BSSS
AUSTRALIAN CAPITAL TERRITORY

Earth and Environmental Science

A/T

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The ACT Senior Secondary System

The ACT senior secondary system recognises a range of university, vocational or life skills pathways.

The system is based on the premise that teachers are experts in their area: they know their students and community and are thus best placed to develop curriculum and assess students according to their needs and interests. Students have ownership of their learning and are respected as young adults who have a voice.

A defining feature of the system is school-based curriculum and continuous assessment. School-based curriculum provides flexibility for teachers to address students' needs and interests. College teachers have an opportunity to develop courses for implementation across ACT schools. Based on the courses that have been accredited by the BSSS, college teachers are responsible for developing programs of learning. A program of learning is developed by individual colleges to implement the courses and units they are delivering.

Teachers must deliver all content descriptions; however, they do have flexibility to emphasise some content descriptions over others. It is at the discretion of the teacher to select the texts or materials to demonstrate the content descriptions. Teachers can choose to deliver course units in any order and teach additional (not listed) content provided it meets the specific unit goals.

School-based continuous assessment means that students are continually assessed throughout years 11 and 12, with both years contributing equally to senior secondary certification. Teachers and students are positioned to have ownership of senior secondary assessment. The system allows teachers to learn from each other and to refine their judgement and develop expertise.

Senior secondary teachers have the flexibility to assess students in a variety of ways. For example: multimedia presentation, inquiry-based project, test, essay, performance and/or practical demonstration may all have their place. College teachers are responsible for developing assessment instruments with task specific rubrics and providing feedback to students.

The integrity of the ACT Senior Secondary Certificate is upheld by a robust, collaborative and rigorous structured consensus-based peer reviewed moderation process. System moderation involves all Year 11 and 12 teachers from public, non-government and international colleges delivering the ACT Senior Secondary Certificate.

Only students who desire a pathway to university are required to sit a general aptitude test, referred to as the ACT Scaling Test (AST), which moderates student course scores across subjects and colleges. Students are required to use critical and creative thinking skills across a range of disciplines to solve problems. They are also required to interpret a stimulus and write an extended response.

Senior secondary curriculum makes provision for student-centred teaching approaches, integrated and project-based learning inquiry, formative assessment and teacher autonomy. ACT Senior Secondary Curriculum makes provision for diverse learners and students with mild to moderate intellectual disabilities, so that all students can achieve an ACT Senior Secondary Certificate.

The ACT Board of Senior Secondary Studies (BSSS) leads senior secondary education. It is responsible for quality assurance in senior secondary curriculum, assessment and certification. The Board consists of representatives from colleges, universities, industry, parent organisations and unions. The Office of the Board of Senior Secondary Studies (OBSSS) consists of professional and administrative staff who support the Board in achieving its objectives and functions.

ACT Senior Secondary Certificate

Courses of study for the ACT Senior Secondary Certificate:

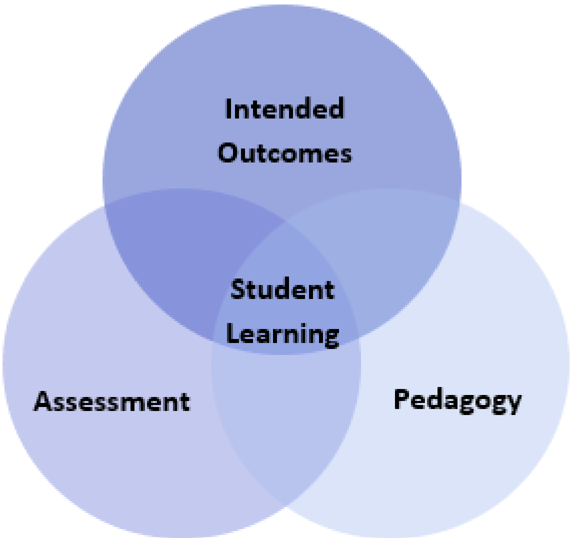
- provide a variety of pathways, to meet different learning needs and encourage students to complete their secondary education
- enable students to develop the essential capabilities for twenty-first century learners
- empower students as active participants in their own learning
- engage students in contemporary issues relevant to their lives
- foster students' intellectual, social and ethical development
- nurture students' wellbeing, and physical and spiritual development
- enable effective and respectful participation in a diverse society.

Each course of study:

- comprises an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum
- is based on a model of learning that integrates intended student outcomes, pedagogy and assessment
- outlines teaching strategies which are grounded in learning principles and encompass quality teaching
- promotes intellectual quality, establish a rich learning environment and generate relevant connections between learning and life experiences
- provides formal assessment and certification of students' achievements.

Underpinning beliefs

- All students are able to learn.
- Learning is a partnership between students and teachers.
- Teachers are responsible for advancing student learning.



Learning Principles

1. Learning builds on existing knowledge, understandings and skills.
   (Prior knowledge)
2. When learning is organised around major concepts, principles and significant real world issues, within and across disciplines, it helps students make connections and build knowledge structures.
   (Deep knowledge and connectedness)
3. Learning is facilitated when students actively monitor their own learning and consciously develop ways of organising and applying knowledge within and across contexts.
   (Metacognition)
4. Learners' sense of self and motivation to learn affects learning.
   (Self-concept)
5. Learning needs to take place in a context of high expectations.
   (High expectations)
6. Learners learn in different ways and at different rates.
   (Individual differences)
7. Different cultural environments, including the use of language, shape learners' understandings and the way they learn.
   (Socio-cultural effects)
8. Learning is a social and collaborative function as well as an individual one.
   (Collaborative learning)
9. Learning is strengthened when learning outcomes and criteria for judging learning are made explicit and when students receive frequent feedback on their progress.
   (Explicit expectations and feedback)

General Capabilities

All courses of study for the ACT Senior Secondary Certificate should enable students to develop essential capabilities for twenty-first century learners. These 'capabilities' comprise an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum.

The capabilities include:

- literacy
- numeracy
- information and communication technology (ICT)
- critical and creative thinking
- personal and social
- ethical behaviour
- intercultural understanding

Courses of study for the ACT Senior Secondary Certificate should be both relevant to the lives of students and incorporate the contemporary issues they face. Hence, courses address the following three priorities. These priorities are:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability

Elaboration of these General Capabilities and priorities is available on the ACARA website at www.australiancurriculum.edu.au.

Literacy

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

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

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

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

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

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

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.

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.

Aboriginal and Torres Strait Islander Histories and Cultures

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.

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 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.

Sustainability

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.

Earth and Environmental Science

A/T

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.

Goals

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.

Student Group

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 $<, >, \Delta, \approx$
- 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.

Unit Titles

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

- Introduction to Earth Systems
- Earth Processes
- Living on Earth
- The Changing Earth

Organisation of Content

Units 1 & 2 - Introduction to Earth Systems / Earth Processes

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 *Introduction to Earth Systems*, students examine the evidence underpinning theories of the development of the Earth systems, their interactions and their components. In *Earth Processes*, students investigate how Earth processes involve interactions of Earth systems and are inter-related through transfers and transformations of energy.

Units 3 & 4 - Living on Earth / The Changing Earth

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 *Living on Earth*, students examine renewable and non-renewable resources, the implications of extracting, using and consuming these resources, and associated management approaches. In *The Changing Earth*, 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).

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:
- Given a specified context (as described in the curriculum content)
- With a defined level of consistency/accuracy (the assumption that each level describes what the student does well, competently, independently, consistently)
- Students perform a specified action (described through a verb)
- In relation to what is valued in the curriculum (specified as the object or subject)
- 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.

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.

Assessment

The identification of criteria within the achievement standards and assessment task types and weightings provides a common and agreed basis for the collection of evidence of student achievement.

Assessment Criteria (the dimensions of quality that teachers look for in evaluating student work) provide a common and agreed basis for judgement of performance against unit and course goals, within and across colleges. Over a course, teachers must use all these criteria to assess students' performance but are not required to use all criteria on each task. Assessment criteria are to be used holistically on a given task and in determining the unit grade.

Assessment Tasks elicit responses that demonstrate the degree to which students have achieved the goals of a unit based on the assessment criteria. The Common Curriculum Elements (CCE) is a guide to developing assessment tasks that promote a range of thinking skills (see Appendix C). It is highly desirable that assessment tasks engage students in demonstrating higher order thinking.

Rubrics are constructed for individual tasks, informing the assessment criteria relevant for a particular task and can be used to assess a continuum that indicates levels of student performance against each criterion.

Assessment Criteria

Students will be assessed on the degree to which they demonstrate an understanding of:

- concepts, models and application
- contexts
- inquiry skills.

Assessment Task Types

Suggested tasks

Individual tasks may incorporate one or more of the following:

- models
- commentary
- debate
- portfolio/journal
- field work
- investigation
- document/source analysis
- practical report
- role play
- research report
- test/quiz
- seminar/workshop/lecture
- poster
- response to stimulus
- essay
- multimedia presentation
- creative response
- interview
- discussion forum
- rationale/validation
- practical skills

It is recommended that a student conceived investigation be undertaken at least once during a minor and twice during a major. This investigation may either be theoretical or practical, or a combination of both.

Weightings in A/T/M 1.0 and 0.5 Units:

No task to be weighted more than 45% for a standard 1.0 unit.

Additional Assessment Information

Requirements

- For a standard unit (1.0), students must complete a minimum of three assessment tasks and a maximum of five.
- For a half standard unit (0.5), students must complete a minimum of two and a maximum of three assessment tasks.
- Students must experience a variety of task types and different modes of communication to demonstrate the Achievement Standards in both theoretical and practical tasks.
- All Achievement Standards must be demonstrated in standard (1.0) or half-standard (0.5) units.
- Task types need to be selected to address all Achievement Standards within the Concepts, Models & Applications, Contexts and Inquiry Skills strands across a standard (1.0) or half-standard (0.5) unit.
- For tasks completed in unsupervised conditions, schools need to have mechanisms to uphold academic integrity, for example: student declaration, plagiarism software, oral defence, interview, or other validation tasks.

Achievement Standards

Years 11 and 12 achievement standards are written for A/T courses. A single achievement standard is written for M courses.

A Year 12 student in any unit is assessed using the Year 12 achievement standards. A Year 11 student in any unit is assessed using the Year 11 achievement standards. Year 12 achievement standards reflect higher expectations of student achievement compared to the Year 11 achievement standards. Years 11 and 12 achievement standards are differentiated by cognitive demand, the number of dimensions and the depth of inquiry.

An achievement standard cannot be used as a rubric for an individual assessment task. Assessment is the responsibility of the college. Student tasks may be assessed using rubrics or marking schemes devised by the college. A teacher may use the achievement standards to inform development of rubrics. The verbs used in achievement standards may be reflected in the rubric. In the context of combined Years 11 and 12 classes, it is best practice to have a distinct rubric for Years 11 and 12. These rubrics should be available for students prior to completion of an assessment task so that success criteria are clear.

Achievement Standards for Science A Course – Year 11

	A student who achieves an **A** grade typically	A student who achieves a **B** grade typically	A student who achieves a **C** grade typically	A student who achieves a **D** grade typically	A student who achieves an **E** grade typically
Concepts, Models & Applications	• analyses the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• explains the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• describes the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• identifies the fundamental properties and functions with some identification of system components and factors that affect processes across a range of temporal and spatial scales	• identifies the fundamental properties and functions with little or no identification of system components, processes, interactions and contextual scales
	• analyses the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence	• identifies the nature, function of theories and models, with an assertion of a few possible limitations
	• assesses processes and claims, provides a critique based on evidence, and discusses alternatives	• explains processes and claims, provides a critique with reference to evidence, and identifies alternatives	• describes processes and claims, and identifies alternatives with some reference to evidence	• identifies processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
Contexts	• analyses how the practice and applications of science meet needs, make decisions; and is influenced by social, economic, technological, and ethical factors	• explains how the practice and applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• describes how the applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• identifies ways in the applications of science meet needs, and is influenced by some factors	• identifies ways in which the application of science has been used in society to meet needs
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that efficiently collect valid and reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid data in response to a complex question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and explains errors	• describes relationships in data sets, reliability and validity of data and representations, and describes common errors	• identifies trends and anomalies in data and representations, with general comments about errors	• identifies trends in data and representations, with little or no reference to anomalies and errors
	• reflects with insight on their own thinking and learning and evaluates planning, time management and use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science T Course – Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• critically analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• explains the fundamental properties and functions of system components, processes and interactions and the effects of factors across a range of scales	• describes the fundamental properties and functions, and with some description of system components, processes and interactions, and the effects of factors across a range of scales	• identifies the fundamental properties and functions of system and identifies components, processes and interactions, and the effects of factors across a range of scales
	• evaluates the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• analyses the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence
	• analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes evidence, and develops conclusions with some reference to models and/or theories	• identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• critically analyses epistemology, role of peer review, collaboration and technology in developing knowledge	• analyses epistemology, role of peer review and technology in developing knowledge	• explain epistemology, role of peer review and technology in developing knowledge	• describes the role of peer review in developing knowledge	• identifies that scientific knowledge has changed over time
	• critically analyses the influence of social, economic, ethical and cultural factors on Science	• analyses the influence of social, economic, ethical and cultural factors on Science	• explains the influence of social, economic, ethical and cultural factors on Science	• describes the influence of social, economic, ethical and cultural factors on Science	• identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors	• describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error	• identifies trends and relationships in data, with little or no reference to sources of error
	• analyses processes and claims, and provides a critique based on evidence, and critically analyses alternatives	• assesses processes and claims, and provides a critique with reference to evidence, and analyses alternatives	• explains processes and claims, and identifies alternatives with reference to reliable evidence	• describes processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
	• reflects with insight on own thinking and that of others, and evaluates planning, time management, and use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking and analyses planning, time management, use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking and explains planning, time management, use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking, with reference to planning and the use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking with little or no reference to planning, time management, and use of work strategies to work independently and collaboratively
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science A Course – Year 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • analyse the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts • assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • explains evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • describes the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • describes evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors • describes the nature, functions, limitations and applications of theories and models with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system components, processes and interactions, and the effects of factors • identifies the nature, functions, applications, and some limitations of theories and models with some evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• analyses epistemology, role of peer review, collaboration and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explains epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes epistemology, role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• describes role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors • analyses processes and claims, and provides a critique based on evidence, and analyses alternatives • reflects with insight on own thinking and that of others and, evaluates planning, time management and use of appropriate independent and collaborative work strategies • communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors • explains processes and claims, and provides a critique with reference to evidence, and proposes alternatives • reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies • communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • describes causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors • describes processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies • communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data, with little or no reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science T Course – Year 12

	A student who achieves an **A** grade typically	A student who achieves a **B** grade typically	A student who achieves a **C** grade typically	A student who achieves a **D** grade typically	A student who achieves an **E** grade typically
Concepts, Models & Applications	• critically analyses the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales • evaluates applications, limitations, and predictions of theories and models to explain systems and create solutions, with evidence, in unfamiliar contexts • evaluates evidence with reference to critical analysis of models and/or theories, and develops evidence-based conclusions and evaluates limitations	• analyses the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales • analyses applications, limitations, and predictions of theories and models to explain systems and create plausible solutions, with evidence in familiar contexts • analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • explains applications, limitations, and predictions of theories and models to explain systems and create plausible solutions in familiar contexts • describes evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors • describes the nature, functions, limitations and applications of theories and models to create solutions to problems with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system components, processes and interactions, and some affective factors • identifies the nature, functions, limitations and applications of theories and models, and suggest solutions to problems with supporting evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• critically analyses epistemology, role of peer review, collaboration, and technology in developing knowledge • critically analyses the influence of social, economic, ethical and cultural factors on Science	• analyses epistemology, role of peer review and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explains epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • critically analyses cause and correlation, anomalies, reliability and validity of data and representations, and critically analyses errors • evaluates processes and claims, and provides a critique based on evidence, and critically analyses alternatives • reflects with insight on own thinking and that of others, evaluates planning, time management, and use of appropriate independent and collaborative work strategies • communicates concisely, effectively and accurately, with scientific literacy in a range of modes, representations, and genres for specific audiences and purposes, and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses cause and correlation, anomalies, reliability and validity of data and representations, and analyses errors • explains processes and claims, and provides a critique with reference to evidence, and analyses alternatives • reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies • communicates clearly and accurately, with scientific literacy in a range of modes, representations and genres for specific audiences and purposes, and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • describes causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses common errors • describes processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies • communicates accurately demonstrating scientific literacy, in a range of modes, representations, and genres for specific purposes, and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and cites sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data with reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Introduction to Earth Systems Value 1.0

Introduction to Earth Systems a Value 0.5

Introduction to Earth Systems b Value 0.5

Unit 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.

Specific Unit Goals

This unit should enable students to:

A Course	T Course
• 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 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

A course	T course
• 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 • assess claims about energy transfers and transformations between and within Earth systems • communicate Earth and environmental understanding using qualitative representations in appropriate modes and genres	• 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

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose basic hypotheses; and predict possible outcomes • conduct 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 • 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	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes • 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 • 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 (

A course	T course
• represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships. qualitatively describe sources of measured error in data and use evidence to make and justify conclusions	• 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
• 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	• 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
• select, construct and use appropriate representations, including maps and other spatial representations, diagrams and flow charts, to communicate understanding	• 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
• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports	• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports
Science as a Human Endeavour	**Science as a Human Endeavour**
• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility	• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility
• development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines	• development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines
• advances in science understanding in one field can influence other areas of science, technology and engineering	• advances in science understanding in one field can influence other areas of science, technology and engineering
• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations	• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations
• the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences	• the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences

A course	T course
• scientific knowledge can enable scientists to offer valid explanations and make reliable predictions • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	• scientific knowledge can enable scientists to offer valid explanations and make reliable predictions • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability
Science Understanding	
• development of the geosphere • observation of present day processes can be used to infer past events and processes by applying the principle of uniformitarianism • a relative geological time scale can be constructed using stratigraphic principles including superposition, cross cutting relationships, inclusions and correlation • 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 • 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 • 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 • 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	• development of the geosphere • observation of present day processes can be used to infer past events and processes by applying the principle of uniformitarianism • a relative geological time scale can be constructed using stratigraphic principles including superposition, cross cutting relationships, inclusions and correlation • 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 • 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 • 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 • 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

A course	T course
Development of the atmosphere and hydrosphere	
• 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 • the modern atmosphere has a layered structure characterised by changes in temperature: the troposphere, mesosphere, stratosphere and thermosphere • 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 • 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)	• 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 • the modern atmosphere has a layered structure characterised by changes in temperature: the troposphere, mesosphere, stratosphere and thermosphere • 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 • 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)
Development of the biosphere	
• fossil evidence indicates that life first appeared on Earth approximately 4 billion years ago • 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 (• 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	• fossil evidence indicates that life first appeared on Earth approximately 4 billion years ago • 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 • 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

A course	T course
• 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 • 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	• 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 • 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

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 14-16.

Earth Processes Value 1.0

Earth Processes a Value 0.5

Earth Processes b Value 0.5

Unit 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.

Specific Unit Goals

This unit should enable students to:

A Course	T Course
• understand how energy is transferred and transformed in Earth systems, the factors that influence these processes	• 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 energy transfers and transformations influence oceanic, atmospheric and biogeochemical cycling

A Course	T Course
• 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 • assess claims about energy transfers and transformations between and within Earth systems • communicate Earth and environmental understanding using qualitative representations in appropriate modes and genres.	• 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.

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose basic hypotheses; and predict possible outcomes • conduct 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 • 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	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes • 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 • 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

A Course	T Course
• represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships. qualitatively describe sources of measured error in data and use evidence to make and justify conclusions • 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 • select, construct and use appropriate representations, including maps and other spatial representations, diagrams and flow charts, to communicate understanding • communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports	• 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 • 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 • 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 • communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports
Science as a Human Endeavour	
• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility • development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines • advances in science understanding in one field can influence other areas of science, technology and engineering • the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations • the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • scientific knowledge can enable scientists to offer valid explanations and make reliable predictions	• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility • development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines • advances in science understanding in one field can influence other areas of science, technology and engineering • the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations • the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences • scientific knowledge can enable scientists to offer valid explanations and make reliable predictions

<table>
<tr><th>A Course</th><th>T Course</th></tr>
<tr><td>scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability</td><td>scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability</td></tr>
<tr><td colspan="2">Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility</td></tr>
<tr><td>development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines
advances in science understanding in one field can influence other areas of science, technology and engineering
the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations
the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences</td><td>Energy for Earth processes
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
processes within and between earth systems require energy that originates either from the sun or the interior of earth
thermal and light energy from the sun drives important earth processes including evaporation and photosynthesis
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</td></tr>
<tr><td colspan="2">Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions</td></tr>
<tr><td>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
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</td><td>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
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</td></tr>
</table>

A Course	T Course
• 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 • 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 • 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	• 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 • 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 • 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
Energy for biogeochemical processes	
• 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 • 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 • biogeochemical cycling of matter, including nitrogen and phosphorus, involves the transfer and transformation of energy between the biosphere, geosphere, atmosphere and hydrosphere • 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 (	• 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 • 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 • biogeochemical cycling of matter, including nitrogen and phosphorus, involves the transfer and transformation of energy between the biosphere, geosphere, atmosphere and hydrosphere • 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 (

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

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Assessment

Refer to pages 14-16.

Living on Earth Value 1.0

Living on Earth a Value 0.5

Living on Earth b Value 0.5

Unit 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.

Specific Unit Goals

This unit should enable students to:

A Course	T Course
• 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 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

A Course	T Course
• 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	• 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	• use science inquiry skills to collect, analyse and communicate primary and secondary data on resource extraction and related impacts on Earth systems
• assess claims about resource extraction and related impacts on Earth systems and justify evaluations	• 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 representations in appropriate modes and genres	• communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose basic hypotheses; and predict possible outcomes	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
• conduct 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	• 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
• conduct investigations, including map and field location techniques and environmental sampling procedures, safely, competently and methodically for the collection of valid and reliable data	• 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

A course	T course
• represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships. qualitatively describe sources of measured error in data and use evidence to make and justify conclusions	• 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
• 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	• 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
• select, construct and use appropriate representations, including maps and other spatial representations, diagrams and flow charts, to communicate understanding	• select, construct and use appropriate representations, including maps and other spatial representations, to communicate conceptual understanding, solve problems and make predictions
• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports	• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports (
Science as a Human Endeavour	
• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work	• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work
• 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	• 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
• the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered	• the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered
• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk
• 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)	• 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

A Course	T Course
• international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	• international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability
Science Understanding	
Use of non-renewable Earth resources • non-renewable mineral and energy resources are formed over geological time scales so are not readily replenished • 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) • 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 • 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) • extraction of mineral and energy resources influences interactions between the abiotic and biotic components of ecosystems, including hydrologic systems	Use of non-renewable Earth resources • non-renewable mineral and energy resources are formed over geological time scales so are not readily replenished • 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) • 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 • 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) • extraction of mineral and energy resources influences interactions between the abiotic and biotic components of ecosystems, including hydrologic systems
Use of renewable Earth resources • 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)	Use of renewable Earth resources • 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)

A Course	T Course
• 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) • 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 • the cost-effective use of renewable energy resources is constrained by the efficiency of available technologies to collect, store and transfer the energy • 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 • 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 • 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 • 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	• 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) • 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 • the cost-effective use of renewable energy resources is constrained by the efficiency of available technologies to collect, store and transfer the energy • 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 • 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 • 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 • 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

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 14-16.

The Changing Earth — Value 1.0

The Changing Earth a — Value 0.5

The Changing Earth b — Value 0.5

Unit 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.

Specific Unit Goals

This unit should enable students to:

A Course	T Course
• 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 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

A Course	T Course
• 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 • assess claims about Earth hazards and related impacts on Earth systems and justify evaluations • communicate Earth and environmental understanding using qualitative representations in appropriate modes and genres	• 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.

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation, propose basic hypotheses and predict possible outcomes • conduct 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 • conduct investigations, including map and field location techniques, environmental sampling procedures and field metering equipment, safely, competently and methodically for the collection of valid and reliable data	• identify, research and construct questions for investigation, propose hypotheses and predict possible outcomes • 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 • 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

A course	T course
• represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships. qualitatively describe sources of measured error in data and use evidence to make and justify conclusions	• 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
• 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	• 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
• select, construct and use appropriate representations, including maps and other spatial representations, to communicate understanding	• select, construct and use appropriate representations, including maps and other spatial representations, to communicate conceptual understanding, make predictions and solve problems
• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports	• communicate to specific audiences and for specific purposes using appropriate language, genres and modes, including compilations of field data and research reports
Science as a Human Endeavour	
• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work	• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work
• 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	• 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
• the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered	• the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered
• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk
• 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	• 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

A Course	T Course
• international collaboration is often required when investing in large scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	• international collaboration is often required when investing in large scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability
Science Understanding	
The cause and impact of Earth hazards • 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 • 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) • 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 • 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) • 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	The cause and impact of Earth hazards • 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 • 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) • 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 • 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) • 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

A Course	T Course
• 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)	• 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
The cause and impact of global climate change • 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 • 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) • 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 • 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 • 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)	The cause and impact of global climate change • 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 • 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) • 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 • 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 • 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)

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Assessment

Refer to pages 14-16.

Appendix A – Implementation Guidelines

Available course patterns

A standard 1.0 value unit is delivered over at least 55 hours. To be awarded a course, students must complete at least the minimum units over the whole minor, major, major/minor or double major course.

Course	Number of standard units to meet course requirements
Minor	Minimum of 2 units
Major	Minimum of 3.5 units

Units in this course can be delivered in any order.

Prerequisites for the course or units within the course:

Nil.

Arrangements for students continuing study in this course

Students who studied the previous course may undertake any units in this course provided there is no duplication of content.

Duplication of Content Rules

Students cannot be given credit towards the requirements for a Senior Secondary Certificate for a unit that significantly duplicates content in a unit studied in another course. The responsibility for preventing undesirable overlap of content studied by a student rests with the principal and the teacher delivering the course. Students will only be given credit for covering the content once.

Guidelines for Delivery

Program of Learning

A program of learning is what a school provides to implement the course for a subject. This meets the requirements for context, scope and sequence set out in the Board endorsed course. Students follow programs of learning in a college as part of their senior secondary studies. The detail, design and layout of a program of learning are a college decision.

The program of learning must be documented to show the planned learning activities and experiences that meet the needs of particular groups of students, taking into account their interests, prior knowledge, abilities and backgrounds. The program of learning is a record of the learning experiences that enable students to achieve the knowledge, understanding and skills of the content descriptions. There is no requirement to submit a program of learning to the OBSSS for approval. The Principal will need to sign off at the end of Year 12 that courses have been delivered as accredited.

Content Descriptions

Are all content descriptions of equal importance? No. It depends on the focus of study. Teachers can customise their program of learning to meet their own students' needs, adding additional content descriptions if desired or emphasising some over others. A teacher must balance student needs with their responsibility to teach all content descriptions. It is mandatory that teachers address all content descriptions and that students engage with all content descriptions.

Half standard 0.5 units

Half standard units appear on the course adoption form but are not explicitly documented in courses. It is at the discretion of the college principal to split a standard 1.0 unit into two half standard 0.5 units. Colleges are required to adopt the half standard 0.5 units. However, colleges are not required to submit explicit documentation outlining their half standard 0.5 units to the BSSS. Colleges must assess students using the half standard 0.5 assessment task weightings outlined in the framework. It is the responsibility of the college principal to ensure that all content is delivered in units approved by the Board.

Moderation

Moderation is a system designed and implemented to:

- provide comparability in the system of school-based assessment
- form the basis for valid and reliable assessment in senior secondary schools
- involve the ACT Board of Senior Secondary Studies and colleges in cooperation and partnership
- maintain the quality of school-based assessment and the credibility, validity and acceptability of Board certificates.

Moderation commences within individual colleges. Teachers develop assessment programs and instruments, apply assessment criteria, and allocate Unit Grades, according to the relevant Framework. Teachers within course teaching groups conduct consensus discussions to moderate marking or grading of individual assessment instruments and Unit Grade decisions.

The Moderation Model

Moderation within the ACT encompasses structured, consensus-based peer review of Unit Grades for all accredited courses over two Moderation Days. In addition to Moderation Days, there is statistical moderation of course scores, including small group procedures, for T courses.

Moderation by Structured, Consensus-based Peer Review

Consensus-based peer review involves the review of student work against system wide criteria and standards and the validation of Unit Grades. This is done by matching student performance with the criteria and standards outlined in the Achievement Standards, as stated in the Framework. Advice is then given to colleges to assist teachers with, or confirm, their judgments. In addition, feedback is given on the construction of assessment instruments.

Preparation for Structured, Consensus-based Peer Review

Each year, teachers of Year 11 are asked to retain originals or copies of student work completed in Semester 2. Similarly, teachers of a Year 12 class should retain originals or copies of student work completed in Semester 1. Assessment and other documentation required by the Office of the Board of Senior Secondary Studies should also be kept. Year 11 work from Semester 2 of the previous year is presented for review at Moderation Day 1 in March, and Year 12 work from Semester 1 is presented for review at Moderation Day 2 in August.

In the lead up to Moderation Day, a College Course Presentation (comprised of a document folder and a set of student portfolios) is prepared for each A, T and M course/units offered by the school and is sent into the Office of the Board of Senior Secondary Studies.

The College Course Presentation

The package of materials (College Course Presentation) presented by a college for review on Moderation Days in each course area will comprise the following:

- a folder containing supporting documentation as requested by the Office of the Board through memoranda to colleges, including marking schemes and rubrics for each assessment item
- a set of student portfolios containing marked and/or graded written and non-written assessment responses and completed criteria and standards feedback forms. Evidence of all assessment responses on which the Unit Grade decision has been made is to be included in the student review portfolios.

Specific requirements for subject areas and types of evidence to be presented for each Moderation Day will be outlined by the Board Secretariat through the *Requirements for Moderation Memoranda* and Information Papers.

Visual evidence for judgements made about practical performances

(also refer to BSSS Website Guidelines)

It is a requirement that schools' judgements of standards to practical performances (A/T/M) be supported by visual evidence (still photos or video).

The photographic evidence submitted must be drawn from practical skills performed as part of the assessment process.

Teachers should consult the BSSS website for current information regarding all moderation requirements including subject specific and photographic evidence.

Appendix B – Course Developers

Name	College
Jane O'Brien	Canberra Girls Grammar School
Colin Price	Daramalan College
Peter Costa	Lake Tuggeranong College

Appendix C – Common Curriculum Elements

Common curriculum elements assist in the development of high-quality assessment tasks by encouraging breadth and depth and discrimination in levels of achievement.

Organisers	Elements	Examples
create, compose and apply	apply	ideas and procedures in unfamiliar situations, content and processes in non-routine settings
	compose	oral, written and multimodal texts, music, visual images, responses to complex topics, new outcomes
	represent	images, symbols or signs
	create	creative thinking to identify areas for change, growth and innovation, recognise opportunities, experiment to achieve innovative solutions, construct objects, imagine alternatives
	manipulate	images, text, data, points of view
analyse, synthesise and evaluate	justify	arguments, points of view, phenomena, choices
	hypothesise	statement/theory that can be tested by data
	extrapolate	trends, cause/effect, impact of a decision
	predict	data, trends, inferences
	evaluate	text, images, points of view, solutions, phenomenon, graphics
	test	validity of assumptions, ideas, procedures, strategies
	argue	trends, cause/effect, strengths and weaknesses
	reflect	on strengths and weaknesses
	synthesise	data and knowledge, points of view from several sources
	analyse	text, images, graphs, data, points of view
	examine	data, visual images, arguments, points of view
	investigate	issues, problems
organise, sequence and explain	sequence	text, data, relationships, arguments, patterns
	visualise	trends, futures, patterns, cause and effect
	compare/contrast	data, visual images, arguments, points of view
	discuss	issues, data, relationships, choices/options
	interpret	symbols, text, images, graphs
	explain	explicit/implicit assumptions, bias, themes/arguments, cause/effect, strengths/weaknesses
	translate	data, visual images, arguments, points of view
	assess	probabilities, choices/options
	select	main points, words, ideas in text
identify, summarise and plan	reproduce	information, data, words, images, graphics
	respond	data, visual images, arguments, points of view
	relate	events, processes, situations
	demonstrate	probabilities, choices/options
	describe	data, visual images, arguments, points of view
	plan	strategies, ideas in text, arguments
	classify	information, data, words, images
	identify	spatial relationships, patterns, interrelationships
	summarise	main points, words, ideas in text, review, draft and edit

Appendix D – Glossary of Verbs

Verbs	Definition
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
Argue	Give reasons for or against something
Assess	Make a Judgement about the value of
Classify	Arrange into named categories in order to sort, group or identify
Compare	Estimate, measure or note how things are similar or dissimilar
Compose	The activity that occurs when students produce written, spoken, or visual texts
Contrast	Compare in such a way as to emphasise differences
Create	Bring into existence, to originate
Demonstrate	Give a practical exhibition an explanation
Describe	Give an account of characteristics or features
Discuss	Talk or write about a topic, taking into account different issues or ideas
Evaluate	Examine and judge the merit or significance of something
Examine	Determine the nature or condition of
Explain	Provide additional information that demonstrates understanding of reasoning and /or application
Extrapolate	Infer from what is known
Hypothesise	Put forward a supposition or conjecture to account for certain facts and used as a basis for further investigation by which it may be proved or disproved
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Planning, inquiry into and drawing conclusions about
Justify	Show how argument or conclusion is right or reasonable
Manipulate	Adapt or change
Plan	Strategize, develop a series of steps, processes
Predict	Suggest what might happen in the future or as a consequence of something
Reflect	The thought process by which students develop an understanding and appreciation of their own learning. This process draws on both cognitive and affective experience
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
Respond	React to a person or text
Select	Choose in preference to another or others
Sequence	Arrange in order
Summarise	Give a brief statement of the main points
Synthesise	Combine elements (information/ideas/components) into a coherent whole
Test	Examine qualities or abilities
Translate	Express in another language or form, or in simpler terms
Visualise	The ability to decode, interpret, create, question, challenge and evaluate texts that communicate with visual images as well as, or rather than, words

Appendix E – Glossary for ACT Senior Secondary Curriculum

Courses will detail what teachers are expected to teach and students are expected to learn for year 11 and 12. They will describe the knowledge, understanding and skills that students will be expected to develop for each learning area across the years of schooling.

Learning areas are broad areas of the curriculum, including English, mathematics, science, the arts, languages, health and physical education.

A **subject** is a discrete area of study that is part of a learning area. There may be one or more subjects in a single learning area.

Frameworks are system documents for Years 11 and 12 which provide the basis for the development and accreditation of any course within a designated learning area. In addition, frameworks provide a common basis for assessment, moderation and reporting of student outcomes in courses based on the framework.

The **course** sets out the requirements for the implementation of a subject. Key elements of a course include the rationale, goals, content descriptions, assessment, and achievement standards as designated by the framework.

BSSS courses will be organised into units. A unit is a distinct focus of study within a course. A standard 1.0 unit is delivered for a minimum of 55 hours generally over one semester.

Core units are foundational units that provide students with the breadth of the subject.

Additional units are avenues of learning that cannot be provided for within the four core 1.0 standard units by an adjustment to the program of learning.

A **independent study unit** is a pedagogical approach that empowers students to make decisions about their own learning. Independent study units can be proposed by a student and negotiated with their teacher but must meet the specific unit goals and content descriptions as they appear in the course.

An **elective** is a lens for demonstrating the content descriptions within a standard 1.0 or half standard 0.5 unit.

A **lens** is a particular focus or viewpoint within a broader study.

Content descriptions refer to the subject-based knowledge, understanding and skills to be taught and learned.

A **program of learning** is what a college develops to implement the course for a subject and to ensure that the content descriptions are taught and learned.

Achievement standards provide an indication of typical performance at five different levels (corresponding to grades A to E) following completion of study of senior secondary course content for units in a subject.

ACT senior secondary system **curriculum** comprises all BSSS approved courses of study.

Appendix F – Course Adoption

Condition of Adoption

The course and units of this course are consistent with the philosophy and goals of the college and the adopting college has the human and physical resources to implement the course.

Adoption Process

Course adoption must be initiated electronically by an email to bssscertification@ed.act.edu.au by the principal or their nominated delegate.

The email will include the **Conditions of Adoption** statement above, and the table below adding the **College** name, and **A** and/or **T** and/or **M** and/or **V** to the **Classification/s** section of the table.

College:					
Course Title:	**Earth & Environmental Science**				
Classification/s:	**A**		**T**		
Framework:	Science 2020				
Dates of Course Accreditation:		**from**	2014	**to**	2022