of these quotas needs to take account of the population dynamics of the species, ecosystem dynamics and the effects of changes in the biotic and abiotic conditions of that ecosystem in order to enable sustainable harvesting of the resource (ACSES070).

Putting a dollar value on ecosystem services

A range of environmentalists and economists have proposed that an economic value be placed on ecosystem services in order to ensure that they are accounted for in business and policy decisions. Such a value could be determined from an analysis of the economic benefits that derive from ecosystems and biodiversity, and a comparison made between the costs of failing to protect these resources with the costs of conserving them (ACSES067). Payment and trading of services is emerging as one way to consider the value of ecosystem services; credits are acquired for activities such as sponsoring the protection of carbon sequestration sources or the restoration of ecosystem service providers. However reliable calculation of values is confounded by the complexity of ecosystem dynamics and the lack of data regarding how changes in one aspect of an ecosystem affects other aspects over time, creating challenges for the implementation of such environmental economics (ACSES068).

Food security and protecting agricultural biodiversity

Food security is increasingly viewed as one of the most significant global issues, and has implications for health, sustainable economic development, environmental protection and trade. Greater agricultural productivity is seen as essential to achieving food security, but this can often lead to a focus on farming high yield species, which may itself lead to a decrease in the genetic diversity of global food species. Decreased genetic diversity increases vulnerability of species to disease and changes in environmental conditions; a focus on high yield species can require additional inputs, such as fertiliser and water, in order to be successful in different environments (ACSES070). Global actions to maintain biodiversity of agricultural species include the International Treaty on Plant Genetic Resources for Food and Agriculture, which provides a framework for national, regional and international efforts to conserve genetic resources and share the benefits of such conservation equally (ACSES069).

Renewable resources are those that are typically replenished at time scales of years to decades and include harvestable resources (for example, water, biota and some energy resources) and services (for example, ecosystem services) (ACSES076)

Ecosystems provide a range of renewable resources, including provisioning services (for example, food, water, pharmaceuticals), regulating services (for example, carbon sequestration, climate control), supporting services (for example, soil formation, nutrient and water cycling, air and water purification) and cultural services (for example, aesthetics, knowledge systems) (ACSES077)

The abundance of a renewable resource and how readily it can be replenished influence the rate at which it can be sustainably used at local, regional and global scales (ACSES078)

The cost-effective use of renewable energy resources is constrained by the efficiency of available technologies to collect, store and transfer the energy (ACSES079)

The availability and quality of fresh water can be influenced by human activities (for example, urbanisation, over-extraction, pollution) and natural processes (for example, siltation, drought, algal blooms) at local and regional scales (ACSES080)

Any human activities that affect ecosystems (for example, species removal, habitat destruction, pest introduction, dryland salinity) can directly or indirectly reduce populations to beneath the threshold of population viability at local, regional and global scales and impact ecosystem services (ACSES081)

Overharvesting can directly reduce populations of biota to beneath the threshold of population viability; the concept of maximum sustainable yield aims to enable sustainable harvesting (ACSES082)

Producing, harvesting, transporting and processing of resources for consumption, and assimilating the associated wastes, involves the use of resources; the concept of an ‘ecological footprint’ is used to measure the magnitude of this demand (ACSES083)

Unit 4: The changing Earth - the cause and impact of Earth hazards

Unit 4: The changing Earth - the cause and impact of Earth hazards Description

Earth hazards occur over a range of time scales and have significant impacts on Earth systems across a wide range of spatial scales. Investigation of naturally occurring and human-influenced Earth hazards enables prediction of their impacts, and the development of management and mitigation strategies. In this unit, students examine the cause and effects of naturally occurring Earth hazards including volcanic eruptions, earthquakes and tsunami. They examine ways in which human activities can contribute to the frequency, magnitude and intensity of Earth hazards such as fire and drought. This unit focuses on the timescales at which the effects of natural and human-induced change are apparent and the ways in which scientific data are used to provide strategic direction for the mitigation of Earth hazards and environmental management decisions.

Students review the scientific evidence for climate change models, including the examination of evidence from the geological record, and explore the tensions associated with differing interpretations of the same evidence. They consider the reliability of these models for predicting climate change, and the implications of future climate change events, including changing weather patterns, globally and in Australia (for example, changes in flooding patterns or aridity, and changes to vegetation distribution, river structure and groundwater recharge).

Through the investigation of appropriate contexts, students explore the ways in which models and theories related to monitoring and managing Earth hazards and climate change have developed over time and through interactions with social, economic, cultural, and ethical considerations. They investigate the ways in which science contributes to contemporary debate regarding local, regional and international management of Earth hazards, evaluation of risk and action for sustainability, and recognise the limitations of science in providing definitive answers in different contexts.

Students use inquiry skills to collect, analyse and interpret data relating to the cause and impact of Earth hazards. They critically analyse the range of factors that influence the magnitude, frequency, intensity and management of Earth hazards at local, regional and global levels.

Unit 4: The changing Earth - the cause and impact of Earth hazards Learning Outcomes

By the end of this unit, students:

- understand the causes of Earth hazards and the ways in which they impact, and are impacted by, Earth systems
- understand how environmental change is modelled, and how the reliability of these models influences predictions of future events and changes
- understand how models and theories have developed over time; and the ways in which Earth and environmental science knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
- use science inquiry skills to collect, analyse and communicate primary and secondary data on Earth hazards and related impacts on Earth systems
- evaluate, with reference to empirical evidence, claims about Earth hazards and related impacts on Earth systems and justify evaluations
- communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.

Unit 4: The changing Earth - the cause and impact of Earth hazards Content Descriptions

Science Inquiry Skills (Earth and Environmental Science Unit 4)

Identify, research and construct questions for investigation, propose hypotheses and predict possible outcomes (ACSES084)

Design investigations including the procedure/s to be followed, the information required and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics (ACSES085)

Conduct investigations, including using spatial analysis to complement map and field location techniques, environmental sampling procedures and field metering equipment, safely, competently and methodically for the collection of valid and reliable data (ACSES086)

Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error and instrumental accuracy, the nature of the procedure and sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSES087)

Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; use reasoning to construct scientific arguments (ACSES088)

Select, construct and use appropriate representations, including maps and other spatial representations, to communicate conceptual understanding, make predictions and solve problems (ACSES089)

Communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports (ACSES090)

Science as a Human Endeavour (Units 3 & 4)

ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work (ACSES091)

Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power (ACSES092)

The acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered (ACSES093)

People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk (ACSES094)

Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question (ACSES095)

International collaboration is often required when investing in large scale science projects or addressing issues for the Asia-Pacific region (ACSES096)

Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSES097)

Science Understanding

The cause and impact of Earth hazards

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Should scientists be held responsible for evaluation of earthquake risk?

In October 2012, six seismologists were convicted of manslaughter for their role in the preparation of a risk report on the seismic activity in L'Aquila, Italy. They were members of a government risk-assessment committee established to investigate the possibility of a large scale earthquake in the L'Aquila region following a series of many low magnitude earthquakes. Just one week prior to the 6.3 magnitude earthquake that devastated the city and killed more than 300 people, the committee had released a report stating that the high incidence of smaller earthquakes was not necessarily a precursor to a larger quake (ACSES094). The report also included advice that earthquakes were unpredictable, and that building codes in the area needed to be adjusted to improve seismic safety (ACSES094). Earthquake prediction is still considered by many as an immature science, as it is not able to predict from first principles the location, date or magnitude of an earthquake (ACSES095). Research focuses on the identification of reliable precursor phenomena or the use of statistical techniques to identify trends or patterns that might lead to an earthquake.

Urban development planning for severe weather events

Severe weather events in Australia have included significant storms, fire and floods, causing widespread damage to property, infrastructure, business, agriculture and compromising human health and safety. Historically, communities settled near food supplies and water sources, however these areas can also be particularly sensitive to the effects of severe weather. Some people argue that governments should create stricter restrictions on urban development in high risk areas such as flood plains and coastal land, given the significant costs accrued by the government in managing mitigation of and recovery from severe weather events. However others believe that such a risk/benefit analysis is the responsibility and right of individuals, as choices of where to live also reflect values of place, beauty and proximity to nature (ACSES093). The level of risk in these areas can also increase as populations increase, changing landscape dynamics and creating greater pressure on infrastructure designed to mitigate risk (ACSES094).

Salinity in Australia

Land clearing and farming practices have led to significant salinity issues for Australian land and water resources. Dryland salinity currently affects over 5 million hectares of land and the National Land and Water Resources Audit predicted that up to 17 million hectares may have high potential for development of dryland salinity by 2050. Historically, land clearing for agriculture was supported by governments as an important measure to increase national economic prosperity, but since the 1980s the rate of land clearing has declined as awareness increases and attitudes change (ACSES093). Salinity causes loss of agricultural land and remnant native vegetation and has a significant impact on public resources such as water supplies, roads, buildings and biodiversity. Mitigation activities include tree planting, planting of deep rooted crops such as lucerne, or salt-adapted species such as salt bush. Using remote sensing technologies to develop models of regional hydrogeology, scientists are increasingly able to predict sites most at risk from salinisation so that preventative measures such as tree planting can be taken (ACSES097).

Earth hazards result from the interactions of Earth systems and can threaten life, health, property, or the environment; their occurrence may not be prevented but their effect can be mitigated (ACSES098)

Plate tectonic processes generate earthquakes, volcanic eruptions and tsunamis; the occurrence of these events affects other Earth processes and interactions (for example, ash clouds influence global weather) (ACSES099)

Monitoring and analysis of data, including earthquake location and frequency data and ground motion monitoring, allows the mapping of potentially hazardous zones, and contributes to the future prediction of the location and probability of repeat occurrences of hazardous Earth events, including volcanic eruptions, earthquakes and tsunamis (ACSES100)

Major weather systems generate cyclones, flood events and droughts; the occurrence of these events affects other Earth processes and interactions (for example, habitat destruction, ecosystem regeneration) (ACSES101)

Human activities, including land clearing, can contribute to the frequency, magnitude and intensity of some natural hazards (for example, drought, flood, bushfire, landslides) at local and regional scales (ACSES102)

The impact of natural hazards on organisms, including humans, and ecosystems depends on the location, magnitude and intensity of the hazard, and the configuration of Earth materials influencing the hazard (for example, biomass, substrate) (ACSES103)

The cause and impact of global climate change

Examples in context

Support materials only that illustrate some possible contexts for exploring Science as a Human Endeavour concepts in relation to Science Understanding content.

Anthropogenic climate change – what's the evidence?

A range of evidence has been put forward by organisations such as the Australian Academy of Science and NASA in support of recent climate change occurring as a result of human activities (ACSES092). Remote sensing technologies and ice core analysis have provided data which is interpreted using climate models and computer simulations (ACSES091). Changes in near-surface air temperatures indicate that temperatures have increased in recent decades and are continuing to do so at an increasing rate. These data are corroborated by satellite observations of Earth's surface and lower atmosphere temperatures, and measurements of the heat absorbed by the oceans. In addition, data indicate widespread melting of mountain glaciers and ice caps, retreat of ice sheets, sea level rise, increases in average water vapour content in the atmosphere and a shift in weather systems. Analysis of gas concentrations in the atmosphere and ice cores indicates that greenhouse gas levels have increased as a result of emissions from human activities over the twentieth century, and the majority of scientists believe that these atmospheric changes are linked to global temperature increases. Although there is disagreement about the magnitude of human-induced climate change, and some scientists contend that it has no significant role, most agree that these data indicate human activity is responsible for the majority of measured global warming (ACSES092).

Predicting future climate change and identifying action

Long range climate predictions are derived from computer models and geological analogues. Computer models incorporate a range of factors, and are tested by their ability to simulate present climate at global and continental scales (ACSES091). Analogues from geological time and recent centuries are used to study how the climate has responded to increased greenhouse gases in the past. Both approaches indicate that, in the absence of changes in any other factors, a continued increase in greenhouse gas concentrations should result in continued global warming and associated climatic changes. Predictions at a regional scale are less reliable than global predictions, owing to changes in atmospheric circulation and other regional factors, but it is likely that changes in surface and ocean temperature will lead to changes in the distribution of some species of plants and animals, with flow on effects for ecosystems (ACSES097). The United Nations Kyoto Protocol and the establishment of the Intergovernmental Panel on Climate Change aim to secure global commitment to a significant reduction in greenhouse gas emissions over the next decades, with the aim of significantly reducing long-term global warming (ACSES096).

Uncertainty and climate change science

Climate change science involves a range of uncertainties, which mean that the scientific community cannot predict future warming precisely, or detail exactly how climate change will affect particular regions. Models improve as the scientific community collects, shares and analyses more data, but even though models can be improved, they will always struggle to make reliable predictions for systems in which small changes can have large effects (ACSES095). However, although scientific models cannot predict the exact trajectory of change, they do provide significant evidence that climate change is occurring and that future global warming is likely. Decisions about actions to mitigate this effect depend on the perception of risk by individuals, communities, governments and international agencies and reflect their social, economic and ethical values (ACSES093).

Natural processes (for example, oceanic circulation, orbitally-induced solar radiation fluctuations, the plate tectonic supercycle) and human activities contribute to global climate changes that are evident at a variety of time scales (ACSES104)

Human activities, particularly land-clearing and fossil fuel consumption, produce gases (including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons) and particulate materials that change the composition of the atmosphere and climatic conditions (for example, the enhanced greenhouse effect) (ACSES105)

Climate change affects the biosphere, atmosphere, geosphere and hydrosphere; climate change has been linked to changes in species distribution, crop productivity, sea level, rainfall patterns, surface temperature and extent of ice sheets (ACSES106)

Geological, prehistorical and historical records provide evidence (for example, fossils, pollen grains, ice core data, isotopic ratios, indigenous art sites) that climate change has affected different regions and species differently over time (ACSES107)

Climate change models (for example, general circulation models, models of El Nino and La Nina) describe the behaviour and interactions of the oceans and atmosphere; these models are developed through the analysis of past and current climate data, with the aim of predicting the response of global climate to changes in the contributing components (for example, changes in global ice cover and atmospheric composition) (ACSES108)

Units 1 and 2 Achievement Standard

Earth and Environmental Science concepts models and applications

A	B	C	D	E
For the Earth systems studied, the student: • analyses how Earth systems and their components are inter-related across a range of spatial scales, and how they have changed over time • analyses how cycling of	*For the Earth systems studied, the student:* • explains how Earth system components are inter-related and how they have changed over time • explains how cycling of matter and transfers and transformations	*For the Earth systems studied, the student:* • describes Earth system components and how they have changed over time • describes the ways in which matter and energy move within and between Earth systems	*For the Earth systems studied, the student:* • identifies Earth system components • identifies processes that cause change in Earth systems • identifies aspects of a theory or model related to the system	*For the Earth systems studied*

matter and transfers and transformations of energy are interrelated within and between Earth systems across a range of temporal and spatial scales • explains the theories and model/s used to explain the system and the aspects of the system they include • applies theories and models of systems and processes to explain phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts *For the Earth and environmental contexts studied, the student:* • analyses the role of collaboration, debate and review, and technologies, in the development of Earth and environmental theories and models	of energy occur between and within Earth systems • describes the theories and model/s used to explain the system • applies theories and models of systems and processes to explain phenomena, interpret problems and make plausible predictions in unfamiliar contexts *For the Earth and environmental contexts studied, the student:* • explains the role of collaboration, debate and review, and technologies, in the development of Earth and environmental theories and models • explains how Earth and environmental science has been used to meet diverse needs and inform decision making; and how these applications are influenced	• describes a theory or model used to explain the system • applies theories or models of systems and processes to explain phenomena, interpret problems and make plausible predictions in familiar contexts *For the Earth and environmental contexts studied, the student:* • describes the role of collaboration and review, and technologies, in the development of Earth and environmental theories or models • discusses how Earth and environmental science has been used to meet needs and inform decision making, and some social, economic or ethical implications of these	• describes phenomena, interprets simple problems and makes simple predictions in familiar contexts *For the Earth and environmental contexts studied, the student:* • describes the role of communication and new evidence in the development of Earth and environmental knowledge • describes ways in which Earth and environmental science has been used in society to meet needs and identifies some implications of these applications	*For th enviro studie*

• evaluates how Earth and environmental science has been used in concert with other sciences to meet diverse needs and inform decision making; and how these applications are influenced by interacting social, economic and ethical factors	by social, economic and ethical factors	applications		

Earth and Environmental Science inquiry skills

A	B	C	D	E
For the Earth and environmental contexts studied, the student: • designs, conducts and improves safe, ethical investigations that efficiently collect valid, reliable data in response to a complex question or problem • analyses data sets to explain causal and correlational relationships, the reliability of the data and sources of error • justifies their selection of data as evidence, analyses evidence with reference to models and/or theories and develops evidence-based conclusions that identify limitations • evaluates processes and claims; provides an evidence-	*For the Earth and environmental contexts studied, the student:* • designs, conducts and improves safe, ethical investigations that collect valid, reliable data in response to a question or problem • analyses data sets to identify causal and correlational relationships, anomalies and sources of error • selects appropriate data as evidence, interprets evidence with reference to models and/or theories and provides evidence for conclusions • evaluates processes and claims; provides a critique with reference to evidence and identifies possible improvements	*For the Earth and environmental contexts studied, the student:* • designs and conducts safe, ethical investigations that collect valid data in response to a question or problem • analyses data to identify relationships, anomalies and sources of error • selects data to demonstrate relationships linked to Earth and environmental knowledge and provides conclusions based on data • evaluates processes and claims and suggests improvements or alternatives • selects, constructs and uses appropriate representations to describe relationships and solve problems • communicates	*For the Earth and environmental contexts studied, the student:* • plans and conducts safe, ethical investigations to collect data in response to a question or problem • analyses data to identify trends and anomalies • selects data to demonstrate trends and presents simple conclusions based on data • considers processes and claims from a personal perspective • constructs and uses simple representations to describe relationships and solve simple problems • communicates in a range of modes and genres	*For t* *envi* *stud*

based critique and discussion of improvements or alternatives • selects, constructs and uses appropriate representations to describe complex relationships and solve complex and unfamiliar problems • communicates effectively and accurately in a range of modes, styles and genres for specific audiences and purposes	or alternatives • selects, constructs and uses appropriate representations to describe complex relationships and solve unfamiliar problems • communicates clearly and accurately in a range of modes, styles and genres for specific audiences and purposes	clearly in a range of modes, styles and genres for specific purposes		

Units 3 and 4 Achievement Standard

Earth and Environmental Science concepts models and applications

A	B	C	D	E
For the Earth systems studied, the student: • analyses how human activities and Earth processes affect components of, and interactions between, Earth systems across a range of temporal and spatial scales • analyses how interactions between Earth systems change, and how these changes are monitored and managed across a range of temporal and spatial scales • explains the theories and model/s used to explain the systems, the supporting evidence and	*For the Earth systems studied, the student:* • explains how human activities and Earth processes affect components of, and interactions between, Earth systems • explains how interactions between Earth systems change, and how these changes are monitored and managed • describes the theories and model/s used to explain the systems, some supporting evidence, and their limitations • applies theories and models of systems and processes to	*For the Earth systems studied, the student:* • explains how human activities and Earth processes affect components of Earth systems • explains how components of Earth systems change, and how these changes are managed • describes key aspects of a theory or model used to explain system processes and the phenomena to which they can be applied • applies theories or models of systems and processes to explain	*For the Earth systems studied, the student:* • describes how human activities and Earth processes affect components of Earth systems • describes changes to components of Earth systems and some management responses • describes key aspects of a theory or model used to explain a system process • describes phenomena, interprets simple problems and makes predictions in familiar contexts *For the Earth and environmental contexts studied, the student:*	*For the E* *studied, t* *For the E* *environm* *studied, t*

their limitations and assumptions • applies theories and models of systems and processes to explain phenomena and critically analyse complex problems and make reasoned, plausible predictions in unfamiliar contexts *For the Earth and environmental contexts studied, the student:* • analyses the role of collaboration, debate and review, and technologies, in the development of Earth and environmental theories and models • evaluates how Earth and environmental science has been used in concert with other sciences to meet diverse needs and inform	explain phenomena, analyse problems and make plausible predictions in unfamiliar contexts *For the Earth and environmental contexts studied, the student:* • explains the role of collaboration, debate and review, and technologies, in the development of Earth and environmental theories and models • explains how Earth and environmental science has been used to meet diverse needs and inform decision making; and how these applications are influenced by social, economic and ethical factors	phenomena, interpret problems and make plausible predictions in some unfamiliar contexts *For the Earth and environmental contexts studied, the student:* • describes the role of collaboration and review, and technologies, in the development of Earth and environmental theories or models • discusses how Earth and environmental science has been used to meet needs and inform decision making, and some social, economic or ethical implications of these applications	• describes the role of communication and new evidence in developing Earth and environmental knowledge • describes ways in which Earth and environmental science has been used in society to meet needs and identifies some implications of these applications	• •

decision making; and how these applications are influenced by interacting social, economic and ethical factors				

Earth and Environmental Science inquiry skills

A	B	C	D	E
For the Earth and environmental contexts studied, the student: • designs, conducts and improves safe, ethical investigations that efficiently collect valid, reliable data in response to a complex question or problem • analyses data sets to explain causal and correlational relationships, the reliability of the data and sources of error • justifies their selection of data as evidence, analyses evidence with reference to models and/or theories and develops evidence-based conclusions that identify limitations • evaluates processes and claims; provides an evidence-	*For the Earth and environmental contexts studied, the student:* • designs, conducts and improves safe, ethical investigations that collect valid, reliable data in response to a question or problem • analyses data sets to identify causal and correlational relationships, anomalies and sources of error • selects appropriate data as evidence, interprets evidence with reference to models and/or theories and provides evidence for conclusions • evaluates processes and claims; provides a critique with reference to evidence and identifies possible improvements	*For the Earth and environmental contexts studied, the student:* • designs and conducts safe, ethical investigations that collect valid data in response to a question or problem • analyses data to identify relationships, anomalies and sources of error • selects data to demonstrate relationships linked to Earth and environmental knowledge and provides conclusions based on data • evaluates processes and claims and suggests improvements or alternatives • selects, constructs and uses appropriate representations to describe relationships and solve problems • communicates	*For the Earth and environmental contexts studied, the student:* • plans and conducts safe, ethical investigations to collect data in response to a question or problem • analyses data to identify trends and anomalies • selects data to demonstrate trends and presents simple conclusions based on data • considers processes and claims from a personal perspective • constructs and uses simple representations to describe relationships and solve simple problems • communicates in a range of modes and genres	*For t[he Earth and] envi[ronmental contexts] stud[ied...]*

based critique and discussion of improvements or alternatives • selects, constructs and uses appropriate representations to describe complex relationships and solve complex and unfamiliar problems • communicates effectively and accurately in a range of modes, styles and genres for specific audiences and purposes	or alternatives • selects, constructs and uses appropriate representations to describe complex relationships and solve unfamiliar problems • communicates clearly and accurately in a range of modes, styles and genres for specific audiences and purposes	clearly in a range of modes, styles and genres for specific purposes		

The Australian Curriculum

Humanities and Social Sciences

(Version 8.4)

Humanities and Social Sciences - How the Learning Area works

Overview of senior secondary Australian Curriculum

ACARA has developed a senior secondary Australian Curriculum for English, Mathematics, Science and Humanities and Social Sciences.

The senior secondary Australian Curriculum specifies content and achievement standards for each senior secondary subject. Content refers to the knowledge, understanding and skills to be taught and learned within a given subject. Achievement standards refer to descriptions of the quality of learning (the depth of understanding, extent of knowledge and sophistication of skill) expected of students who have studied the content for the subject.

The senior secondary Australian Curriculum for each subject has been organised into four units. The last two units are cognitively more challenging than the first two units. Each unit is designed to be taught in about half a 'school year' of senior secondary studies (approximately 50–60 hours duration including assessment and examinations). However, the senior secondary units have also been designed so that they may be studied singly, in pairs (that is, year-long), or as four units over two years.

State and territory curriculum, assessment and certification authorities are responsible for the structure and organisation of their senior secondary courses and will determine how they will integrate the Australian Curriculum content and achievement standards into their courses. They will continue to be responsible for implementation of the senior secondary curriculum, including assessment, certification and the attendant quality assurance mechanisms. Each of these authorities acts in accordance with its respective legislation and the policy framework of its state government and Board. They will determine the assessment and certification specifications for their local courses that integrate the Australian Curriculum content and achievement standards and any additional information, guidelines and rules to satisfy local requirements including advice on entry and exit points and credit for completed study.

The senior secondary Australian Curriculum for each subject should not, therefore, be read as a course of study. Rather, it is presented as content and achievement standards for integration into state and territory courses.

Senior Secondary History subjects

The senior secondary Australian Curriculum: History consists of two subjects – Ancient History and Modern History. Ancient History focuses on the nature of the evidence of the ancient world, and the key features and developments of ancient societies. Modern History focuses on key events, ideas, movements, developments and people that have shaped the modern world.

Glossary

Ancient

As defined in the Australian Curriculum: Senior Secondary Ancient History, the Ancient period covers history from the development of early human communities to the end of late antiquity (around AD 650).

Cause and effect

Used by historians to identify chains of events and developments over time, short term and long term.

Concepts

A concept (in the study of history) refers to any general notion or idea that is used to develop an understanding of the past, such as concepts related to the process of historical inquiry (for example evidence, continuity and change, perspectives, significance).

Contestability

Occurs when particular interpretations about the past are open to debate, for example, as a result of a lack of evidence or different perspectives.

Continuity and change

Aspects of the past that remained the same over certain periods of time are referred to as continuities. Continuity and change are evident in any given period of time and concepts such as progress and decline may be used to evaluate continuity and change.

Empathy

Empathy is an understanding of the past from the point of view of a particular individual or group, including an appreciation of the circumstances they faced, and the motivations, values and attitudes behind their actions.

Evidence

In History, evidence is the information obtained from sources that is useful for a particular inquiry (for example the relative size of historical figures in an ancient painting may provide clues for an inquiry into the social structure of the society). Evidence can be used to help construct a historical narrative, to support a hypothesis or to prove or disprove a conclusion.

Historical authentication

A process of verifying the origins of an artefact or object and establishing it as genuine.

Historical inquiry

Historical inquiry is the process of investigation undertaken in order to understand the past. Steps in the inquiry process include posing questions, locating and analysing sources and using evidence from sources to develop an informed explanation about the past.

Interpretation

An interpretation is an explanation of the past, for example about a specific person, event or development. There may be more than one interpretation of a particular aspect of the past because historians may have used different sources, asked different questions and held different points of view about the topic.

Perspective

A person’s perspective is their point of view, the position from that they see and understand events going on around them. People in the past may have had different points of view about a particular event, depending on their age, gender, social position and their beliefs and values. Historians also have perspectives and this can influence their interpretation of the past. A way of viewing the world, the people in it, their relationship to each other and their relationship to communities and environments.

Reconstruction

A process of piecing together evidence from sources to develop an understanding or explanation of the past.

Representation

A picture or image of the past that may be a popular portrayal within society (past or present) or that may be created by historians.

Significance

The importance that is assigned to particular aspects of the past, eg events, developments, and historical sites. Significance includes an examination of the principles behind the selection of what should be investigated and remembered and involves consideration of questions such as: How did people in the past view the significance of an event? How important were the consequences of an event? What was the duration of the event? How relevant is it to the contemporary world?

Source

Any written or non-written materials that can be used to investigate the past, for example coins, letters, tombs, buildings. A source becomes ‘evidence’ if it is of value to a particular inquiry.

Terms

A word or phrase used to describe abstract aspects or features of the past (for example imperialism, democracy, republic) and more specific features such as a pyramid, gladiator, and temple.

Anthropocene

An informal term commonly used to define the most recent period of geologic time. It is used to highlight the extent to which human activities have impacted on the Earth's ecosystems. Evidence of human impact such as the proliferation and spread of managed and constructed elements of environments – together with climate change, habitat loss and species extinctions – are cited by scientists as evidence that human impact has significantly changed the nature of the earth's biodiversity. There is not, however, a consensus on when the anthropocene commenced. Some scientists identify the Industrial Revolution as the start date. Others trace its beginnings to the rise of agriculture and the Neolithic Revolution some 12,000 years ago.

Anthropogenic biomes

Biomes that are the result of sustained direct human interactions with ecosystems.

Biophysical processes

The atmospheric, biological, chemical and physical processes that take place in the lithosphere, hydrosphere, atmosphere and biosphere. They can be further broken down, for example, soil- forming processes, mass wasting, cloud-forming processes, fluvial processes, marine processes, glacial processes and biogeochemical cycling.

Change

The concept of change involves both time and space. Geographical phenomena are constantly changing, and can often be best understood by investigating how they have developed over time periods ranging from a few years to thousands of years. This is important in helping students to understand what is happening around them and to see their world as dynamic.

Cultural internationalisation

The increasing integration of the different cultures found throughout the world and the diffusion of a dominant 'global culture'. It can be argued that the hybridisation of cultures is an outcome of the process.

Ecological hazard

A biological or chemical hazard that has the potential to impact adversely on the wellbeing of people or the environment more generally. Ecological hazards include biological and chemical agents. Biological factors can lead to infectious diseases. While many of these diseases have proven difficult to eradicate, enough is known about them to use interventions that drastically reduce their incidence. Chemical hazards can cause immediate, dangerous health effects and can also contribute to chronic, or long-term, problems. In contrast to infectious diseases, our understanding of the consequences of chemical exposure for people's health, especially very low-level exposures typically found in the environment, remains incomplete.

Economic integration

An outcome of the reduction or elimination of the barriers to the flow of goods, services and factors of production between nations. The stated aims of economic integration are to reduce costs incurred by consumers and producers, and to increase trade between countries.

Economic restructuring

Significant and enduring changes to the nature and structure of an economy.

Enterprise

An enterprise is an activity that produces goods and/or services. Enterprises are run for the benefit of an individual or a group of individuals. They can range in scale from a transnational corporation to home-based economic activities.

Environment/environments

The term ‘environment’, where unqualified, means the living and non-living elements of the earth’s surface and atmosphere. It includes human changes to the earth’s surface, for example, croplands, planted forests, buildings and roads.

Fieldwork

Fieldwork is an integral part of geographical learning. It provides a planned opportunity for students to engage with the environment – to observe and investigate in the ‘real world’ the geographical phenomena, issues and processes studied in the classroom. It also enables students to explore different perspectives or points of view on important geographical issues. There are multiple approaches to fieldwork ranging from the observational to the fully participatory. Fieldwork can be undertaken in a range of settings including school grounds. It includes ‘virtual fieldwork’ – the use of the Internet to virtually visit a site and engage in a guided geographical inquiry. A virtual field trip gives students the opportunity to investigate geographical phenomena not normally accessible due to distance or cost.

Geographical inquiry methodologies

An approach to the study focused on the development of a wide variety of skills such as observing, reading, gathering, organising, preparing, presenting, analysing, interpreting and synthesising geographic information from a variety of sources including spatial technologies and fieldwork. In short, it involves the skills needed to formulate questions and initiate, plan and implement an inquiry relevant to a geographical issue, process or phenomenon.

Geographical processes

The combination of physical and human forces that form and transform our world.

Global distribution

The spatial distribution of geographical phenomena throughout the world, for example, megacities, earthquake hazards, deforestation and fashion design.

Globalisation

In its broad sense, the term 'globalisation' refers to the diffusion of manufacturing, services, markets, culture, lifestyle, capital, technology and ideas across national boundaries and around the world. It also refers to the integration of these geographically dispersed economic and social activities. The particular character of individual countries, regions and even localities interacts with the larger scale general processes of change to produce quite specific outcomes (P. Dicken - Global Shift, 1992)

Hazards

When the forces of nature combine to become destructive and have potential to damage the environment and endanger communities.

Hybridisation of cultures

The process by which cultures around the world adopt a certain degree of homogenised global culture while clinging to aspects of their own traditional culture.

Interconnection

The concept of interconnection emphasises that no object of geographical study can be viewed in isolation. It is about the ways that geographical phenomena are connected to each other through environmental processes, the movement of people, flows of trade and investment, the purchase of goods and services, cultural influences, the exchange of ideas and information, political power and international agreements. Interconnections can be complex, reciprocal or interdependent, and have a strong influence on the characteristics of places. An understanding of the significance of interconnection leads to holistic thinking and helps students to see the various aspects of Geography as connected rather than separate bodies of knowledge.

International integration

The term international integration refers to a process whereby the nature of the relationship among economic or cultural entities changes in ways that erode the autonomy or uniqueness of each and make them part of a larger aggregate.

Liveability

Liveability is concerned with the quality of space and the built environment. The concept of liveability has been linked to a range of factors, for example, quality of life, health, sense of safety, access to services, cost of living, comfortable living standards, mobility and transport, air quality and social participation.

Megacity

Typically defined as a metropolitan area with a total population in excess of 10 million.

Natural carbon sequestration

The process of capture and long-term storage of atmospheric carbon dioxide by the natural biogeochemical cycling of carbon.

Natural hazard

Atmospheric, hydrological and geomorphic processes and events in our environment that have the potential to affect people adversely.

Place

Places play a fundamental role in human life. The world is made up of places, from those with largely natural features, for example, an area of rainforest, to those with largely constructed features such as the centre of a large city. Places are where we live and grow up. Our most common relationships are likely to be with people in the same place. The environmental and human qualities of places influence our lives and life opportunities. Places are, therefore, cultural constructs. They are sites of biodiversity; locations for economic activity; centres of decision-making and administration; sites for the transmission and exchange of knowledge and ideas; meeting places for social interaction; sources of identity, belonging and enjoyment; and areas of natural beauty and wonder. They are where major events occur, from natural disasters and financial crises to sporting events.
Places can also be laboratories for the comparative study of the relationships between processes and phenomena, because the uniqueness of each place means that similar processes and influences can produce different outcomes in different places.
The importance of Country/Place to Aboriginal and Torres Strait Islander Peoples is an example of the interaction between culture and identity, and shows how places can be invested with spiritual and other significance.

Risk management

In the Australian Curriculum: Geography, risk management is defined in terms of preparedness, mitigation and/or prevention of a natural or ecological hazard. Preparedness involves planning the interventions needed to prevent or mitigate the effects of a hazard. Mitigation involves the implementation of strategies to eliminate or minimise the effects of these hazards. Adaptation involves adjusting to the changed environmental circumstances.

Rural and remote

The Australian Bureau of Statistics defines ‘rural’ as any area which is not part of any urban area. Urban areas in Australia are defined as population clusters of 1,000 or more people, with a density of at least 200 people per square kilometre. The remoteness of a place is determined by the physical distance of a location from the nearest urban centre.

Scale

The concept of scale is used to analyse phenomena and look for explanations at different spatial levels, from the personal to the local, regional, national and global. Different factors can be involved in explaining phenomena at different scales. For example, in studies of vegetation, climate is the main factor at the global scale, but soil and drainage may be the main factors at the local scale. Deciding on the appropriate scale for an inquiry is therefore important.

Scale is also involved when geographers look for explanations or outcomes at different levels. Local events can have global outcomes. For example, the effects of local actions such as permanent vegetation removal on global climate. National and regional changes can also have local outcomes, as in the effects of economic policies on local economies.

Scale, however, may be perceived differently by diverse groups of people and organisations, and can be used to elevate or diminish the significance of an issue, for example, by labelling it as local or global.

Social exclusion

The processes by which individuals and even entire communities are systematically blocked from rights, opportunities and resources (for example, housing, employment, healthcare, civic engagement, democratic participation and due process) that are normally available to members of society and which are key to social integration.

Social justice

The concept that all people have the right to fair treatment and equal access to the benefits of society.

Socio-spatial inequality

Social and economic inequalities across space. It includes unequal access to essential goods and services depending on the area or location in which a person lives.

Space

The concept of space includes location, spatial distribution and the organisation of space. Location plays an important role in determining the environmental characteristics of a place, the viability of an economic activity or the opportunities open to an individual, but the effects of location on human activities also depend on the infrastructure and technology that link places, and the way these are managed by businesses and governments.

Spatial distribution, the second element in the concept of space, underlies much geographical study. The geographical characteristics of places have distributions across space that form patterns, and the analysis of these patterns contributes to an understanding of the causes of these characteristics and of the form they take in particular places. Spatial distributions also have significant environmental, economic, social and political consequences. (Students learn to identify and evaluate these consequences and the policies that could be adopted to respond to them.)

The organisation of space concerns how it is perceived, structured, organised and managed by people within specific cultural contexts, and how this creates particular types of spaces.

Spatial distribution

The arrangement of geographical phenomena or activities across the surface of the Earth.

Spatial technologies

Any software or hardware that interacts with real-world locations. The use of spatial technologies forms the basis of many geographers' work practice. The Global Positioning System (GPS), Google Earth, geographic information systems (GIS) and the use of satellite images are the most commonly used spatial technologies to visualise, manipulate, analyse, display and record spatial data.
The use of spatial technologies is integral to the inquiry and skills process. The spatial technology application links geographic locations to information about them so you can:
find information about places across the globe or locally
analyse relationships between locations
make decisions on the location of facilities
map the demographics of target markets
integrate maps with information from a variety of sources.

Sustainability

The concept of sustainability is used as a way to evaluate decisions and proposals as well as to measure the capacity of something to be maintained indefinitely into the future. It is used to frame questions, evaluate the findings of investigations, guide decisions and plan actions about environments, places and communities.

Temporal distribution

The distribution of geographical phenomena over time.

Thinking geographically

To think geographically involves the application of the discipline's organising concepts to investigation of geographical issues and phenomena. It involves conceptual knowledge – the ideas we use to enhance our knowledge and understanding of the world. The organising concepts in senior secondary Geography are place, space, environment, interconnection, sustainability, scale and change.

Transformation

In the context of this curriculum the term transformation refers to the processes of change from which forms of environmental, social, cultural and economic relationships and patterns emerge.

Urbanisation

The increasing percentage, or proportion of a population, living in urban areas of a country. The term 'level of urbanisation' is often used.

Variety of scales

The geographical view of processes and phenomena at different levels on a continuum from the local to the international and global scales. It may include: comparative studies at the same scale, studying the same issue and phenomenon at a range of scales, or seeking explanations at a different scale to the one being studied.

World city

World cities (sometimes referred to as global cities) are centres of global economic and cultural authority. They are the places where the world's most important financial and corporate institutions are based and where decisions that 'drive' the global economy are made. They also play a globally significant role in the production and dissemination of knowledge (for example, news, entertainment) and art. They are centres of research and innovation.

Contemporary world

The period of modern world history from 1945 to 2010.

Modern world

As defined in the Australian Curriculum: Senior Secondary Modern History, the period of time in the modern world between 1750 and 2010.

Secondary sources

In History, secondary sources are accounts about the past that were created after the time being investigated and which often use or refer to primary sources and present a particular interpretation. Examples of secondary sources include writings of historians, encyclopaedia, documentaries, history textbooks, and websites.

Sources

Any written or non-written materials that can be used to investigate the past, for example coins, letters, tombs, buildings. A source becomes 'evidence' if it is of value to a particular inquiry.

Primary and secondary sources

In History, primary sources are objects and documents created or written during the time being investigated, for example during an event or very soon after. Examples of primary sources include official documents, such as laws and treaties; personal documents, such as diaries and letters; photographs; film and documentaries. These original, firsthand accounts are analysed by the historian to answer questions about the past.
Secondary sources are accounts about the past that were created after the time being investigated and which often use or refer to primary sources and present a particular interpretation. Examples of secondary sources include writings of historians, encyclopaedia, documentaries, history textbooks, and websites.

Perspectives

A person’s perspective is their point of view, the position from that they see and understand events going on around them. People in the past may have had different points of view about a particular event, depending on their age, gender, social position and their beliefs and values. Historians also have perspectives and this can influence their interpretation of the past.

Interpretations

An interpretation is an explanation of the past, for example about a specific person, event or development. There may be more than one interpretation of a particular aspect of the past because historians may have used different sources, asked different questions and held different points of view about the topic

Abstract

Abstract scenario: a scenario for which there is no concrete referent provided.

Account

Account for: provide reasons for (something).
Give an account of: report or describe an event or experience.
Taking into account: considering other information or aspects.

Analyse

Consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.

Apply

Use, utilise or employ in a particular situation.

Assess

Determine the value, significance or extent of (something).

Coherent

Orderly, logical, and internally consistent relation of parts.

Communicates

Conveys knowledge and/or understandings to others.

Compare

Estimate, measure or note how things are similar or dissimilar.

Complex

Consisting of multiple interconnected parts or factors.

Considered

Formed after careful thought.

Critically analyse

Examine the component parts of an issue or information, for example the premise of an argument and its plausibility, illogical reasoning or faulty conclusions.

Critically evaluate

Evaluation of an issue or information that includes considering important factors and available evidence in making critical judgement that can be justified.

Deduce

Arrive at a conclusion by reasoning.

Demonstrate

Give a practical exhibition as an explanation.

Describe

Give an account of characteristics or features.

Design

Plan and evaluate the construction of a product or process.

Develop

In history: to construct, elaborate or expand.
In English: begin to build an opinion or idea.

Discuss

Talk or write about a topic, taking into account different issues and ideas.

Distinguish

Recognise point/s of difference.

Evaluate

Provide a detailed examination and substantiated judgement concerning the merit, significance or value of something.
In mathematics: calculate the value of a function at a particular value of its independent variables.

Explain

Provide additional information that demonstrates understanding of reasoning and/or application.

Familiar

Previously encountered in prior learning activities.

Identify

Establish or indicate who or what someone or something is.

Integrate

Combine elements.

Investigate

Plan, collect and interpret data/information and draw conclusions about.

Justify

Show how an argument or conclusion is right or reasonable.

Locate

Identify where something is found.

Manipulate

Adapt or change.

Non-routine

Non-routine problems: Problems solved using procedures not previously encountered in prior learning activities.

Reasonableness

Reasonableness of conclusions or judgements: the extent to which a conclusion or judgement is sound and makes sense.

Reasoned

Reasoned argument/conclusion: one that is sound, well-grounded, considered and thought out.

Recognise

Be aware of or acknowledge.

Relate

Tell or report about happenings, events or circumstances.

Represent

Use words, images, symbols or signs to convey meaning.

Reproduce

Copy or make close imitation.

Responding

In English: When students listen to, read or view texts they interact with those texts to make meaning. Responding involves students identifying, selecting, describing, comprehending, imagining, interpreting, analysing and evaluating.

Routine problems

Routine problems: Problems solved using procedures encountered in prior learning activities.

Select

Choose in preference to another or others.

Sequence

Arrange in order.

Solve

Work out a correct solution to a problem.

Structured

Arranged in a given organised sequence.
In Mathematics: When students provide a structured solution, the solution follows an organised sequence provided by a third party.

Substantiate

Establish proof using evidence.

Succinct

Written briefly and clearly expressed.

Sustained

Consistency maintained throughout.

Synthesise

Combine elements (information/ideas/components) into a coherent whole.

Understand

Perceive what is meant, grasp an idea, and to be thoroughly familiar with.

Unfamiliar

Not previously encountered in prior learning activities.

Geography - How the Subject works

Rationale/Aims

Rationale

The study of Geography draws on students' curiosity about the diversity of the world's places and their peoples, cultures and environments. It enables students to appreciate the complexity of our world and the diversity of its environments, economies and cultures. Students can use this knowledge to promote a more sustainable way of life and awareness of social and spatial inequalities.

In the senior secondary years, Geography provides a structured, disciplinary framework to investigate and analyse a range of challenges and associated opportunities facing Australia and the global community. These challenges include rapid change in biophysical environments, the sustainability of places, dealing with environmental risks and the consequences of international integration.

Geography as a discipline values imagination, creativity and speculation as modes of thought. It provides a systematic, integrative way of exploring, analysing and applying the concepts of place, space, environment, interconnection, sustainability, scale and change. These principal geographical concepts are applied and explored in depth through unit topics, to provide a deeper knowledge and understanding of the complex processes shaping our world. Taken together, the ability of students to apply conceptual knowledge in the context of an inquiry, and the application of skills, constitute 'thinking geographically' – a uniquely powerful way of viewing the world.

The subject builds students' knowledge and understanding of the uniqueness of places and an appreciation that place matters in explanations of economic, social and environmental phenomena and processes. It also develops students' knowledge about the interconnections between places. Nothing exists in isolation. Consequently, the subject considers the significance of location, distance and proximity.

Through the study of Geography students develop the ability to investigate the arrangement of biophysical and human phenomena across space in order to understand the interconnections between people, places and environments. As a subject of the Humanities and Social Sciences, Geography studies spatial aspects of human culture using inquiry methods that are analytical, critical and speculative. In doing so, it values imagination and creativity. As a Science, Geography develops an appreciation of the role of the biophysical environment in human life and an understanding of the effects of human activities on environments. As a result, it develops students' ability to identify, evaluate and justify appropriate and sustainable approaches to the future by thinking holistically and spatially when seeking answers to questions. Students are encouraged to investigate geographical issues and phenomena from a range of perspectives including those of Aboriginal and Torres Strait Islander Peoples.

In Geography, students investigate geographical issues and phenomena at a variety of scales and contexts. This may include: doing comparative studies at the same scale, studying the same issue or phenomenon at a range of scales, or seeking explanations at a different scale to the one being studied. The ability to perform multiscale and hierarchical analysis is developed in the senior years.

Students apply geographical inquiry through a more advanced study of geographical methods and skills in the senior years. They learn how to collect information from primary and secondary sources such as field observation and data collection, mapping, monitoring, remote sensing, case studies and reports. Fieldwork, in all its various forms, is central to such inquiries as it enables students to develop their understanding of the world through direct experience.

Geography promotes students' communication abilities by building their skills of spatial and visual representation, and interpretation, through the use of cartographic, diagrammatic, graphical, photographic and multimodal forms. In addition, students communicate their conclusions by traditional written and oral means.

Aims

The Senior Secondary Australian Curriculum: Geography aims to develop students':

- knowledge and understanding of the nature, causes and consequences of natural and ecological hazards; the challenges affecting the sustainability of places; land cover transformations; and international integration in a range of spatial contexts
- understanding and application of the concepts of place, space, environment, interconnection, sustainability, scale and change through inquiries into geographical phenomena and issues
- capacity to be accomplished, critical users of geographical inquiry and skills, and have the ability to think and communicate geographically
- ability to identify, evaluate and justify alternative responses to the geographical challenges facing humanity, and propose and justify actions taking into account environmental, social and economic factors.

Structure of Geography

Units

In Senior Secondary Geography, students develop their understanding about themes of immediate relevance to them and which have scope for application at a variety of scales, from the local to the global. There are four units:

Unit 1: Natural and ecological hazards

Unit 2: Sustainable places

Unit 3: Land cover transformations

Unit 4: Global transformations.

In Units 1 and 2 students are provided with a sound foundation for the study of the subject at the senior level. They are introduced to natural and ecological hazards, and challenges related to the liveability of places. In Unit 1, students examine the management of hazards and the risk they pose to people and environments. Risk management is defined in terms of preparedness, mitigation and/or prevention. In Unit 2, students investigate how the outcomes of processes, for example, population growth and decline, and economic restructuring, vary depending on local responses and adaptations. In this unit students also examine the causes and consequences of urbanisation with specific reference to the megacities of the developing world.

In Units 3 and 4 students apply the understandings and skills of Geography with greater rigour. They focus on human-initiated changes to biophysical cover of the earth's surface, leading to the creation of anthropogenic biomes, and the processes of international integration (globalisation). In Unit 3, students assess the impacts of land cover transformations with particular reference to climate change. In Unit 4, students evaluate the economic and cultural transformations taking place in the world, the spatial outcomes of these processes, and their social and geopolitical consequences. Through this study, students will be better able to understand the dynamic nature of the world in which they live.

Each unit comprises:

- a unit description – a short description of the purpose of and rationale
- learning outcomes – between five to seven statements describing the learning expected as a result of studying the unit
- content descriptions – descriptions of the essential content to be taught and learned, organised into two strands:
    - Geographical Knowledge and Understanding
    - Geographical Inquiry and Skills.

Organisation of content

The Australian Curriculum: Geography has two interrelated strands: Geographical Knowledge and Understanding and Geographical Inquiry and Skills. These strands are used to organise the geography learning from Foundation to Year 12. In the senior secondary Australian Curriculum: Geography the two strands build on students' learning from the Foundation to Year 10 Australian Curriculum: Geography. This strand organisation provides an opportunity to integrate content in flexible and meaningful ways.

Geographical knowledge and understanding

Geographical knowledge refers to the facts, generalisations, principles, theories and models developed in Geography. This knowledge is dynamic and its interpretation can be contested. Opinions and conclusions must be supported by evidence and logical argument.

Geographical understanding is the ability to see the relationships between items of knowledge and construct explanatory frameworks to illustrate these relationships. It is also the ability to apply this knowledge to new situations or to solve new problems.

Geographical inquiry and skills

Geographical inquiry is a process by which students learn and deepen their understanding. It involves individual or group investigations that start with geographical questions and proceed through the collection, interpretation, analysis and evaluation of information to the development of conclusions and proposals for actions. Inquiries may vary in scale and geographic context.

Geographical skills are the techniques that geographers use in their investigations undertaken during fieldwork and in classrooms. Students learn to think critically about the methods used to get information and represent, analyse and interpret it and communicate findings. Key skills developed through the Australian Curriculum: Geography include formulating a question and research plan; and recording and representing data, using a variety of spatial technologies including, where appropriate, geographic information systems. Students also learn to communicate using geographical terminology.

Relationships between the strands

The two strands are interrelated and the content has been written in a way that enables integration of the strands in the development of a teaching and learning program. The Geographical Knowledge and Understanding strand provides the contexts through which particular inquiries and skills are to be developed. The same set of geographical skills has been included in each of the four units to provide a common focus for the teaching and learning of content in the Geographical Knowledge and Understanding strand.

Organisation of achievement standards

The achievement standards in Geography have been organised into two dimensions: 'Geographical Knowledge and Understanding' and 'Geographical Inquiry and Skills'. These two dimensions reflect students' understanding and skills in the study of Geography. Senior secondary achievement standards have been written for each Australian Curriculum senior secondary subject.

The achievement standards indicate typical performance at five different levels (corresponding to grades A to E) following the completion of study of senior secondary Australian Curriculum content for a pair of units. They are broad statements of understanding and skills that are best read and understood in conjunction with the relevant unit content. They are structured to reflect key dimensions of the content of the subjects in the relevant learning area. Eventually they will be accompanied by illustrative and annotated samples of student work/performance/responses. The achievement standards will be refined empirically through an analysis of samples of student work and responses to assessment tasks: they cannot be maintained a priori without reference to actual student performance. Inferences can be drawn about the quality of student learning on the basis of observable differences in the extent, complexity, sophistication and generality of the understanding and skills typically demonstrated by students in response to well-designed assessment activities and tasks.

In the short term, achievement standards will inform assessment processes used by curriculum, assessment and certifying authorities for course offerings based on senior secondary Australian Curriculum content.

ACARA has made reference to a common syntax (as a guide, not a rule) in constructing the achievement standards across the subjects within each learning area. The common syntax that has guided development is as follows:

1. Given a specified context (as described in the curriculum content)
2. With a defined level of consistency/accuracy (the assumption that each level describes what the student does well, competently, independently, consistently)
3. Students perform a specified action (described through a verb)
4. In relation to what is valued in the curriculum (specified as the object or subject)
5. With a defined degree of sophistication, difficulty, complexity (described as an indication of quality).

Terms such as ‘analyse’ and ‘describe’ have been used to specify particular action but these can have everyday meanings that are quite general. ACARA has therefore associated these terms with specific meanings that are defined in the senior secondary achievement standards glossary and used precisely and consistently across the subjects within each learning area.

Links to Foundation to Year 10

The senior secondary Geography curriculum builds on the knowledge, conceptual understandings and inquiry skills developed in the Foundation to Year 10 Australian Curriculum: Geography.

Through a carefully selected series of units and their associated depth studies, the senior secondary Geography curriculum further develops students’ ability to explore, analyse and apply the concepts of place, space, environment, interconnection, sustainability, scale and change using the same strands used in the Foundation to Year 10 curriculum. It does, however, feature a wider range of geographical contexts and introduces students to a more diverse, and increasingly sophisticated, range of geographical tools and skills.

Representation of General capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that, together with the Geography curriculum content and the cross-curriculum priorities, will help students to live and work successfully in the twenty-first century.

The senior secondary Australian Curriculum: Geography includes all seven general capabilities:

- Literacy
- Numeracy

- Information and Communication Technology (ICT) capability
- Critical and creative thinking
- Personal and social capability
- Ethical understanding
- Intercultural understanding.

Literacy

Literacy involves students using their literacy skills to explore, interpret and evaluate geographical phenomena and issues and communicate geographically. Students work with oral, print, visual and digital texts to gather, synthesise and analyse information from a range of sources, and present and justify ideas, conclusions and opinions within a broad range of geographical contexts. They understand how language is used and modified for specific purposes, and question attitudes and assumptions embedded in texts.

Geography students also develop visual literacy skills as they make meaning of information communicated through modes including maps, graphs, cartoons and other images.

Numeracy

Numeracy involves students using numeracy skills to identify and describe a wide range of patterns and relationships, including those that can be visually represented on a graph or map. Geography students also apply their numeracy skills to interpret and manipulate data. These skills help students to realise and describe change as it occurs over time. Students demonstrate numeracy capability by making connections between apparently diverse facts and suggesting solutions to problems in a range of circumstances, for example, the relationship between weather patterns and the likelihood of natural hazards such as drought or landslides.

Information and Communication Technology (ICT) capability

Information and Communication Technology (ICT) capability involves students using ICT to develop geographical understanding and support the application of geographical skills. Students use digital tools, including spatial technologies, to support their inquiries into geographical phenomena and issues. They also use these tools to collect and analyse data, represent it in a digital form, access and manipulate databases, and model conceptual constructs. In addition, students critically analyse the quality of digital information and sources of information. They also create multimodal and multifaceted reports and presentations to represent and communicate the results of geographical inquiry.

Students recognise the relative possibilities, limitations and consequences of using different forms of digital information and methods of distributing this information, and apply sophisticated understandings of social and ethical practices in the use of digital information and communications. In particular, they consider how geographical and demographic data may be used and the ethical considerations involved.

Critical and creative thinking

Critical and creative thinking processes and skills are used by students when examining diverse interactions between people, perspectives, interpretations, phenomena and environments. Through multifaceted problem posing and solving they explore the interconnections, uncertainty and consequences of these relationships.

Thinking laterally, visualising possibilities, testing options using criteria, and making judgements are essential skills for conducting geographical investigations connected with the environment, space, sustainability, scale and change. When seeking answers to questions students think holistically and spatially using skills such as analysis, interpretation, extrapolation from trends, synthesis of relationships and exploration of anomalies evident in patterns.

Through developing dispositions such as intellectual openness, curiosity and initiative they investigate biophysical and human phenomena. As independent and autonomous thinkers who seek explanations and value discovery, students turn creativity and innovation into action, apply new knowledge to identified gaps, and justify their action.

Personal and social capability

Personal and social capability involves students taking responsible personal, social and environmental action against, or in support of, decisions by organisations, governments or other bodies. Through the study of Geography, students are provided with learning opportunities to help them to develop, rehearse and refine their skills in listening to, respecting and acknowledging diverse perspectives and opinions. Students participate in collaborative investigative group-work to make ethical, rational social decisions and solve problems that relate to their social and environmental contexts. Developing these personal and social capabilities positions them positively to advocate for opportunities and methods for change in a democratic society.

Personal and social capability occurs when responsible social and environmental actions and participation are promoted and this should be a logical outcome of many geographical investigations.

Ethical understanding

Ethical understanding plays an important role in geographical inquiry. Students uncover and assess ethical considerations such as the links between human rights and responsibilities and the ways diverse perspectives, values and cultures impact on geographical issues. Through geographical inquiry students have opportunities to analyse, qualify and test their own attitudes, values and beliefs and explore how people's knowledge, attitudes and values affect judgements, decisions and actions as they apply to their interactions with environments. They become aware of the need for social responsibility when confronted with alternative opinions and when seeking to resolve problems. Students apply ethical standards to guide their use of digital representations of phenomena and statistics associated with biophysical and environmental factors and relationships.

Intercultural understanding

Students deepen their intercultural understanding as they examine geographical issues in a broad range of cultural contexts. This involves students in developing their understanding of the complexity and diversity of the world's cultures and evaluating alternative responses to the world's environments and challenges. It enables students to find interconnections and sustainable solutions in an internationally integrated world, and consider the implications of their responses from different cultural responses.

Representation of Cross-curriculum priorities

While the significance of the cross-curriculum priorities for Geography varies, there are opportunities for teachers to select contexts that incorporate the key concepts from each priority.

Aboriginal and Torres Strait Islander histories and cultures

Students are provided with a range of opportunities to learn about *Aboriginal and Torres Strait Islander histories and cultures* in Geography. They can, for example, investigate how Aboriginal and Torres Strait Islander People may be unequally affected by natural and ecological hazards, are represented in the challenges faced by places, have contributed to land cover change in Australia through their land management practices over time, and have been affected by land cover change and the process of international cultural integration. More broadly, students develop a range of capabilities that enable them to independently construct informed responses to the range of geographical issues involving Aboriginal and Torres Strait Islander Peoples.

Asia and Australia's engagement with Asia

Students could investigate a wide range of contexts that draw on *Asia and Australia's engagement with Asia* through Geography. This priority can be addressed through: the study of natural and ecological hazards and how the risks associated with such occurrences can be managed to eliminate or minimise harm to people and the environment; the challenges faced by megacities in developing countries, particularly those from the Asia region; human-related land cover transformations; and other transformations taking place as a result of economic and cultural integration.

Sustainability

Students can explicitly address *Sustainability* in Geography through an investigation of the approaches to sustainability and through an evaluation of alternative responses to geographical issues and phenomena. In doing so, they use economic, social and environmental criteria to frame investigative questions and to measure the capacity of something to be maintained indefinitely into the future.

Unit 1: Natural and ecological hazards

Unit 1: Natural and ecological hazards Description

Natural and ecological hazards represent potential sources of harm to human life, health, income and property, and may affect elements of the biophysical, managed and constructed elements of environments.

This unit focuses on identifying risks and managing those risks to eliminate or minimise harm to people and the environment. Risk management, in this particular context, refers to prevention, mitigation and preparedness. Prevention is about things we can do to prevent a hazard from happening. Mitigation is about reducing or eliminating the impact if the hazard does happen. Preparedness refers to actions taken to create and maintain the capacity of communities to respond to, and recover from, natural disasters, through measures such as planning, community education, information management, communications and warning systems.

Building on their existing geographical knowledge and understandings, students examine natural hazards including atmospheric, hydrological and geomorphic hazards, for example, storms, cyclones, tornadoes, frosts, droughts, bushfires, flooding, earthquakes, volcanoes and landslides. They also explore ecological hazards, for example, environmental diseases/pandemics (toxin-based respiratory ailments, infectious diseases, animal-transmitted diseases and water-borne diseases) and plant and animal invasions.

This unit includes an overview of natural and ecological hazards and two depth studies: one focusing on a natural hazard and one focusing on an ecological hazard.

The scale of study for this unit, unless specified, can range from local to global, as appropriate. The potential for fieldwork will depend on the hazards selected.

In undertaking these depth studies, students develop an understanding about using and applying geographical inquiry, tools such as spatial technologies, and skills, to model, assess and forecast risk, and to investigate the risks associated with natural and ecological hazards.

Unit 1: Natural and ecological hazards Learning Outcomes

By the end of this unit, students will:

- understand that places and environments can be influenced by both natural and ecological hazards
- understand the complexity of human–environment interdependence in relation to natural and ecological hazards
- demonstrate knowledge of the concept of risk management
- understand and apply key geographical concepts – including place, space, environment, interconnection, sustainability, scale and change – as part of a geographical inquiry
- apply geographical inquiry and a range of skills, including spatial technologies and fieldwork, to investigate natural and ecological hazards
- compare Australian and international risk management policies, procedures and practices
- evaluate Australian and international risk management policies, procedures and practices.

Unit 1: Natural and ecological hazards Content Descriptions

Geographical Inquiry and Skills

Observing, questioning and planning

formulates geographical inquiry questions (ACHGE001)

plans a geographical inquiry with clearly defined aims and appropriate methodology (ACHGE002)

Collecting, recording, evaluating and representing

collects geographical information incorporating ethical protocols from a range of primary and secondary sources (ACHGE003)

records observations in a range of graphic representations using spatial technologies and information and communication technologies (ACHGE004)

evaluates the reliability, validity and usefulness of geographical sources and information (ACHGE005)

Interpreting, analysing and concluding

analyses geographical information and data from a range of primary and secondary sources and a variety of perspectives to draw reasoned conclusions and make generalisations (ACHGE006)

identifies and analyses trends and patterns, infers relationships, and makes predictions and inferences (ACHGE007)

Communicating

communicates geographical information, ideas, issues and arguments using appropriate written and/or oral, cartographic and graphic forms (ACHGE008)

uses geographical language in appropriate contexts to demonstrate geographical knowledge and understanding (ACHGE009)

Reflecting and responding

applies generalisations to evaluate alternative responses to geographical issues at a variety of scales (ACHGE010)

proposes individual and collective action, taking into account environmental, social and economic factors; and predicts the outcomes of the proposed action (ACHGE011)

Geographical Knowledge and Understanding

Overview of natural and ecological hazards

An overview of the nature of natural hazards (atmospheric, hydrological, and geomorphic) and ecological hazards (ACHGE012)

The concept of risk as applied to natural and ecological hazards (ACHGE013)

The temporal and spatial distribution, randomness, magnitude, frequency and scale of spatial impact of natural and ecological hazards at a global scale (ACHGE014)

The role of spatial technologies in the study of natural and ecological hazards (ACHGE015)

Students complete both depth studies which are to be taught with the requisite geographical inquiry and skills described as part of this unit:

Depth study of a natural hazard

A depth study, using fieldwork and/or secondary sources, to investigate one natural hazard, and how the risks associated with the hazard are being managed. The scale of study is determined by the nature of the natural hazard selected.

Students select ONE natural hazard to investigate:

the nature and causes of the selected hazard and explain how the activities of people can intensify its impacts (ACHGE016)

the magnitude, frequency, duration, temporal spacing and effects of the hazard (ACHGE017)

the spatial distribution of the hazard, and how an understanding of biophysical and human processes can be used to explain the patterns that are identified (ACHGE018)

the physical and human factors that explain why some places are more vulnerable than others (ACHGE019)

the environmental, economic and social impacts of the hazard in a developed country such as Australia compared with at least one developing country or region (ACHGE020)

the sustainable risk management policies, procedures and practices designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. (ACHGE021)

Depth study of an ecological hazard

A depth study, using fieldwork and/or secondary sources, to investigate one ecological hazard, and how the risks associated with the hazard are being managed. The scale of study is determined by the nature of the ecological hazard selected.

Students select ONE ecological hazard to investigate:

the nature and causes of the selected hazard and how the activities of people can intensify its impacts (ACHGE022)

the magnitude, frequency, duration, temporal spacing and effects of the hazard (ACHGE023)

the diffusion and resulting spatial distribution of the hazard, and how an understanding of biophysical and human processes can be used to explain its spread (ACHGE024)

the physical and human factors that explain why some places are more vulnerable than others (ACHGE025)

the environmental, economic and social impacts of the hazard in a developed country such as Australia compared with at least one developing country or region (ACHGE026)

the sustainable risk management policies, procedures and practices designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. (ACHGE027)

Unit 2: Sustainable places

Unit 2: Sustainable places Description

This unit examines the economic, social and environmental sustainability of places. While all places are subject to changes produced by economic, demographic, social, political and environmental processes, the outcomes of these processes vary depending on local responses and adaptations.

At a global scale, the process of urbanisation is not only affecting the rate of world population growth and human wellbeing, it has created a range of challenges for both urban and rural places. How people respond to these challenges, individually and collectively, will determine the sustainability and liveability of places into the future.

The interconnected challenges faced in places, including population growth and decline, employment, economic restructuring, transport infrastructure needs, housing, demands for improved health and education services, and other matters related to liveability, are a particular focus of this unit.

In Australia's metropolitan and regional cities, the challenges may also include managing economic growth, urban sprawl, car dependency, environmental degradation, abandoned land, and deficiencies in urban planning, service provision and management. In rural and remote places the challenges may include lack of employment for young people, lack of educational services, poor transportation connections to major centres, closure of a major industry, lack of service provision, isolation and remoteness.

Students examine how governments, planners, communities, interest groups and individuals try to address these challenges to ensure that places are sustainable. They also investigate the ways that geographical knowledge and skills can be applied to identify and address these challenges.

This unit includes an overview of places and the challenges faced by cities in the developed and developing world. The unit also includes two depth studies: one focusing on challenges faced by a place in Australia, and one focusing on challenges faced by a megacity in a developing country. The scale of study for this unit, unless specified, can range from local to global, as appropriate.

The scale of study in this unit begins at the global, through an examination of the process of urbanisation and its consequences, before focusing on the challenges facing places in Australia, with the opportunity to undertake a local area study. The scale of study then shifts to national and regional to investigate megacities in developing countries. This approach enables students to develop an understanding of the challenges for places in both the developed and developing worlds. It also enables them to compare and contrast the way in which the challenges are addressed at a variety of scales and in different contexts.

In undertaking these depth studies, students develop an understanding about using and applying geographical inquiry, tools such as spatial technologies, and skills, to investigate the sustainability of places.

Unit 2: Sustainable places Learning Outcomes

By the end of this unit, students will:

- understand the processes resulting in change in places and how the places investigated can be made more sustainable
- understand the outcomes of the processes creating change in different communities
- understand and apply key geographical concepts – including place, space, environment, interconnection, sustainability, scale and change – as part of a geographical inquiry

- gather and analyse primary and secondary data to reveal trends in and relationships between the processes resulting in changes in places
- apply geographical inquiry and a range of skills, including spatial technologies and fieldwork, to investigate a challenge associated with the sustainability of places
- evaluate alternative strategies or proposals to manage the selected challenge.

Unit 2: Sustainable places Content Descriptions

Geographical Inquiry and Skills

Observing, questioning and planning

formulates geographical inquiry questions (ACHGE028)

plans a geographical inquiry with clearly defined aims and appropriate methodology (ACHGE029)

Collecting, recording, evaluating and representing

collects geographical information incorporating ethical protocols from a range of primary and secondary sources (ACHGE030)

records observations in a range of graphic representations using spatial technologies and information and communication technologies (ACHGE031)

evaluates the reliability, validity and usefulness of geographical sources and information (ACHGE032)

Interpreting, analysing and concluding

analyses geographical information and data from a range of primary and secondary sources and a variety of perspectives to draw reasoned conclusions and make generalisations (ACHGE033)

identifies and analyses relationships, spatial patterns and trends and makes predictions and inferences (ACHGE034)

Communicating

communicates geographical information, ideas, issues and arguments using appropriate written and/or oral, cartographic and graphic forms (ACHGE035)

uses geographical language in appropriate contexts to demonstrate geographical knowledge and understanding (ACHGE036)

Reflecting and responding

applies generalisations to evaluate alternative responses to geographical issues at a variety of scales (ACHGE037)

proposes individual and collective action, taking into account environmental, social and economic factors; and predicts the outcomes of the proposed action (ACHGE038)

Geographical Knowledge and Understanding

Overview of places and their challenges

Places:

The process of urbanisation, its implications for world population growth, human wellbeing and urban and rural places. (ACHGE039)

The economic and environmental interdependence of urban and rural places. (ACHGE040)

The spatial distribution of metropolitan, regional, rural and remote places in Australia, and the factors that have contributed to this. (ACHGE041)

The changing demographic characteristics and economic functions of metropolitan, regional, rural and remote places in Australia. (ACHGE042)

Challenges facing places:

An overview of challenges for rural and remote places in Australia, including Indigenous communities. (ACHGE043)

An overview of challenges in metropolitan and regional cities in Australia. (ACHGE044)

An overview of the challenges faced in megacities in developing countries. (ACHGE045)

Students complete both depth studies which are to be taught with the requisite geographical inquiry and skills described as part of this unit:

Depth study of challenges facing a place in Australia

A depth study, using fieldwork and/or secondary sources, to investigate significant related challenges faced in one Australian place and how these challenges are being addressed.

Students select significant related challenges in a metropolitan, regional, rural or remote place, to investigate:

the nature, scope and causes of the selected challenges being confronted and the implication for the place (ACHGE046)

the range of strategies used to address the selected challenges and how these compare with, and/or have been informed by, responses implemented in other places both within and outside of Australia (ACHGE047)

the extent to which the strategies adopted have been, or could be, informed by the concept of sustainability (ACHGE048)

the strategies adopted and an assessment of how these have enhanced the sustainability and liveability of the place. (ACHGE049)

Depth study of challenges facing a megacity in a developing country

A depth study investigating significant challenges faced by **one** megacity in a developing country.

Students select significant selected challenges in a megacity to investigate:

the nature, scope and causes of the selected challenges being addressed and the implications for the selected megacity (ACHGE050)

the range of strategies used to address the selected challenges and how these compare with, and/or have been informed by, responses implemented in other developing and developed world megacities (ACHGE051)

the extent to which the strategies adopted have been, or could be, informed by the concept of sustainability (ACHGE052)

the strategies adopted and an assessment of how these have enhanced the sustainability and liveability of the megacity. (ACHGE053)

Unit 3: Land cover transformations

Unit 3: Land cover transformations Description

This unit focuses on the changing biophysical cover of the earth's surface, its impact on global climate and biodiversity, and the creation of anthropogenic biomes. In doing so, it examines the processes causing change in the earth's land cover. These processes may include: deforestation, the expansion and intensification of agriculture, rangeland modification, land and soil degradation, irrigation, land drainage, land reclamation, urban expansion and mining.

These processes have altered local and regional climates and hydrology, damaged ecosystem services, contributed to the loss of biodiversity, and altered soils. The scale at which these processes now occur is so extensive that there no longer exist any truly 'natural' environments. All environments are, to a greater or lesser extent, modified by human activity. This focus on anthropogenic biomes differentiates Geography from Earth and Environmental Science. The processes of land cover transformation have also changed the global climate through their interaction with atmospheric processes, and climate change is, in turn, producing further transformations in land cover.

The unit integrates aspects of physical and environmental Geography to provide students with a comprehensive and integrated understanding of processes related to land cover change, and their local and global environmental consequences. It also examines and evaluates the ways people seek to reverse the negative effects of land cover change.

This unit includes an overview of land cover change and two depth studies: one focusing on the interrelationship between land cover and either global climate change or biodiversity loss, and one focusing on a program designed to address land cover change.

The scale of study for this unit, unless specified, can range from local to global, as appropriate. There is, for example, the requirement that students investigate the impacts of land cover change on local and regional environments; a local land cover change initiative designed to address the issue of climate change of biodiversity loss; and the evaluation of program to address land cover change. Each of these provides opportunities for fieldwork.

In undertaking these depth studies, students develop an understanding about using and applying geographical inquiry, tools such as spatial technologies, and skills to investigate human–environment systems.

Unit 3: Land cover transformations Learning Outcomes

By the end of this unit, students will:

- understand the nature, extent and causes of the changing land cover of the earth's surface, including the presence of anthropogenic biomes, and evaluate projections of future changes in global land cover
- understand the local and regional effects of land cover change on ecosystems, and the interrelationships between land cover change and global climate change or biodiversity loss
- understand and apply key geographical concepts – including place, space, environment, interconnection, sustainability, scale and change – as part of a geographical inquiry
- apply geographical inquiry and a range of skills, including spatial technologies and fieldwork, to investigate land cover change and its consequences

- evaluate the environmental, economic and social benefits and costs of a program aimed at responding to the negative impacts of land cover change.

Unit 3: Land cover transformations Content Descriptions

Geographical Inquiry and Skills

Observing, questioning and planning

formulates geographical inquiry questions (ACHGE054)

plans a geographical inquiry with clearly defined aims and appropriate methodology (ACHGE055)

Collecting, recording, evaluating and representing

collects geographical information incorporating ethical protocols from a range of primary and secondary sources (ACHGE056)

records observations in a range of graphic representations using spatial technologies and information and communication technologies (ACHGE057)

evaluates the reliability, validity and usefulness of geographical sources and information (ACHGE058)

Interpreting, analysing and concluding

analyses geographical information and data from a range of primary and secondary sources and a variety of perspectives to draw reasoned conclusions and make generalisations (ACHGE059)

identifies and analyses trends and patterns, infers relationships, and makes predictions and inferences (ACHGE060)

Communicating

communicates geographical information, ideas, issues and arguments using appropriate written and/or oral, cartographic and graphic forms (ACHGE061)

uses geographical language in appropriate contexts to demonstrate geographical knowledge and understanding (ACHGE062)

Reflecting and responding

applies generalisations to evaluate alternative responses to geographical issues at a variety of scales (ACHGE063)

proposes individual and collective action taking into account environmental, social and economic factors; and predicts the outcomes of the proposed action (ACHGE064)

Geographical Knowledge and Understanding

Overview: nature, extent, causes and consequences of land cover change

Reference should be made to global forests, cropland, rangelands, pasture and urban land cover using illustrative examples drawn from different regions and countries and at different scales.

The identification and classification of land cover change using remotely sensed images and aerial photographs. (ACHGE065)

The interpretation of data sourced from spatial technologies and fieldwork to explain the nature, rate, extent and consequences of land cover change. (ACHGE066)

World population growth, growing affluence, advances in technology and their impact on the rate and extent of land cover change and biodiversity. (ACHGE067)

The differences in the process of land cover change between countries due to factors such as government policy, institutional arrangements, land ownership, type of economy, ideology and culture, in addition to the range of physical factors. (ACHGE068)

Methods of projecting changes in land cover using spatial modelling, incorporating both environmental and socioeconomic variables. (ACHGE069)

Indigenous peoples' land management practices and their impact on land cover over time including those of Aboriginal and Torres Strait Islander Peoples. (ACHGE070)

The relationship between land cover change and climate change and the long-term impact of climate change on land cover. (ACHGE071)

The impacts of land cover change on local and regional environments. (ACHGE072)

Human-generated land cover change and its consequences including: the competitive advantages of indigenous and introduced species; the balance within each of these groups; and the effects such changes might have on land cover changes and biodiversity. (ACHGE073)

The concept of anthropogenic biomes and its implications for our understanding of the functioning of the world's ecosystems. (ACHGE074)

Students complete both depth studies which are to be taught with the requisite geographical inquiry and skills described as part of this unit:

Depth study of the interrelationship between land cover change and changes in either global climate or biodiversity

A depth study to investigate the links between changes in land cover and changes in global climate or biodiversity:

Climate change

The causes, rate and projected impacts of global climate change. (ACHGE075)

The interrelationships between land cover change and climate change, for example, the impacts of land cover loss on surface reflectivity (albedo) and the process of natural carbon sequestration. (ACHGE076)

The effects of climate change on land cover, for example, vegetation, ice sheets, glaciers and coral reefs. (ACHGE077)

A local initiative designed to address the effects of global climate change on land cover. (ACHGE078)

Biodiversity

The causes, rate and projected impacts of declining biodiversity. (ACHGE079)

The interrelationships between land cover change and biodiversity loss, for example, the processes of evolutionary diversification and species extinction and their implications for land cover in the future. (ACHGE080)

The effects of biodiversity loss on ecosystem services and species, and ecosystem and genetic diversity. (ACHGE081)

A local initiative designed to address the effects of biodiversity loss or change. (ACHGE082)

Depth study of a program to address land cover change

A depth study, using fieldwork and/or secondary sources, to investigate how land cover change is being addressed and evaluated.

Students select ONE existing program that addresses land cover change in order to investigate:

approaches to land cover restoration and rehabilitation, and the mitigation of future land cover changes, for example, debt-for-nature swaps and preservation strategies (ACHGE083)

a program designed to address the issue of land cover change and its consequences at a local scale (for example, coast dune rehabilitation, urban zoning regulations) (ACHGE084)

the selected program’s environmental, economic, and social benefits and costs (ACHGE085)

an assessment of the program’s effectiveness (ACHGE086)

an evaluation of alternative approaches to the restoration and rehabilitation of the area being studied using the concept of sustainability to determine which approach has the potential to address the issue into the future. (ACHGE087)

Unit 4: Global transformations

Unit 4: Global transformations Description

This unit focuses on the process of international integration (globalisation) as a conceptual 'lens' through which to investigate issues in human geography. In doing so, it integrates the sub disciplines of economic and cultural geography, and political geography. Economic geography involves study of the changing location, distribution and spatial organisation of economic activities across the world, while cultural geography focuses on the patterns and interactions of human culture, both material and non-material. Both sub disciplines make an important contribution to our understanding of the human organisation of space. Political geography examines the spatial consequences of power at all scales from the personal to global.

The topic provides students with an understanding of the economic and cultural transformations taking place in the world today, the spatial outcomes of these processes, and their political and social consequences. It will better enable them to make sense of the dynamic world in which they will live and work. It will also allow them to be active participants in the public discourses and debate related to such matters.

The unit is based on the reality that we live in an increasingly interconnected world. This is a world in which advances in transport and telecommunications technologies have not only transformed global patterns of production and consumption but also facilitated the diffusion of ideas and cultures. Of particular interest is the ways in which people adapt and respond to these changes.

Students have the opportunity to explore the ideas developed in the unit through an investigation of the changes taking place in the spatial distribution of the production and consumption of a selected commodity, good or service or the study of an example of cultural diffusion, adoption and adaptation. They also investigate the ways people either embrace, adapt to, or resist the forces of international integration.

This unit includes an overview of international integration (globalisation) and a choice of depth studies: one focusing on economic integration, and one focusing on international cultural integration.

While the scale of study in this unit begins with the global, locally based examples can be used to enhance students' conceptual understanding. The scale of study for the selected depth study, unless specified, can range from local to global, as appropriate.

In undertaking these studies, students develop an understanding about using and applying geographical inquiry, tools such as spatial technologies, and skills to investigate the transformations taking place throughout the world.

Unit 4: Global transformations Learning Outcomes

By the end of this unit, students will:

- understand the nature and causes of international integration and its spatial, economic, political and social consequences
- understand the ways people adapt to and resist the forces of international integration
- understand and apply key geographical concepts – including place, space, environment, interconnection, sustainability, scale and change – as part of a geographical inquiry
- think geographically, based on an understanding of the complexities of an increasingly interdependent world
- apply geographical inquiry and a range of skills, including spatial technologies and fieldwork, to

investigate the complexity of the integrated world
- evaluate alternative futures drawing on an understanding of an integrated global society.

Unit 4: Global transformations Content Descriptions

Geographical Inquiry and Skills

Observing, questioning and planning

formulates geographical inquiry questions (ACHGE088)

plans a geographical inquiry with clearly defined aims and appropriate methodology (ACHGE089)

Collecting, recording, evaluating and representing

collects geographical information incorporating ethical protocols from a range of primary and secondary sources (ACHGE090)

records observations in a range of graphic representations using spatial technologies and information and communication technologies (ACHGE091)

evaluates the reliability, validity and usefulness of geographical sources and information (ACHGE092)

Interpreting, analysing and concluding

analyses geographical information and data from a range of primary and secondary sources and a variety of perspectives to draw reasoned conclusions and make generalisations (ACHGE093)

identifies and analyses trends and patterns, infers relationships, and makes predictions and inferences (ACHGE094)

Communicating

communicates geographical information, ideas, issues and arguments using appropriate written and/or oral, cartographic and graphic forms (ACHGE095)

uses geographical language in appropriate contexts to demonstrate geographical knowledge and understanding (ACHGE096)

Reflecting and responding

applies generalisations to evaluate alternative responses to geographical issues at a variety of scales (ACHGE097)

proposes individual and collective action, taking into account environmental, social and economic factors; and predicts the outcomes of the proposed action (ACHGE098)

Geographical Knowledge and Understanding

Overview of international integration

The process of international integration, especially as it relates to the transformations taking place in the spatial distribution of production and consumption of commodities and services, and the diffusion and adaptation of ideas, meanings and values that continuously transform and renew cultures. (ACHGE099)

Advances in transport and telecommunications technologies as a facilitator of international integration including their role in the expansion of world trade, the emergence of global financial markets and the dissemination of ideas and culture through corporate, retail outlets, and the hubs of international literature, music, film and media. (ACHGE100)

The economic and cultural importance of world cities in the integrated global economy and their emergence as centres of cultural innovation, transmission and integration of new ideas about the plurality of life throughout the world. (ACHGE101)

The re-emergence of China and India as global economic powers and the relative economic decline but sustained cultural influence of the United States of America and Europe. (ACHGE102)

Students complete ONE of the depth studies which is to be taught with the requisite geographical inquiry and skills described as part of this unit:

A. International economic integration

A depth study, using fieldwork and/or secondary sources, to investigate the changing spatial distribution of production and consumption (and, where appropriate, re-use) of a selected commodity, good or service.

Students should make reference to ONE of the following:

- a mineral ore or fossil-based energy resource
- a food or fibre-based commodity
- a complex manufactured commodity
- a commodity typical of the 'weightless' or service-based economy.

For the selected commodity, good or service, investigate:

the changes occurring in the spatial distribution of its production and consumption, and the geographical factors responsible for these changes (ACHGE103)

the role played by technological advances in transport and/or telecommunications in facilitating these changes (ACHGE104)

the role played by the reduction or elimination of the barriers to its movement between countries (ACHGE105)

the role played by enterprises in the internationalisation of its production and consumption (ACHGE106)

implications of these changes for people, places and the biophysical environment at a variety of scales including the local (ACHGE107)

likely future changes in the nature and spatial distribution of its production and consumption (ACHGE108)

the ways people and places embrace, adapt to, or resist the forces of international economic integration (ACHGE109)

the spatial, economic, social and geopolitical consequences of these responses. (ACHGE110)

B. International cultural integration

A depth study, using fieldwork and/or secondary sources, to investigate an example of cultural diffusion, adoption and adaptation, and its consequences for the cultural geography of places.

For the selected element of culture investigate the following as applicable:

the process of diffusion and its spatial outcomes (ACHGE111)

the role played by technological advances in transport and/or telecommunications in its diffusion (ACHGE112)

the role played by transnational institutions and/or corporations in its dispersion (ACHGE113)

the role played by media and emerging technologies in its generation and dispersion (ACHGE114)

implications of these changes for peoples and places at a range of scales including the local (ACHGE115)

likely future changes in its nature and spatial distribution (ACHGE116)

the ways people embrace, adapt to, or resist international cultural integration (ACHGE117)

the spatial, economic, social and geopolitical consequences of these responses. (ACHGE118)

Units 1 and 2 Achievement Standard

Geographical Knowledge and Understanding

A	B	C	D	E
The student: • analyses how processes of change have spatial consequences in places and environments at a range of scales, and explains the role of context • analyses interconnections between people, places and environments, and their geographical significance and consequences • analyses spatial distributions, patterns and associations at a range of scales and in different contexts, and predicts plausible future changes • analyses alternative views on a geographical issue or challenge and explains how decision-making is informed by interacting environmental, economic and social factors	The student: • explains how processes of change have consequences in places and environments at a range of scales and in different contexts • explains interconnections between people, places and environments, and their geographical significance and consequences • explains spatial distributions, patterns and associations at a range of scales and in different contexts • explains alternative views on a geographical issue or challenge and how decision-making is informed by environmental, economic and social factors	The student: • explains how processes of change affect places and environments at different scales • describes interconnections between people, places and environments, and their geographical significance and consequences • describes spatial distributions, patterns and associations at a range of scales • describes alternative views on a geographical issue or challenge and how decision-making is informed by environmental, economic and social factors	The student: • describes how change affects places and environments with limited reference to scale • identifies interconnections between people, places and environments and outlines their geographical significance and consequences • describes spatial distributions, patterns and associations • describes alternative views on a geographical issue or challenge	T

Geographical Inquiry and Skills

A	B	C	D	E
The student: • plans and undertakes independent geographical inquiries to collect and analyse relevant data and information based on a critical evaluation of reliable and useful sources • selects, constructs and uses appropriate representations to explain relationships, spatial patterns and trends • analyses information and multivariable data to draw evidence-based conclusions that identify limitations • communicates complex ideas and coherent	The student: • plans and undertakes independent geographical inquiries to collect and analyse relevant data and information based on an assessment of reliable and useful sources • selects, constructs and uses appropriate representations to describe relationships, spatial patterns and trends • interprets information and multivariable data to draw evidence-based conclusions • communicates ideas and coherent explanations, selecting appropriate	The student: • undertakes guided geographical inquiries to collect and analyse data and information based on a range of appropriate sources • selects, constructs and uses appropriate representations to describe relationships, simple spatial patterns and trends • interprets information and multivariable data to draw conclusions • communicates ideas and explanations in written, oral and graphic forms using appropriate language • uses	The student: • undertakes guided geographical inquiries using limited sources • constructs and uses representations to describe relationships and identify simple spatial patterns and trends • interprets information and data to draw simple conclusions • communicates ideas and information in written, oral and graphic forms • proposes action in response to a contemporary issue, and identifies some of the possible outcomes	The

and sustained explanations, selecting appropriate language and forms for audience and purpose • uses reasoned criteria to propose and justify action in response to a contemporary geographical issue or challenge and analyses possible outcomes of the action	language and forms for audience and purpose • uses appropriate criteria to propose and justify action in response to a contemporary geographical issue or challenge, and describes a range of possible outcomes of the action	appropriate criteria to propose action in response to a contemporary geographical issue or challenge, and predicts possible outcomes of the action		

Units 3 and 4 Achievement Standard

Geographical Knowledge and Understanding

A	B	C	D	E
The student: • analyses how processes of change have spatial consequences in places and environments across a range of scales, and evaluates the role of context • analyses interconnections between people, places and environments, and evaluates their geographical significance and consequences • analyses spatial distributions, patterns and associations at a range of scales and in different contexts, and makes reasoned predictions about plausible future changes • evaluates alternative views on a geographical issue or challenge, and analyses how decision-making is informed by interacting environmental,	The student: • explains how processes of change have spatial consequences in places and environments at a range of scales, and explains the role of context • explains interconnections between people, places and environments, and analyses their geographical significance and consequences • explains spatial distributions, patterns and associations at a range of scales and in different contexts, and predicts plausible future changes • analyses alternative views on a geographical issue or challenge and explains how decision-making is informed by interacting environmental, economic and social factors	The student: • explains how processes of change have consequences in places and environments at a range of scales and in different contexts • describes interconnections between people, places and environments, and explains their geographical significance and consequences • describes spatial distributions, patterns and associations at a range of scales and in different contexts, and predicts future changes • explains alternative views on a geographical issue or challenge and describes how decision-making is informed by environmental, economic and social factors	The student: • describes how processes of change affect places and environments at different scales • identifies interconnections between people, places and environments, and describes their geographical significance and consequences • describes spatial distributions, patterns and associations at a range of scales and in different contexts • describes alternative views on a geographical issue or challenge, and identifies the role of environmental, economic and social factors in making decisions	T

economic and social factors at a range of scales			

Geographical Inquiry and Skills

A	B	C	D	E
• plans and undertakes comprehensive, independent geographical inquiries to collect and analyse relevant data and information based on a critical evaluation of a range of reliable and useful sources using valid methods • selects, constructs and uses a range of appropriate representations to describe and analyse change in relationships and spatial patterns and trends over time and at a range of scales • evaluates information and multivariable data to draw evidence-based conclusions that identify limitations and explain anomalies	• plans and undertakes independent geographical inquiries selecting and using relevant methods and data and information based on a critical evaluation of a range of reliable and useful sources • selects, constructs and uses appropriate representations to describe relationships and explain change in spatial patterns and trends over time and at different scales • analyses information and multivariable data to draw evidence-based conclusions that identify limitations • communicates complex ideas	• undertakes independent geographical inquiries, selecting and using relevant methods and data and information from a range of appropriate sources • selects, constructs and uses appropriate representations to describe relationships and spatial patterns and trends over time • interprets information and multivariable data to draw evidence-based conclusions • communicates ideas and explanations clearly, using appropriate language and forms • uses appropriate criteria to propose	• undertakes guided geographical inquiries using some appropriate sources • constructs and uses representations to describe relationships and spatial patterns and trends • interprets information and data to draw conclusions • communicates ideas and information using appropriate language • proposes action in response to a contemporary issue and describes some of the possible outcomes	

• communicates complex ideas and coherent and sustained explanations effectively, selecting appropriate language and forms for specific audiences and purposes • uses a range of reasoned criteria to propose and justify action in response to a contemporary geographical issue or challenge, and analyses probable outcomes of the action over a range of spatial and temporal scales	and coherent explanations clearly, selecting appropriate language and forms for audience and purpose • uses a range of appropriate criteria to propose and justify action in response to a contemporary geographical issue or challenge and describes a range of probable outcomes of the action over time	plausible action in response to a contemporary geographical issue or challenge, and describes possible outcomes of the action over time		