EARTH AND ENVIRONMENTAL STAGE 6

DRAFT SYLLABUS FOR CONSULTATION

20 JULY – 31 AUGUST 2016

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THE BOSTES SYLLABUS DEVELOPMENT PROCESS

BOSTES began its syllabus development process for Stage 6 English, Mathematics, Science and History in 2014. This followed state and territory Education Ministers' endorsement of senior secondary Australian curriculum.

The development of the Stage 6 syllabuses involved expert writers and opportunities for consultation with teachers and other interest groups across NSW in order to receive the highest-quality advice across the education community.

A number of key matters at consultations were raised, including the need for the curriculum to cater for the diversity of learners, the broad range of students undertaking Stage 6 study in NSW, development of skills and capabilities for the future, school-based assessment and providing opportunities for assessing and reporting student achievement relevant for post-school pathways.

There was broad support that changes to curriculum and assessment would contribute to the reduction of student stress. BOSTES will continue to use NSW credentialling processes aligned with Stage 6 assessment and HSC examination structures.

A summary of the BOSTES syllabus development process is available at http://www.boardofstudies.nsw.edu.au/syllabuses/syllabus-development.

ASSISTING RESPONDENTS

The following icons are used to assist respondents:

 for your information	This icon indicates general information that assists in reading or understanding the information contained in the document. Text introduced by this icon will not appear in the final syllabus.
 consult	This icon indicates material on which responses and views are sought through consultation.

CONSULTATION

The *Earth and Environmental Science Stage 6 Draft Syllabus* is accompanied by an online consultation survey on the BOSTES website. The purpose of the survey is to obtain detailed comments from individuals and systems/organisations on the syllabus. Please comment on both the strengths and the weaknesses of the draft syllabus. Feedback will be considered when the draft syllabus is revised.

The consultation period is from 20 July to 31 August 2016.

Written responses may be forwarded to:

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INTRODUCTION

STAGE 6 CURRICULUM

Board of Studies, Teaching and Educational Standards NSW (BOSTES) Stage 6 syllabuses have been developed to provide students with opportunities to further develop skills which will assist in the next stage of their lives, whether that is academic study, vocational education or employment.
The purpose of the Higher School Certificate program of study is to:

- provide a curriculum structure which encourages students to complete secondary education
- foster the intellectual, social and moral development of students, in particular developing their:
  - knowledge, skills, understanding, values and attitudes in the fields of study they choose
  - capacity to manage their own learning
  - desire to continue learning in formal or informal settings after school
  - capacity to work together with others
  - respect for the cultural diversity of Australian society
- provide a flexible structure within which students can prepare for:
  - further education and training
  - employment
  - full and active participation as citizens
- provide formal assessment and certification of students' achievements
- provide a context within which schools also have the opportunity to foster students' physical and spiritual development.

The Stage 6 syllabuses reflect the principles of the BOSTES *K–10 Curriculum Framework* and *Statement of Equity Principles*, and the *Melbourne Declaration on Educational Goals for Young Australians* (December 2008). The syllabuses build on the continuum of learning developed in the K–10 syllabuses.

The Stage 6 syllabuses provide a set of broad learning outcomes that summarise the knowledge, understanding, skills, values and attitudes essential for students to succeed in and beyond their schooling. In particular, the literacy and numeracy skills needed for future study, employment and life are provided in Stage 6 syllabuses in alignment with the *Australian Core Skills Framework (ACSF)*.

The syllabuses have considered agreed Australian curriculum content and included content that clarifies the scope and depth of learning in each subject.

Stage 6 syllabuses support a standards-referenced approach to assessment by detailing the essential knowledge, understanding, skills, values and attitudes students will develop and outlining clear standards of what students are expected to know and be able to do. In accordance with the *Statement of Equity Principles*, Stage 6 syllabuses take into account the diverse needs of all students. The syllabuses provide structures and processes by which teachers can provide continuity of study for all students.

DIVERSITY OF LEARNERS

NSW Stage 6 syllabuses are inclusive of the learning needs of all students. Syllabuses accommodate teaching approaches that support student diversity including Students with special education needs, Gifted and talented students and Students learning English as an additional language or dialect (EAL/D).

STUDENTS WITH SPECIAL EDUCATION NEEDS

All students are entitled to participate in and progress through the curriculum. Schools are required to provide additional support or adjustments to teaching, learning and assessment activities for some students. Adjustments are measures or actions taken in relation to teaching, learning and assessment that enable a student to access syllabus outcomes and content and demonstrate achievement of outcomes.

Students with special education needs can access the Stage 6 outcomes and content in a range of ways. Students may engage with:

- syllabus outcomes and content with adjustments to teaching, learning and/or assessment activities
- selected outcomes and content appropriate to their learning needs
- selected Stage 6 Life Skills outcomes and content appropriate to their learning needs.

Decisions regarding adjustments should be made in the context of collaborative curriculum planning with the student, parent/carer and other significant individuals to ensure that syllabus outcomes and content reflect the learning needs and priorities of individual students.

Further information can be found in support materials for:

- Science
- Special education needs
- Life Skills.

GIFTED AND TALENTED STUDENTS

Gifted students have specific learning needs that may require adjustments to the pace, level and content of the curriculum. Differentiated educational opportunities assist in meeting the needs of gifted students.

Generally, gifted students demonstrate the following characteristics:

- the capacity to learn at faster rates
- the capacity to find and solve problems
- the capacity to make connections and manipulate abstract ideas.

There are different kinds and levels of giftedness. Gifted and talented students may also possess learning difficulties and/or disabilities that should be addressed when planning appropriate teaching, learning and assessment activities.

Curriculum strategies for gifted and talented students may include:

- differentiation: modifying the pace, level and content of teaching, learning and assessment activities
- acceleration: promoting a student to a level of study beyond their age group
- curriculum compacting: assessing a student's current level of learning and addressing aspects of the curriculum that have not yet been mastered.

School decisions about appropriate strategies are generally collaborative and involve teachers, parents and students with reference to documents and advice available from BOSTES and the education sectors.

Gifted and talented students may also benefit from individual planning to determine the curriculum options, as well as teaching, learning and assessment strategies, most suited to their needs and abilities.

STUDENTS LEARNING ENGLISH AS AN ADDITIONAL LANGUAGE OR DIALECT (EAL/D)

Many students in Australian schools are learning English as an additional language or dialect (EAL/D). EAL/D students are those whose first language is a language or dialect other than Standard Australian English and who require additional support to assist them to develop English language proficiency.

EAL/D students come from diverse backgrounds and may include:

- overseas and Australian-born students whose first language is a language other than English, including creoles and related varieties
- Aboriginal and Torres Strait Islander students whose first language is Aboriginal English, including Kriol and related varieties.

EAL/D students enter Australian schools at different ages and stages of schooling and at different stages of Australian Standard English language learning. They have diverse talents and capabilities and a range of prior learning experiences and levels of literacy in their first language and in English. EAL/D students represent a significant and growing percentage of learners in NSW schools. For some, school is the only place they use Australian Standard English.

EAL/D students are simultaneously learning a new language and the knowledge, understanding and skills of the Earth and Environmental Science Stage 6 syllabus through that new language. They require additional time and support, along with informed teaching that explicitly addresses their language needs, and assessments that take into account their developing language proficiency.

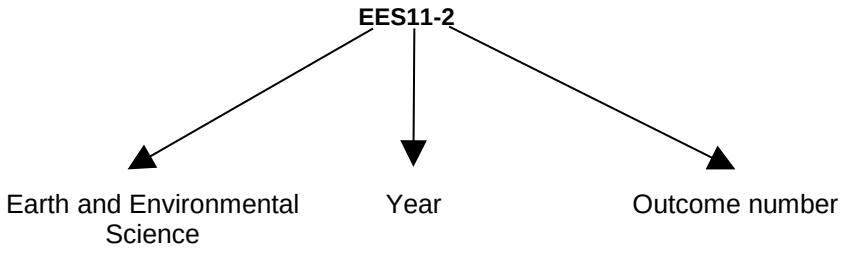
EARTH AND ENVIRONMENTAL SCIENCE KEY

The following codes and icons are used in the *Earth and Environmental Science Stage 6 Draft Syllabus*.

OUTCOME CODING

Syllabus outcomes have been coded in a consistent way. The code identifies the subject, Year and outcome number.

In the *Earth and Environmental Science Stage 6 Draft Syllabus*, outcome codes indicate the subject, Year and outcome number, for example:

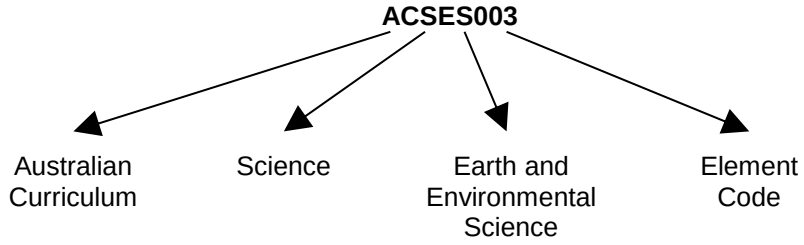


Outcome code	Interpretation
EES11-1	Earth and Environmental Science, Year 11 – Outcome number 1
EES12-4	Earth and Environmental Science, Year 12 – Outcome number 4

CODING OF THE AUSTRALIAN CURRICULUM CONTENT

Australian curriculum content descriptions included in the syllabus are identified by an Australian curriculum code which appears in brackets at the end of each content description, for example:

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



Where a number of content descriptions are jointly represented, all description codes are included, eg (ACSES001, ACSES002, ACSES003).

LEARNING ACROSS THE CURRICULUM ICONS

Learning across the curriculum content, including cross-curriculum priorities, general capabilities and other areas identified as important learning for all students, is incorporated and identified by icons in the *Earth and Environmental Science Stage 6 Draft Syllabus*.

Cross-curriculum priorities	
	Aboriginal and Torres Strait Islander histories and cultures
	Asia and Australia's engagement with Asia
	Sustainability
General capabilities	
	Critical and creative thinking
	Ethical understanding
	Information and communication technology capability
	Intercultural understanding
	Literacy
	Numeracy
	Personal and social capability
Other learning across the curriculum areas	
	Civics and citizenship
	Difference and diversity
	Work and enterprise

RATIONALE

 for your information

The rationale describes the distinctive nature of the subject and outlines its relationship to the contemporary world and current practice. It explains the place and purpose of the subject in the curriculum, including:

- why the subject exists
- the theoretical underpinnings
- what makes the subject distinctive
- why students would study the subject
- how it contributes to the purpose of the Stage 6 curriculum
- how it prepares students for post-school pathways.

 consult

The Earth and Environmental Science Stage 6 course explores Earth's resources and environmental issues that affect the environment. An understanding of the use of renewable and non-renewable resources and the ability to live sustainably on the planet is central to the study of Earth and Environmental Science.

Earth and Environmental Science not only incorporates Working Scientifically processes to develop skills, it also focuses on the application of models and data in order to make predictions and solve problems.

Earth and Environmental Science involves the use and analysis of qualitative and quantitative data, representations, explanations in order to solve problems. In conjunction with knowledge and understanding, communication skills in developing evidence-based arguments are essential components.

The Earth and Environmental Science course builds on the knowledge and skills of Earth and Space found in the Science Stage 5 course. The course includes a practical emphasis for the delivery of course content and engages with technologies that assist in developing Earth and Environmental Science applications.

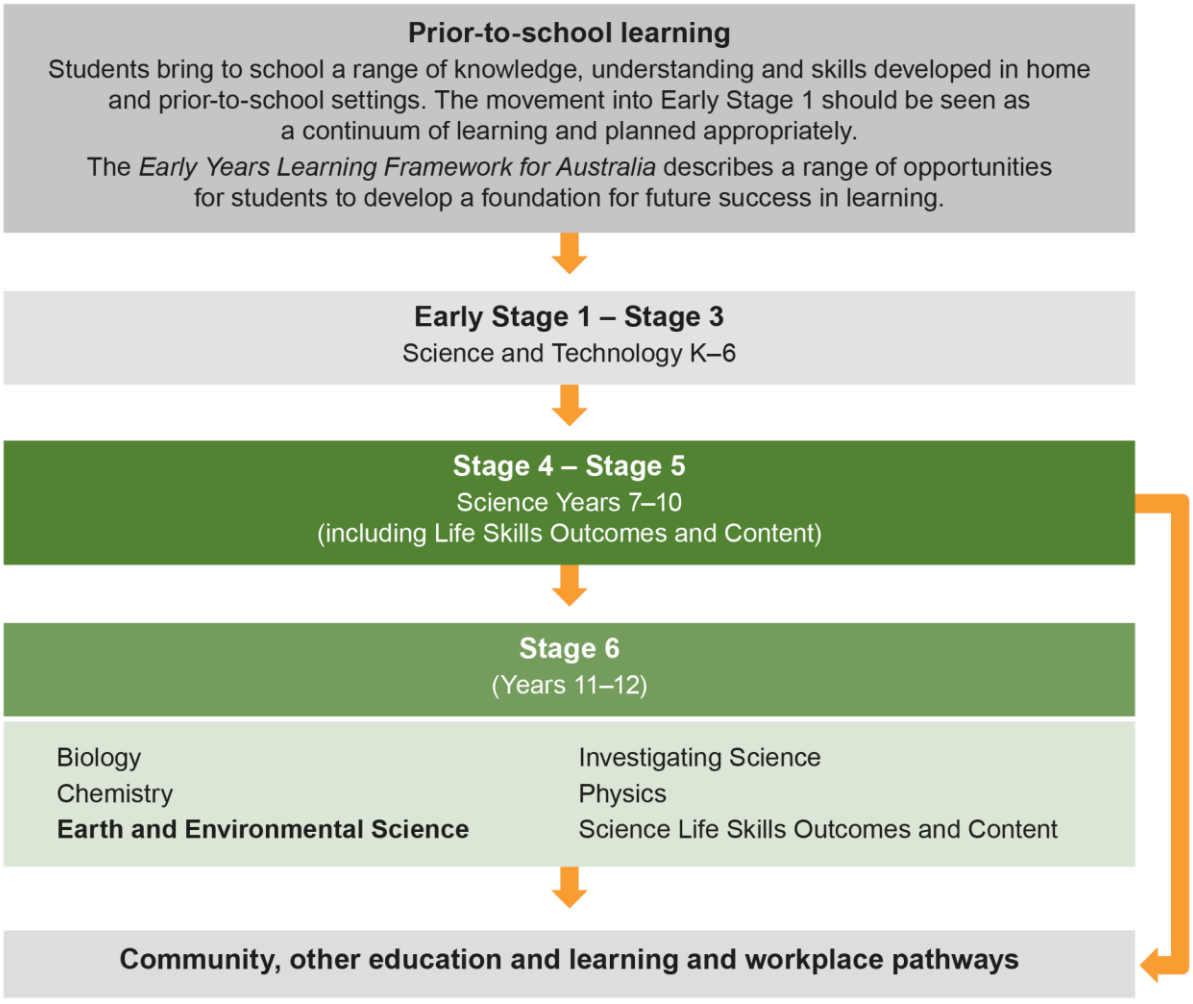
The study of Earth and Environmental Science provides the foundation knowledge and skills required to study Earth and Environmental Science post-school and supports careers in a range of related industries. The application of Earth and Environmental Science is essential in addressing current and future environmental issues and challenges and the use and management of geological resources which are essential to Australia's sustainable future.

THE PLACE OF THE EARTH AND ENVIRONMENTAL SCIENCE STAGE 6 DRAFT SYLLABUS IN THE K-12 CURRICULUM

for your information

NSW syllabuses include a diagram that illustrates how the syllabus relates to the learning pathways in K–12. This section places the Earth and Environmental Science Stage 6 syllabus in the K–12 curriculum as a whole.

consult



AIM

 for your information

In NSW syllabuses, the aim provides a succinct statement of the overall purpose of the syllabus. It indicates the general educational benefits for students from programs based on the syllabus.

The aim, objectives, outcomes and content of a syllabus are clearly linked and sequentially amplify details of the intention of the syllabus.

 consult

The study of Earth and Environmental Science in Stage 6 enables students to develop an appreciation and understanding of geological and environmental concepts that help interpret the changing face of the Earth over time. Through applying Working Scientifically processes, the course aims to examine how Earth and Environmental Science models and practices are used and developed.

OBJECTIVES

 for your information

In NSW syllabuses, objectives provide specific statements of the intention of a syllabus. They amplify the aim and provide direction to teachers on the teaching and learning process emerging from the syllabus. They define, in broad terms, the knowledge, understanding, skills, values and attitudes to be developed through study in the subject. They act as organisers for the intended outcomes.

 consult

VALUES AND ATTITUDES

- develop positive, informed values and attitudes towards Earth and Environmental Science
- recognise the importance and relevance of Earth and Environmental Science in their lives
- recognise the influence of economic, political and societal impacts on the development of scientific knowledge
- develop an appreciation of the influence of imagination and creativity in scientific research

SKILLS

Students:

- develop skills in and apply the processes of Working Scientifically

KNOWLEDGE AND UNDERSTANDING

Students:

- develop knowledge and understanding of the Earth's systems
- develop knowledge and understanding of the Earth processes and human impacts
- develop knowledge and understanding of the evolving Earth
- develop knowledge and understanding of the impacts of living on Earth

OUTCOMES

 for your information

In NSW syllabuses, outcomes provide detail about what students are expected to achieve at the end of each Year in relation to the objectives. They indicate the knowledge, understanding and skills expected to be gained by most students as a result of effective teaching and learning. They are derived from the objectives of the syllabus.

 consult

TABLE OF OBJECTIVES AND OUTCOMES – CONTINUUM OF LEARNING

SKILLS

Objective Students • develop skills in and apply the processes of Working Scientifically	
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
Questioning **EES11-1** poses questions and hypotheses for scientific investigation	**Questioning** **EES12-1** develops and evaluates questions and hypotheses for scientific investigation
Designing investigations **EES11-2** designs and plans appropriate scientific investigations	**Designing investigations** **EES12-2** designs, plans and evaluates primary and secondary-sourced investigations
Conducting investigations **EES11-3** conducts primary or secondary-sourced investigations individually or in a team	**Conducting investigations** **EES12-3** conducts primary and secondary-sourced investigations individually or in a team
Representing **EES11-4** represents qualitative and quantitative data and information using a range of appropriate media	**Representing** **EES12-4** selects and represents key qualitative and quantitative data and information using a range of appropriate media
Analysing **EES11-5** analyses primary and secondary information sources	**Analysing** **EES12-5** analyses primary and secondary information sources

Solving problems **EES11-6** solves scientific problems	**Solving problems** **EES12-6** solves scientific problems using primary and secondary data
Communicating **EES11-7** communicates scientific understanding	**Communicating** **EES12-7** communicates scientific understanding using suitable language and terminology

The Skills outcomes found at the beginning of each module are targeted for emphasis. It is recognised that the other Skills outcomes will also be addressed in each module.

KNOWLEDGE AND UNDERSTANDING

Year 11 course Unit 1	**Year 12 course Unit 3**
Objective Students: ● develop knowledge and understanding of the Earth's systems	**Objective** Students: ● develop knowledge and understanding of the evolving Earth
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
EES11-8 describes the key features of Earth's systems including the geosphere, atmosphere, hydrosphere and biospheres and how they are interrelated	**EES12-8** describes and evaluates the models that show the structure and development of the Earth over its history
EES11-9 describes the evidence for the Theory of Plate Tectonics and the energy and geological changes that occur at plate boundaries	**EES12-9** describes and evaluates the causes of Earth hazards and the ways in which they affect, and are affected by, Earth's systems
Year 11 course Unit 2	**Year 12 course Unit 4**
Objective Students: ● develop knowledge and understanding of the Earth's processes and human impacts	**Objective** Students: ● develop knowledge and understanding of the impacts of living on Earth
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
EES11-10 describes the factors that influence how energy is transferred and transformed in Earth's systems	**EES12-10** analyses the natural processes and human impacts on the Earth including the evidence for climate change
EES11-11 describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes	**EES12-11** describes and assesses the difference between renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal affect Earth's systems

WORKING SCIENTIFICALLY

Working Scientifically skills are at the core of conducting primary and secondary-sourced investigations in science.

Opportunities are to be provided for students to engage with all the Working Scientifically skills for each investigation. In each module, particular outcomes have been identified as those that are most relevant to the intended learning.

In Stage 6 students are challenged to further develop their understanding of Working Scientifically as a group of dynamic and interdependent processes that are applied in each scientific investigation in a way that is appropriate for the task. This dynamism and interrelatedness adds a level of sophistication to students' understanding of the true nature and practice of Science. Through regular involvement in these processes, applying them as they arise, in a range of varied primary investigations, students will broaden their interpretation of Working Scientifically beyond the common linear model that suggests science is a process that simply confirms the way things are.

Students, through a variety of activities, are encouraged to select the most appropriate gateway to the Working Scientifically processes. These gateways become self-evident through the nature of the investigation. An inquiry may be instigated, for example, by direct observation of a phenomenon, or emerge from inconsistencies in results, from quantitative and/or qualitative analysis of data or from secondary research previously conducted by others. Students are challenged to be open to refining or redeveloping their chosen procedures, redefining their questions and/or hypotheses, modifying their methodologies or designs, conducting further secondary research and encouraged to communicate evidence based conclusions and novel ideas for future research. The processes are informed by the unexpected. Unexpected results are to be used to further inform the pathway towards scientific truth. Knowledge and understanding of science is essential to these processes being performed and, in turn, a deeper knowledge and understanding of scientific concepts emerges from students learning through the practice of science.

Each of the seven Working Scientifically outcomes represents a part of the interdependent dynamic process and its centrality to the study of science and the acquisition of scientific knowledge and skills. This course is structured to provide ongoing opportunities for students to implement these processes, particularly through the depth study provision. The following descriptions of these outcomes provide further information about the skills students are expected to develop throughout the course.

Questioning
Developing, proposing and evaluating inquiry questions and hypotheses challenge students to identify an area that can be investigated scientifically, involving primary and/or secondary-sourced data. Students demonstrate the development of inquiry question(s) that require observations, experimentation and/or research to aid in constructing a reasonable and informed hypothesis. The consideration of variables is to be included in the questioning process.

Designing investigations
In designing investigations, students ensure that all risks are assessed, appropriate materials and technologies are sourced and that all ethical concerns are considered. Variables are to be identified as independent, dependent and controlled, to ensure a valid procedure is developed that will allow for the reliable collection of data. Investigations are to include strategies that ensure that controlled variables are kept constant. Students justify and evaluate the design of investigations.

Conducting investigations
Students are to select appropriate equipment, employ safe work practices and ensure that risk assessments are conducted and followed. Appropriate technologies are to be used and procedures followed when disposing of waste. The selection and criteria for collecting valid and reliable data is to be methodical and, where appropriate, secondary-sourced information is referenced correctly. Reliability is ensured by making modifications to procedure and repeating the investigation or referring to other reliable secondary sources. Accuracy is ensured by using appropriate technologies in a consistent manner.

Representing
In representing data and information, students use the most appropriate and meaningful methods and media to organise and analyse data and information sources, including digital technologies and the use of a variety of visual representations. From these representations students identify trends, patterns and relationships in data and information and recognise error, uncertainty and limitations. Representations are to communicate data and information in order to help solve problems. They make predictions and assist in synthesising data and information to develop evidence-based conclusions and arguments.

Analysing
Students identify trends, patterns and relationships; recognise error, uncertainty and limitations in data; and interpret scientific and media texts. Students evaluate the relevance, accuracy, validity and reliability of the primary or secondary-sourced data in relation to investigations. They evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments. Where appropriate, mathematical models should be constructed and calculations applied to best demonstrate the trends and relationships that occur in data.

Solving problems
Students use critical thinking skills and creativity to demonstrate an understanding of scientific principles underlying the solutions to inquiry questions and problems posed in investigations. Appropriate and varied strategies are employed including using models to quantitatively and qualitatively explain and predict cause and effect relationships. In Working Scientifically, students synthesise and use evidence to construct and justify conclusions. Students interpret scientific and media texts and evaluate processes, claims and conclusions and consider the quality of available evidence to solve problems.

Communicating

Communicating all components of the Working Scientifically processes with clarity and accuracy is essential. Students use qualitative and quantitative information gained from primary and secondary-sourced investigations including digital, visual, written and verbal forms of communication as appropriate. Students apply appropriate scientific notations, nomenclature and scientific language where appropriate and use scientific language suitable for specific audiences and contexts.

INVESTIGATIONS

Primary and secondary-sourced investigations emphasise a range of types of practical activities and may include:

- undertaking laboratory investigations, including fair tests and controlled experiments
- undertaking fieldwork and surveys
- researching by using a variety of print and multimedia, as well as internet and electronic sources of data and information
- using a range of strategies and technologies to collect and record data, including appropriate use of digital technologies
- using and constructing models
- using or reorganising second-hand data, including those in spreadsheets and databases
- extracting and reorganising information in the form of flow charts, tables, graphs, diagrams, prose, keys, spreadsheets and databases
- using digital technologies, eg computer animations and simulations, to capture and analyse data and information
- presenting data and information in multimodal texts.

COURSE STRUCTURE AND REQUIREMENTS

 for your information

The following provides an outline of the Year 11 and Year 12 course structure and requirements for the *Earth and Environmental Science Stage 6 Draft Syllabus* with indicative hours, arrangement of content, and an overview of course content.

 consult

<table>
<tr><td rowspan="9">Year 11 course (120 hours)</td><td rowspan="17">Working Scientifically Skills</td><td>Unit</td><td>Module</td><td>Indicative hours</td></tr>
<tr><td rowspan="2">Unit 1
Early Earth</td><td>Module 1
Earth’s resources</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 2
Plate tectonics and energy</td></tr>
<tr><td colspan="2">Depth study
Drawn from knowledge outcome(s) in Unit 1 and/or 2</td><td>15</td></tr>
<tr><td rowspan="2">Unit 2
Earth Changes</td><td>Module 3
Energy transformations</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 4
Human impacts</td></tr>
<tr><td rowspan="8">Year 12 course (120 hours)</td><td rowspan="2">Unit 3
Evolving Earth</td><td>Module 5
Evolution of the Earth</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 6
Hazards</td></tr>
<tr><td colspan="2">Depth study
Drawn from knowledge outcome(s) in Unit 3 and/or 4</td><td>15</td></tr>
<tr><td rowspan="2">Unit 4
Living on Earth</td><td>Module 7
Climate change</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 8
Resource management</td></tr>
</table>

DEPTH STUDY: YEARS 11 AND 12

What are depth studies?

A depth study is any type of investigation/activity that a student completes individually or collaboratively that allows extension of one or more concepts found within or inspired by the syllabus. It may be one investigation/activity or a series of investigations/activities. Depth studies must address at least one knowledge outcome, the Questioning and Communicating skills outcomes and at least two other skills outcomes.

Depth studies allow students the avenue to pursue interests, to acquire a depth of understanding and to take responsibility for their own learning. They promote differentiation, engagement, ongoing feedback and support all forms of assessment.

A depth study may be, but is not limited to:

- a primary investigation or a series of primary investigations
- a secondary-sourced investigation or series of secondary-sourced investigations
- presentations, research assignments or fieldwork reports
- extension of concepts found within the course, either qualitatively and/or quantitatively.

A minimum of 15 hours per year of in-class course time is to be allocated to depth studies. The length of time for any individual study and pedagogies employed are not prescribed. The time for the depth study may be allocated to a single study or spread over the year and incorporate several studies depending on individual school and/or class requirements.

Requirements for depth studies

- A minimum of 15 hours of in-class time is allocated in each of Years 11 and 12.
- At least one depth study must be included in each of Years 11 and 12.
- Depth studies are to form part of the school-based assessment in each of Years 11 and 12.
- Depth studies must contribute a minimum of 20% to a maximum of 40% towards a student's' school-based assessment in each of Years 11 and 12.
- The Working Scientifically outcomes of Questioning and Communicating must be addressed in the school-based assessment component in each of Years 11 and 12.
- A minimum of two additional Working Scientifically skills outcomes, and at least one knowledge outcome, are to be addressed in depth studies.

The following outcomes must be addressed in depth studies:

- Questioning and Communicating skills
- A minimum of two additional skills
- At least one Knowledge outcome

POSSIBLE DEPTH STUDIES

Primary investigations

- Design and conduct experiments
- Test a claim
- Test a device.

Secondary-sourced investigations

- Make a documentary or media report
- Conduct a literature review
- Develop an evidence-based argument
- Write a journal article
- Write an essay–historical or theoretical
- Develop an environmental management plan
- Analyse a work of fiction or film for scientific relevance
- Create a visual presentation
- Investigate emerging technologies.

Create

- Design and invent
- Create a working model
- Create a portfolio.

Fieldwork

Fieldwork may be a starting point for a primary investigation or secondary-sourced study and could be initiated by the following stimuli:

- an excursion
- engagement with community experts.

Data analysis

This could be incorporated into a primary investigation or secondary-sourced investigation, for example:

- constructing and analysing graphs/tables
- data analysis from a variety of sources
- analysing research, eg longitudinal data, resource management data.

ASSESSMENT

 for your information

The key purpose of assessment is to gather valid and useful information about student learning and achievement. It is an essential component of the teaching and learning cycle. School-based assessment provides opportunities to measure student achievement of outcomes in a more diverse way than the HSC examination.

BOSTES continues to promote a standards-referenced approach to assessing and reporting student achievement. Assessment for, as and of learning are important to guide future teaching and learning opportunities and to give students ongoing feedback. These approaches are used individually or together, formally or informally, to gather evidence of student achievement against standards. Assessment provides teachers with the information needed to make judgements about students' achievement of outcomes.

Ongoing stakeholder feedback, analysis of BOSTES examination data and information gathered about assessment practices in schools has indicated that school-based and external assessment requirements require review and clarification. The HSC Reforms outline changes to school-based and HSC assessment practices to:

- make assessment more manageable for students, teachers and schools
- maintain rigorous standards
- strengthen opportunities for deeper learning
- provide opportunities for students to respond to unseen questions, and apply knowledge, understanding and skills to encourage in-depth analysis
- support teachers to make consistent judgements about student achievement.

Students with special education needs

Some students with special education needs will require adjustments to assessment practices in order to demonstrate what they know and can do in relation to syllabus outcomes and content. The type of adjustments and support will vary according to the particular needs of the student and the requirements of the assessment activity. Schools can make decisions to offer adjustments to coursework and school-based assessment.

Life Skills

Students undertaking Years 11–12 Life Skills courses will study selected outcomes and content. Assessment activities should provide opportunities for students to demonstrate achievement in relation to the outcomes, and to apply their knowledge, understanding and skills to a range of situations or environments.

The following general descriptions have been provided for consistency. Further advice about assessment, including in support materials, will provide greater detail.

Assessment for Learning	• enables teachers to use formal and informal assessment activities to gather evidence of how well students are learning • teachers provide feedback to students to improve their learning • evidence gathered can inform the directions for teaching and learning programs.
Assessment as Learning	• occurs when students use self-assessment, peer-assessment and formal and informal teacher feedback to monitor and reflect on their own learning, consolidate their understanding and work towards learning goals.
Assessment of Learning	• assists teachers to use evidence of student learning to assess student achievement against syllabus outcomes and standards at defined key points within a Year or Stage of learning.
Formal assessment	• tasks which students undertake as part of the internal assessment program, for example a written examination, research task, oral presentation, performance or other practical task • tasks appear in an assessment schedule and students are provided with sufficient written notification • evidence is gathered by teachers to report on student achievement in relation to syllabus outcomes and standards, and may also be used for grading or ranking purposes.
Informal assessment	• activities undertaken and anecdotal evidence gathered by the teacher throughout the learning process in a less prescribed manner, for example class discussion, questioning and observation • used as part of the ongoing teaching and learning process to gather evidence and provide feedback to students • can identify student strengths and areas for improvement.
Written examination	• a task undertaken individually, under formal supervised conditions to gather evidence about student achievement in relation to knowledge, understanding and skills at a point in time, for example a half-yearly, yearly or trial HSC examination • a task which may include one or more unseen questions or items, assessing a range of outcomes and content.

consult

Earth and Environmental Science Draft Assessment Requirements
The draft guidelines for school-based assessment provide specific advice about the number of formal assessment tasks, course components and weightings, and the nature of task types to be administered in Year 11 and Year 12.

The components and weightings for Year 11 and Year 12 are mandatory.

Year 11
- There will be 3 formal assessment tasks
- The maximum weighting for each formal assessment task is 40%
- One task may be a formal written examination
- One task must include an assessment of the depth study and its related knowledge, understanding and skills outcomes with a weighting of 20–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	60
Knowledge and understanding of course content	40
	100

Year 12
- There will be no more than 4 formal assessment tasks
- The maximum weighting for each formal assessment task is 40%
- One task may be a formal written examination, eg a trial HSC, with a maximum weighting of 25%
- One task must include an assessment of the depth study and its related knowledge, understanding and skills outcomes with a weighting of 20–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	60
Knowledge and understanding of course content	40
	100

Earth and Environmental Science Draft Examination Specifications

Sections
Section I Objective response questions *Questions may include stimulus material*
Section II Short response questions which may include multiple sections *Questions may include stimulus material*

HSC examination specifications will be reviewed following finalisation of the syllabuses.

Updated assessment and reporting advice will be provided when syllabuses are released.

The Assessment Certification Examination website will be updated to align with the syllabus implementation timeline.

CONTENT

 for your information

For Kindergarten to Year 12 courses of study and educational programs are based on the outcomes and content of syllabuses. The content describes in more detail how the outcomes are to be interpreted and used, and the intended learning appropriate for each Year. In considering the intended learning, teachers will make decisions about the emphasis to be given to particular areas of content, and any adjustments required based on the needs, interests and abilities of their students.

The knowledge, understanding and skills described in the outcomes and content provide a sound basis for students to successfully transition to their selected post-school pathway.

 consult

LEARNING ACROSS THE CURRICULUM

 for your information

NSW syllabuses provide a context within which to develop core skills, knowledge and understanding considered essential for the acquisition of effective, higher-order thinking skills that underpin successful participation in further education, work and everyday life including problem-solving, collaboration, self-management, communication and information technology skills.

BOSTES has described learning across the curriculum areas that are to be included in syllabuses. In Stage 6 syllabuses, the identified areas will be embedded in the descriptions of content and identified by icons. Learning across the curriculum content, including the cross-curriculum priorities and general capabilities, assists students to achieve the broad learning outcomes defined in the BOSTES *Statement of Equity Principles*, the *Melbourne Declaration on Educational Goals for Young Australians* (December 2008) and in the Australian Government's *Core Skills for Work Developmental Framework* (2013).

Knowledge, understanding, skills, values and attitudes derived from the learning across the curriculum areas will be included in BOSTES syllabuses, while ensuring that subject integrity is maintained.

Cross-curriculum priorities enable students to develop understanding about and address the contemporary issues they face.

The cross-curriculum priorities are:

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

General capabilities encompass the knowledge, skills, attitudes and behaviours to assist students to live and work successfully in the 21st century.

The general capabilities are:

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability

BOSTES syllabuses include other areas identified as important learning for all students:

- Civics and citizenship
- Difference and diversity
- Work and enterprise

 consult

Aboriginal and Torres Strait Islander histories and cultures

Aboriginal and Torres Strait Islander communities have diverse cultures, social structures and a history of unique, complex knowledge systems. Students are provided with opportunities to learn about how Aboriginal and Torres Strait Islander peoples have developed and refined knowledge about the world through observation, making predictions, testing (trial and error) and responding to environmental factors within specific contexts. Students will investigate examples of Aboriginal and Torres Strait Islander peoples' understanding of the environment and the ways that traditional knowledge and western scientific knowledge can be complementary.

When planning and programming content relating to Aboriginal and Torres Strait Islander histories and cultures teachers are encouraged to consider involving local Aboriginal communities and/or appropriate knowledge holders in determining suitable resources, or to use Aboriginal or Torres Strait Islander authored or endorsed publications.

Asia and Australia's engagement with Asia

Asia and Australia's engagement with Asia provides rich and engaging contexts for developing students' science and technology skills, knowledge and understanding. Students are provided with opportunities to recognise that the Asia region includes diverse environments. Students appreciate how interactions within and between these environments and the impacts of human activity influence the region, including Australia, and have significance for the rest of the world.

The Asia region plays an important role in scientific and technological research and development in areas such as medicine, natural resource management and natural disaster prediction and management.

Sustainability

Sustainability is concerned with the ongoing capacity of the Earth to maintain all life. It provides authentic contexts for exploring, investigating and understanding systems in the natural and made environments. Students are provided with opportunities to investigate relationships between systems and system components, and consider the sustainability of food sources and the natural and human environments. Students will engage with ethical debate and learn to engage with different perspectives in solving ethical problems.

Critical and creative thinking

Critical and creative thinking are integral to activities where students learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are embedded in the skills and processes of Working Scientifically and Working Technologically. The Year 11 and 12 Earth and Environmental Science *Syllabus* provides students with opportunities to develop critical and creative thinking skills through asking and posing questions, making predictions, engaging in primary and secondary source investigations and analysing and evaluating evidence in order to making evidence-based decisions.

Ethical understanding

Students develop the capability to assess ethical values and principles, and understand how reasoning can assist ethical judgement. Students are provided with opportunities for students to form and make ethical judgements in relation to scientific investigations, design, codes of practice, and the use of scientific information and applications. Students explore the importance of reporting honestly based on evidence. They apply ethical guidelines in their investigations, particularly in their implications for others and the environment.

Information and communication technology capability

Information and communication technology (ICT) can be used effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively. Students are provided with opportunities to develop ICT capability when they develop ideas and solutions, research science concepts and applications, investigate scientific phenomena, and communicate their scientific and technological understandings. In particular, they learn to access information, collect, analyse and represent data, model and investigate relationships, and communicate scientific and technological ideas, processes and information.

Intercultural understanding

Students develop intercultural understanding as they learn to understand themselves in relation to others. This involves students valuing their own cultures and those of others, and engaging with people of diverse cultures in ways that recognise commonalities and differences, create connections and cultivate respect. Students are provided with opportunities for students to appreciate how diverse cultural perspectives have impacted on the development, breadth and diversity of scientific knowledge and applications. Students learn about and engage with issues requiring cultural sensitivity, and that scientists work in culturally diverse teams to address issues and solve problems of national and international importance.

Literacy

Literacy is the ability to use a repertoire of knowledge and skills to communicate and comprehend effectively, using a variety of modes and media. Being ‘literate’ is more than the acquisition of technical skills – it includes the ability to identify, understand, interpret, create and communicate effectively using written, visual and digital forms of expression and communication for a number of purposes. Students are provided with opportunities to understand that language varies according to the context and engage with different forms of written and spoken language to communicate scientific concepts. Students learn that scientific information can also be presented in the form of diagrams, flowcharts, tables, graphs and models.

Numeracy

Numeracy involves students in recognising and understanding the role of Mathematics in the world. Students become numerate as they develop the confidence, willingness and ability to apply mathematics in their lives in constructive and meaningful ways. Students are provided with opportunities to develop numeracy skills through practical measurement and the collection, representation and interpretation of data from first-hand investigations and secondary sources. Students consider issues of uncertainty and reliability in measurement and learn data-analysis skills, identifying trends and patterns from numerical data and graphs. Students will apply mathematical equations and concepts in order to solve problems.

Personal and social capability

Students develop personal and social capability as they learn to understand and manage themselves, their relationships and their lives more effectively. This includes establishing positive relationships, making responsible decisions, working effectively individually and in teams and constructively handling challenging situations. Through applying the processes of Working Scientifically students develop skills in collaboration, peer assessment and review. Students learn to plan and conduct a depth study either individually or in a team.

Civics and citizenship

Civics and citizenship content involves knowledge and understanding of how our Australian society operates. Students are provided with opportunities to broaden their understanding of aspects of civics and citizenship in relation to the application of science ideas and technological advances, including ecological sustainability and the development of environmental and sustainable practices at a local, regional and national level.

Difference and diversity

Difference and diversity comprise gender, race and socio-economic circumstances. Students are provided with opportunities for students to understand and appreciate the difference and diversity they experience in their everyday lives. Working Scientifically and Working Technologically provide opportunities for students to work collaboratively, where they can develop an appreciation of the values and ideas of all group members. This also enables them to identify individual rights, challenge stereotypes and engage with opinions different to their own.

Work and enterprise

Students develop work-related skills and an appreciation of the value of working individually and collaboratively when conducting investigations. Students are provided with opportunities for students to prioritise safe practices and understand the potential risks and hazards present when conducting investigations. They engage with risk assessment whilst working safely in the laboratory or in the field.

ORGANISATION OF CONTENT

for your information

The following provides a diagrammatic representation of the relationships between syllabus content.

consult

The Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation.

EARTH AND ENVIRONMENTAL SCIENCE YEAR 11 COURSE CONTENT

 consult

WORKING SCIENTIFICALLY SKILLS

The following Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation

1. QUESTIONING

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation EES11-1

CONTENT

Students:

- develop and propose inquiry questions and hypotheses to identify an area that can be investigated scientifically, involving primary and/or secondary source data (ACSBL001)

2. DESIGNING INVESTIGATIONS

OUTCOMES

A student:

> designs and plans appropriate scientific investigations EES11-2

CONTENT

Students:

- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning investigations (ACSBL031)
- include the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data (ACSBL002)

3. CONDUCTING INVESTIGATIONS

OUTCOMES

A student:

> conducts primary or secondary-sourced investigations individually or in a team EES11-3

CONTENT

Students:

- employ safe work practices and manage risks (ACSBL031)
- use appropriate technologies to ensure accuracy
- select and extract information from reliable secondary sources, acknowledge them using an accepted referencing style

4. REPRESENTING

OUTCOMES

A student:

> represents qualitative and quantitative data and information using a range of appropriate media EES11-4

CONTENT

Students:

- represent qualitative and quantitative data and information using a range of formats, digital technologies and appropriate media (ACSBL004, ACSBL007)

5. ANALYSING

OUTCOMES

A student:

> analyses primary and secondary information sources EES11-5

CONTENT

Students:

- determine trends, patterns and relationships; identify error, uncertainty and limitations in data, including primary data and secondary-sourced information (ACSBL004, ACSBL005, ACSBL033)
- evaluate the relevance, accuracy, validity and reliability of primary and secondary-sourced data (ACSBL005)

6. SOLVING PROBLEMS

OUTCOMES

A student:

> solves scientific problems EES11-6

CONTENT

Students:

- use modelling (including mathematical examples) to explain phenomena, make predictions and/or solve problems using evidence from primary and/or secondary sources (ACSBL006, ACSBL010)

7. COMMUNICATION

OUTCOMES

A student:

> communicates scientific understanding EES11-7

CONTENT

Students:

- use suitable forms of digital, visual, written and verbal forms of communication
- apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSBL008, ACSBL036)

UNIT 1 EARLY EARTH

MODULE 1 EARTH'S RESOURCES

OUTCOMES

A student:

> conducts primary or secondary-sourced investigations individually or in a team EES11-3
> represents qualitative and quantitative data and information using a range of appropriate media EES11-4
> analyses primary and secondary information sources EES11-5
> describes the key features of Earth's systems including the geosphere, atmosphere, hydrosphere and biospheres and how they are interrelated EES11-8

CONTENT FOCUS

In this module compositional layers of the Earth are investigated and students engage with rock composition and origins of the component materials including minerals. Students extend their knowledge of geology from Stage 5 Science by learning about soil, the Rock Cycle and technologies used to gather geological data. Data is introduced and analysed relating to the ages of geological materials.

Science as a human endeavour is explored in relation to the work of geologists and the significance of this work to the mining of non-renewable resources. Technologies used to gather data and the interpretation of this data will also be explored; including absolute and relative dating of rocks.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on conducting investigations to collect, represent and analyse data to identify trends, patterns and relationships about the Earth's resources.

CONTENT

Structure of the Earth, the early geosphere, atmosphere and hydrosphere

Inquiry question: How did the compositional layers of the Earth develop?

Students:

- investigate and model the processes that formed the geosphere (ACSES018), atmosphere (ACSES022) and hydrosphere (ACSES023)
- investigate evidences for the structure of the Earth using technologies, including:
  - seismic wave velocities
  - meteorite evidence to demonstrate differences in density and composition (ACSES009, ACSES018)
- describe the compositional layers and thickness of Earth's layers, including:
  - the lithosphere (ACSES015)
  - asthenosphere
  - crust mantle and core and their compositional layers (ACSES006)
- conduct a primary investigation to compare the differences in density of rock samples found in the crust, mantle and core (ACSES003)
- analyse evidence for the Earth's age, including:

  - the formation and age of zircon crystals
  - radioactive decay
  - meteorite evidence (ASCES009)

Rocks, minerals and the Rock Cycle

Inquiry question: What are the components of rocks and soils?

Students:

- investigate the chemical composition of a variety of minerals and explain their formation, including:
  - silicates
  - mafic minerals
- investigate the physical properties of minerals that are used to assist in classification
- investigate methods of classifying rocks and minerals used by Aboriginal and Torres Strait Islander peoples
- examine a range of rocks and minerals and classify samples using dichotomous keys
- explain the formation of rocks as characteristic assemblages of mineral crystals or grains that are formed through igneous, sedimentary and metamorphic processes, as part of the Rock Cycle (ACSES019)
- explain the formation of soil in terms of the interaction of atmospheric, geologic, hydrologic and biotic processes (ACSES020)
- conduct a primary investigation to examine soil types and component materials (ACSES020)

Geological timescale

Inquiry question: How do we determine the age of geological materials?

Students:

- describe relative and absolute dating of the geosphere (ACSES017)
- use data from secondary sources of both relative and absolute dating to determine the age of geological materials (ACSES013, ACSES015, ACSES016, ACSES017)

Geological resources

Inquiry question: How are non-renewable geological resources discovered and extracted? (ACSES071)

Students:

- investigate traditional Aboriginal quarrying and mining methods
- locate and relate a range of non-renewable resources to their location, for example:
  - minerals
  - fossil fuels (ACSES072)
  - ores of economic significance (ACSES072)
- examine the economic importance of Australian non-renewable resources (ACSES061)
- investigate and assess the appropriateness of direct sampling techniques and remote sensing techniques in discovering non-renewable sources. (ACSES073) For example:
  - satellite images
  - aerial photographs
  - geophysical data

- assess the influence by type, volume and location of different extraction methods, including: (ACSES074)
  - open-pit mining
  - underground mining methods
  - offshore and onshore drilling

UNIT 1 EARLY EARTH

MODULE 2 PLATE TECTONICS AND ENERGY

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation EES11-1
> designs and plans appropriate scientific investigations EES11-2
> conducts primary or secondary-sourced investigations individually or in a team EES11-3
> represents qualitative and quantitative data and information using a range of appropriate media EES11-4
> analyses primary and secondary information sources EES11-5
> describes the evidence for the theory of of plate tectonics and the energy and geological changes that occur at plate boundaries EES11-9

CONTENT FOCUS

While it is now understood that the Earth's surface is made from a series of tectonic plates, which move and interact with one another, solid evidence for the Theory of Plate Tectonics was not proposed until the early twentieth century. Initially the theory was dismissed because of a lack of evidence but eventually the work of a series of scientists combined to produce enough evidence to support its acceptance. In some cases, it was the development of new technologies that allowed individual pieces of the puzzle to be put together.

It is now known that the Theory of Plate Tectonics can explain not only the location and causes of earthquakes and volcanoes, but also the location of mountain ranges (both above and under the oceans) and deep ocean floor trenches. This theory also helps to explain many aspects of climate, evolution and extinction, and supports predictions about the future.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing questions and hypotheses when designing and conducting investigations to analyse trends, patterns and relationships in data about plate tectonics, the energy and geological changes that occur.

CONTENT

Evidence for Plate Tectonics

Inquiry question: What is the current evidence for the Theory of Plate Tectonics and how did it develop?

Students:

- analyse evidence that supports the Theory of Plate Tectonics including data and models, including:
  - the 'jigsaw fit' of the continental shelves (ACSES004, ACSES006)
  - matching up identical fossils on different continents (ACSES004, ACSES006)
  - the profile of the ocean floor
  - the age of sea floor rocks (ACSES004)
  - magnetic reversals in sea floor rocks (ACSES035)

- evaluate the contributions of the following to our understanding of the movement of plates, including: (ACSES005, ACSES009, ACSES035, ACSES038)
  - Wegener–continental drift
  - Holmes–convection in the mantle
  - Hess–sea floor spreading
  - Vine and Matthews–magnetic reversals (ACSES004)
  - Glomar Challenger–age of oceanic floors

Plate boundaries

Inquiry question: What occurs at plate boundaries?

Students:

- use geological maps of the Earth to locate boundary types and model the processes that have contributed to their formation, including: (ACSES006, ACSES035, ACSES099)
  - divergent boundaries
  - convergent boundaries
  - conservative boundaries

Plate boundaries and tectonic structures

Inquiry question: What are the geological and topographic features resulting from plate tectonics at each boundary type?

Students:

- model types of plate boundaries showing the dominant topographic and geological features, including: (ACSES006)
  - divergent boundaries: rift valley, mid-ocean ridge, normal and transform faults
  - convergent boundaries: mountain range, trench, reverse faults and folds

UNIT 2 EARTH CHANGES

MODULE 3 ENERGY TRANSFORMATIONS

OUTCOMES

A student:

> analyses primary and secondary information sources EES11-5
> solves scientific problems EES11-6
> communicates scientific understanding EES11-7
> describes the factors that influence how energy is transferred and transformed in Earth's systems EES11-10

CONTENT FOCUS

Earth's Processes require energy. This energy may be transformed from one form to another or transferred between objects. Energy from the Sun and Earth's interior control processes within and between Earth's spheres. Heat and gravitational energy in Earth's interior also drives the movements of tectonic plates. Energy transfers on different timescales between the atmosphere, oceans and land generate weather and climate phenomena. These result in global weather patterns influenced by ocean currents such as El Niño and La Niña.

Knowledge of processes and energy transfer allows scientists to explain phenomena and to predict areas at risk.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on collecting and analysing data and information to identify trends, patterns and relationships, solve problems and communicate ideas about energy transformations in Earth's systems.

CONTENT

The role of energy in Earth's processes

Inquiry question: How does energy drive Earth's processes?

Students:

- conduct a primary investigation to demonstrate convection currents (ACSES031)
- investigate the role of gravity and heat in tectonic plate movements, including: (ACSES033, ACSES047)
  - analysing the role of solar radiation in driving Earth's processes such as photosynthesis and the water cycle (ACSES046, ACSES048)
  - comparing the movement of Earth's plates to surface movements on other bodies in the solar system
  - modelling movement caused by gravity and/or heat (ACSES048, ACSES049)
  - describing the contributions of convection and slab pull to plate speed

Geological transformations: Earthquakes, volcanoes and mountain ranges

Inquiry question: How do energy transfers and transformations alter the lithosphere (ACSES055) (ACSES056)

Students:

- explain how the release of elastic potential energy in rock leads to earthquakes (ACSES044, ACSES047)
- describe the role of heat and its interactions with the lithosphere in creating different types of volcanic eruptions and magma compositions, for example: (ACSES099)
  - thermal plumes resulting in effusive mafic eruptions
  - partial melting of subducted oceanic plates resulting in explosive felsic eruptions
  - interactions of magma and overlying ice resulting in ash clouds
- represent these energy transformations in the formation of mountains due to:
  - thermal expansion
  - deformation of the lithosphere (ACSES035)

Transformations in the oceans, biosphere and the cryosphere

Inquiry question: How do energy transformations influence the oceans, biosphere and cryosphere?

Students:

- examine the unique properties of water that make it such an important component of the Earth's systems, including: (ACSES024)
  - boiling point
  - ability to act as a solvent
  - density
  - thermal capacity
  - surface tension
- outline the roles of energy, water masses and salinity in producing ocean currents (ACSES051)
- explain the role of heat transfer by ocean currents and atmospheric movement in causing weather patterns such as El Niño and La Niña (ACSES052)
- extract information from secondary sources to document and investigate changes in the cryosphere (ACSES034)

UNIT 2 EARTH CHANGES

MODULE 4 HUMAN IMPACTS

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation EES11-1
> designs and plans appropriate scientific investigations EES11-2
> conducts primary or secondary-sourced investigations individually or in a team EES11-3
> describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11

CONTENT FOCUS

Humans use Earth's resources to maintain life and provide infrastructure. However, natural resources are not infinite and renewable resources such as water, soil, plants and animals can be sustainably managed using scientific knowledge. Incomplete information or failure to consider the impact of resource use may cause environmental damage.

Scientific knowledge enables efficient use of resources and also the rehabilitation of damaged ecosystems. Healthy ecosystems provide renewable resources, purify air and water, regulate climate and provide cultural services. Reduction in human impacts enhances ecosystem quality and increases resources and services.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing questions and hypotheses when designing and conducting investigations about the human impacts on the Earth.

CONTENT

Water management

Inquiry question: How can water be managed for use by humans and ecosystems?

Students:

- represent the distribution of Earth's water, including the amount available to plants and animals (ACSES060)
- investigate the treatment and potential reuse of different types of water, for example: (ACSES058)
  - industrial wastewater
  - sewage
  - stormwater
- Describe ways in which human activity can influence the availability and quality of water both directly, eg over-extraction or indirectly, eg algal blooms (ACSES080)

Salinity and erosion

Inquiry question: How does human land use affect soil?

Students:

- explain causes of salinisation, for example: (ACSES024)
  - land clearing
  - irrigation
- investigate the rehabilitation of salinity-affected area(s) by preparing a case study (ACSES070)
- perform a primary investigation of erosion prevention and analyse the efficacy of the method(s) used (ACSES060, ACSES102)
- investigate sources and effects of soil contamination, for example:
  - heavy metal contamination

Effects of introduced species

Inquiry question: How do introduced species affect the Australian environment and ecosystems? (ACSES053, ACSES054, ACSES055, ACSES081)

Students:

- outline the biotic and abiotic effects of introduced species
- perform an investigation about a local introduced species, including:
  - reason for introduction
  - biotic and abiotic effects of the species
  - area affected by the species
  - human impacts which favour the introduced species
  - control or mitigation methods
  - economic impact of the species
  - different views about the value of and/or harm caused by the introduced species including the views of Aboriginal and Torres Strait Islander peoples
- analyse ways in which human activity can upset ecosystem balance and favour introduced species (ACSES027)
- describe ways in which introduced species contribute to the decline or extinction of native Australian species (ACSES081)

DEPTH STUDY: YEAR 11

OUTCOMES

Skills

A student:

> poses questions and hypotheses for scientific investigation EES11-1
> designs and plans appropriate scientific investigations EES11-2
> conducts primary or secondary-sourced investigations individually or in a team EES11-3
> represents qualitative and quantitative data and information using a range of appropriate media EES11-4
> analyses primary and secondary information sources EES11-5
> solves scientific problems EES11-6
> communicates scientific understanding EES11-7

Knowledge and understanding

A student:

> describes the key features of Earth's systems including the geosphere, atmosphere, hydrosphere and biospheres and how they are interrelated EES11-8
> describes the evidence for the Theory of Plate Tectonics and the energy and geological changes that occur at plate boundaries EES11-9
> describes the factors that influence how energy is transferred and transformed in Earth's systems EES11-10
> describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes EES11-11

CONTENT

Possible depth studies:

Unit 1. Early Earth

- Investigate and model possible future plate movements to form supercontinents on Earth
- Analyse new evidence for plate tectonics, and the technologies that have produced it
- Investigate a range of technologies that are used to determine the age of geological materials
- Fieldwork to a local area of geological significance to investigate rock formations and soil composition
- Model mineral extraction techniques from ores of economic significance

Unit 2. The Earth's Biodiversity

- Evaluate different methods of treating stormwater (gross-pollutant trap, artificial wetland) in terms of their efficacy and their practical use in the local area, possibly incorporating a field study of water quality at different stages
- Visit to local farm or Landcare project to observe salinity and/or erosion management in local conditions. Describe the scientific basis of chosen techniques
- Investigate the efficiency of energy conversion in photosynthesis and compare this to the efficiency of solar technologies
- Investigate non-renewable energy use in Australia
- Model the processes of mountain building from thermal expansion and/or crustal compression

EARTH AND ENVIRONMENTAL SCIENCE YEAR 12 COURSE CONTENT

WORKING SCIENTIFICALLY SKILLS

The following Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation.

1. QUESTIONING

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation EES12-1

CONTENT

Students:

- develop and evaluate inquiry questions and hypotheses to identify an area that can be investigated scientifically, involving primary and/or secondary-sourced data (ACSBL001)

2. DESIGNING INVESTIGATIONS

OUTCOMES

A student:

> designs, plans and evaluates primary and secondary-sourced investigations EES12-2

CONTENT

Students:

- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation (ACSBL031)
- justify and evaluate the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data (ACSBL002)

3. CONDUCTING INVESTIGATIONS

OUTCOMES

A student:

> conducts primary and secondary-sourced investigations individually or in a team EES12-3

CONTENT

Students:

- employ and evaluate safe work practices and manage risks (ACSBL031)
- use appropriate technologies, evaluate accuracy and identify sources of error
- select and extract information from a wide range of reliable secondary sources and acknowledging them using an accepted referencing style

4. REPRESENTING

OUTCOMES

A student:

> selects and represents key qualitative and quantitative data and information using a range of appropriate media EES12-4

CONTENT

Students:

- select and represent qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media (ACSBL004, ACSBL007)

5. ANALYSING

OUTCOMES

A student:

> analyses primary and secondary information sources EES12-5

CONTENT

Students:

- derive trends, patterns and relationships; consider error, uncertainty and limitations in data; and interpret scientific and media texts (ACSBL004, ACSBL005, ACSBL033)
- evaluate the relevance, accuracy, validity and reliability of primary and secondary-sourced data and suggest improvements to investigations (ACSBL005)

6. SOLVING PROBLEMS

OUTCOMES

A student:

> solves scientific problems using primary and secondary data EES12-6

CONTENT

Students:

- use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources (ACSBL006, ACSBL010)

7. COMMUNICATION

OUTCOMES

A student:

> communicates scientific understanding using suitable language and terminology EES12-7

CONTENT

Students:

- select and use suitable forms of digital, visual, written and verbal forms of communication
- select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSBL008, ACSBL036)
- construct evidence based arguments and engage in peer feedback to evaluate an argument and assess its validity (ACSBL034, ACSBL036)

UNIT 3 EVOLVING EARTH

MODULE 5 EVOLUTION OF THE EARTH

OUTCOMES

A student:

> analyses primary and secondary information sources EES12-5
> solves scientific problems using primary and secondary data EES12-6
> communicates scientific understanding using suitable language and terminology EES12-7
> describes and evaluates the models that show the structure and development of the Earth over its' history EES12-8

CONTENT FOCUS

Since the formation of the Earth, both the atmosphere and lithosphere have been continually changing, each influencing the other. The processes of plate tectonics have further contributed to this, as has the formation of liquid water and the introduction of life. Combined, these have, and continue to alter both the atmosphere and lithosphere.

With the discovery of fossils, it became possible to develop the geological timescale and to determine when mass evolution and extinction events occurred. We now know that these are strongly influenced by the phases of the plate tectonic supercycle and that this has a significant effect on climate. This knowledge leaves us better informed about global climate change, giving us new information about climate and natural cycles of change.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on analysing trends, patterns and relationships in data to solve problems and to communicate ideas about the evolution of the Earth.

CONTENT

The development of the Biosphere

Inquiry question: How did today's biosphere originate and develop?

Students:

- investigate explanations of the Earth's origin by Aboriginal and Torres Strait Islander peoples and other cultural groups
- investigate theories proposed to explain the origin of organic molecules on Earth, including: (ACSES025)
  - Urey and Miller's experiments (ACSES026)
  - communities around Black smokers (ACSES026, ACSES027)
  - meteorites/Panspermia
- examine the evidence for the development of photosynthetic life, including cyanobacteria and stromatolites (ACSES021, ACSES028)
- evaluate the evidence for the origin of multicellular life and the resulting changes to ecosystems, for example, the Ediacaran and Cambrian fauna (ACSES029)
- investigate the conquest of land by both plants and animals (ACSES029)

Changes in the geosphere, atmosphere and hydrosphere

Inquiry question: How did the changes to the biosphere effect the Earth's geosphere, atmosphere and hydrosphere?

Students:

- analyse the changes in the geosphere, atmosphere and hydrosphere that resulted from the development and evolution of the biosphere, for example: (ACSES022, ACSES023)
  - the effect of photosynthesising cyanobacteria and stromatolites on each of the spheres (ACSES021, ACSES025)
  - the role and effects of banded iron formations and red beds

The Plate Tectonic Supercycle

Inquiry question: What effect does the plate tectonic supercycle have on the Earth?

Students:

- model the plate tectonic supercycle (ACSES025, ACSES038)
- outline the effect of the plate tectonic supercycle on large scale phenomena such as climate and evolution (ACSES003, ACSES010, ACSES013, ACSES014)

Fossil formation and stratigraphy

Inquiry question: Explain the role of fossils in expanding our knowledge of geological time and past life on Earth.

Students:

- investigate and model the processes of fossil formation by examining a variety of methods in rock, including: (ACSES028)
  - mould formations
  - cast formations
  - trace fossils
- investigate how megafauna fossils reveal evidence of indigenous Australian ancestor interactions
- discuss the significance of index fossils in generating a geological time scale
- extrapolate how the principles of Uniformitarianism and Superposition in addition to fossils and absolute dating can be used to date events of geological significance, for example: (ACSES006, ACSES015, ACSES016)
  - the evolution of the Cambrian fauna (ACSES029)
  - mass extinction events (ACSES029)

UNIT 3 EVOLVING EARTH

MODULE 6 HAZARDS

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation EES12-1
> designs, plans and evaluates primary and secondary-sourced investigations EES12-2
> conducts primary and secondary-sourced investigations individually or in a team EES12-3
> selects and represents key qualitative and quantitative data and information using a range of appropriate media EES12-4
> describes and evaluates the causes of Earth hazards and the ways in which they impact, and are impacted by, Earth's systems EES12-9

CONTENT FOCUS

Natural disasters such as earthquakes, volcanoes and cyclones have a significant impact on our environments, and often affect thousands of people, causing enormous damage. In many cases, the probability of such an event occurring is closely linked to the proximity of the area to a plate boundary, and indeed the type of boundary can also influence the severity of the event.

To some extent, technologies can be used to predict hazardous events and mitigate their effects; however, we are still not able to prevent them from occurring. Whether the changing climate is altering the frequency and magnitude of these events is also uncertain. During this module, students will explore the use and development and analysis of seismic data in order to examine significant seismic events.

Working Scientifically

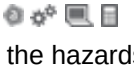
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing and evaluating questions and hypotheses when designing and conducting investigations to analyse trends, patterns and relationships in data about the evolving Earth.

CONTENT

Geological natural disasters

Inquiry question: How and why do geological disasters occur?

Students:

- using data, predict the zones along which earthquakes and both effusive and explosive volcanic eruptions are likely to occur and relate these to plate boundaries (ACSES094)
- investigate and model, using secondary sources, the changing depth of focus of earthquakes at convergent and divergent boundaries (ACSES100) 
- investigate and evaluate, using secondary sources, the hazards associated with earthquakes, including ground motion and tsunamis (ACSES100) 
- investigate and evaluate, using secondary sources, the hazards associated with volcanoes, for example ash eruptions and lava flows, lahars and poisonous gas emissions

- account for the types of magma in each of the above volcano types, and analyse how this affects the explosivity of their eruptions
- investigate the point at which a geological hazard becomes a disaster

Impact of natural disasters on the biosphere

Inquiry question: How do natural disasters such as explosive volcanic eruptions, earthquakes and extreme weather events influence the biosphere and atmosphere?

Students:

- investigate and assess the effect that a major earthquake would have on the local biotic population in an urban area
- using data from secondary sources, compare the eruptions that occur at explosive and effusive volcanoes in terms of the impact to the biosphere and atmosphere (ACSES099)
- investigate the physical and chemical effects that volcanoes have on soils
- analyse the effects of a major volcanic eruption on the atmosphere in changing climate (both warming and cooling) (ACSES099)
- investigate, in a case study, one eruption that has had a significant effect on the biosphere and atmosphere and assess its impacts, including:
  - Mount Pinatubo (ACSES099)
- evaluate the causes and physical impact of climatic phenomena on a local ecosystem, including: (ACSES101, ACSES103)
  - hailstorm
  - east coast low
  - drought or flood
  - bushfire
- investigate how human activities can contribute to the frequency and magnitude of some natural disasters, including: (ACSES102)
  - drought or flood
  - bushfire
  - landslides

Prediction and prevention of natural disasters

Inquiry question: What technologies allow us to predict natural disasters and minimise their effects on the biosphere?

Students:

- using secondary sources, evaluate the effectiveness of technologies in predicting natural disasters such as:
  - volcanoes: three-dimensional imaging, seismic data, early-warning systems, ground-movement data, analysis of historical data (ACSES095, ACSES098, ACSES100)
  - earthquakes: ground movement detectors, anomalous animal behaviour, strain meters
  - east coast low or drought or flood; water temperatures, pressure systems
- investigate and evaluate the technologies used to minimise the effect of natural disasters associated with volcanoes, earthquakes, including building codes, disaster warning systems and education (ACSES103)
- using secondary sources, assess the accuracy of technologies used in meteorology in predicting and preventing damage to life and infrastructure as a result of natural weather events
- using secondary sources, evaluate the effectiveness of technologies in preventing damage to build environments and impacts on human life resulting from natural disasters

UNIT 4 LIVING ON EARTH

MODULE 7 CLIMATE CHANGE

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation EES12-1
> solves scientific problems using primary and secondary data EES12-6
> communicates scientific understanding using suitable language and terminology EES12-7
> analyses the natural processes and human impacts on the Earth including the evidence for climate change EES12-10

CONTENT FOCUS

Globally, a significant concern of governments and non-government bodies is climate change and its effects. The atmospheric effects of climate change and the effects on the hydrosphere and cryosphere as a result of global warming are examined. The acidification and the warming of the oceans can have an impact on the life that they contain, and evidence already shows that rising sea levels could also have an impact on human communities in low-lying locations around the world.

In this module, students examine the mechanisms and evidence for climate change. They will distinguish between natural processes that induce a change in climate and anthropogenic causes of climate change. This will assist students to form evidence-based opinions and develop strategies to manage climate change in the future.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing and evaluating questions and hypotheses, analysing trends, patterns and solving problems with data while communicating ideas about climate change.

CONTENT

The natural processes of climate change

Inquiry question: How long does it take for the climate to change naturally and what causes these changes?

Students:

- use modelling to explain the causes of the natural greenhouse effect and examine the timescales in which changes occur (ACSES049, ACSES084)
- using secondary sources, assess the different causes of natural change to the greenhouse effect and the timescales in which they occur, including: (ACSES104, ACSES105)
  - the Plate Tectonic Supercycle
  - massive volcanic eruptions such as the Deccan and Siberian Traps
  - changes in the Earth's orbit around the Sun
  - changes in ocean currents and ocean circulation

The effect of human activity

Inquiry question: What evidence do we have for climate change in the past?

Students:

- describe and discuss ancient evidence for climate change, including but not limited to: (ACSES088, ACSES108)
  - pollen grains in sedimentary rocks
  - rock type changes
  - fossils and/or microfossils
  - changing isotope ratios in rocks and deep sea sediments
- identify and explain more recent evidence for climate change, including but not limited to: (ACSES091, ACSES107, ACSES108)
  - ice cores containing gas bubbles and oxygen isotopes
  - dendrochronology
  - Aboriginal art sites showing now-extinct species and environments (ACSES107)
  - human instrumental records (ACSES087, ACSES107)
  - isotope ratios shown in stalagmites, stalactites and corals

The effect of human activities on climate change

Inquiry question: How have the actions of humans contributed to climate change since the Industrial Revolution?

Students:

- distinguish between the natural greenhouse effect and the anthropogenic greenhouse effect
- investigate the effects that human induced climate change has had on the environment since the Industrial Revolution, for example
  - an increase in greenhouse gases (ACSES104)
  - ocean acidification (ACSES105)
- investigate the flow on effects of anthropogenic climate change, for example: (ACSES106, ACSES108)
  - changing weather patterns (ACSES049, ACSES050, ACSES052)
  - the changes in glaciers, sea ice and ice sheets
  - changing species ranges
  - rising sea level

Mitigation and adaptation strategies for climate change

Inquiry question: What can humans do to minimise and respond to climate change?

Students:

- investigate human-induced causes for the enhanced greenhouse effect. Including:
  - burning fossil fuels for energy
  - land use and land cover change (ACSES092, ACSES093, ACSES094, ACSES105)
- investigate ways that humans can minimise their contribution to the greenhouse effect in their everyday lives (ACSES098, ACSES108)
- evaluate the usefulness of a range of mitigation and adaptation strategies, for example: (ACSES090, ACSES097, ACSES108)
  - urban design
  - using different energy sources

- using or changing agricultural practices of a range of cultural groups including those of Aboriginal and Torres Strait Islander peoples
- government and non-government bodies policies and strategies

UNIT 4 LIVING ON EARTH

MODULE 8 RESOURCE MANAGEMENT

OUTCOMES

A student:

> analyses primary and secondary information sources EES12-5
> solves scientific problems using primary and secondary data EES12-6
> communicates scientific understanding using suitable language and terminology EES12-7
> describes and assesses the differences between renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal impact Earth's systems EES12-11

CONTENT FOCUS

Australia is rich in both renewable (eg agricultural production, sunlight) and non-renewable (eg minerals, fossil fuels) natural resources. Extraction and disposal of waste can greatly impact the surrounding environment, affecting the quality and availability of renewable resources such as water and living organisms. The magnitude of this is referred to as an 'ecological footprint'.

Scientific models of resource extraction, use and management have developed over time in response to new discoveries and the incorporation of sustainable practices; many developed by Aboriginal and Torres Strait Islander peoples. World population is increasing and more resources are being extracted for food, consumer goods, energy and infrastructure. Sustainable management of both resources and waste is vital for our long-term survival.

Working Scientifically

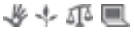
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on collecting and representing data to analyse trends and patterns and solve problems while communicating ideas about resource management.

CONTENT

Using Australia's natural resources

Inquiry question: What are Australia's natural resources? How are these resources obtained, maintained and/or used?

Students:

- identify Australian renewable resources and their locations, including but not limited to: (ACSES062, ACSES072) 
  - agricultural resources: terrestrial, aquatic, native crops
  - water
  - energy sources
- investigate how mining sites affect the environment including Aboriginal cultural sites, and examine methods of reclamation of the environment and sites once mining operations cease, for example: 
  - open-pit mining
  - underground mining methods
  - offshore and onshore drilling

- prepare a case study to investigate the involvement of traditional owners in the planning procedures, mining practice and restoration of damaged lands after mining operations cease
- prepare a case study of an important Australian renewable or non-renewable resource, for example:
  - how is the resource found, obtained and/or maintained? (ACSES073, ACSES074)
  - how is the resource used? (ACSES078)
  - can the resource be sustainably extracted and/or used? (ACSES075, ACSES076)
  - examine the past, present and future use/importance of the resource (ACSES079)

Waste management

Inquiry question: How is waste managed?

Students:

- perform a first-hand investigation of the composition of household or organisational waste (ACSES058)
- outline the management options for different types of solid waste (ACSES062)
- evaluate the sustainability of a named waste management option, for example: (ACSES061, ACSES083)
  - energy used to produce and/or recycle the waste
  - environmental impact of waste disposal
  - space for disposal or storage
  - local management facilities
  - demand for reused or recycled waste

Sustainability

Inquiry question: How can humans sustainably manage resources?

Students:

- investigate different definitions of sustainability and the rationale underpinning these (ACSES066)
- investigate human activities that affect sustainability, including but not limited to:
  - overharvesting (ACSES082, ACSES083)
  - water pollution (ACSES080)
  - habitat removal or destruction (ACSES081)
- investigate the processes Aboriginal and Torres Strait Islander peoples use as sustainable resource managers, for example: (ACSES040)
  - cultural traditions which preserve Country and/or Place and the resources therein
  - ongoing engagement with groups such as Land Councils, National Parks, municipal councils and others to improve resource management
  - legislation and actions to protect significant areas of Country and/or Place
- research and present information about a sustainability initiative in your community (ACSES063)

DEPTH STUDY: YEAR 12

OUTCOMES

Skills

A student:

> develops and evaluates questions and hypotheses for scientific investigation EES12-1
> designs, plans and evaluates primary and secondary-sourced investigations EES12-2
> conducts primary and secondary-sourced investigations individually or in a team EES12-3
> selects and represents key qualitative and quantitative data and information using a range of appropriate media EES12-4
> analyses primary and secondary information sources EES12-5
> solves scientific problems using primary and secondary data EES12-6
> communicates scientific understanding using suitable language and terminology EES12-7

Knowledge and understanding

A student:

> describes and evaluates the models that show the structure and development of the Earth over its 4.5 million-year history EE12-8
> describes and evaluates the causes of Earth's hazards and the ways in which they impact, and are impacted by, Earth's systems EES12-9
> assesses the natural processes and human impacts on the Earth including the evidence for climate change EES12-10
> describes and assesses the difference between renewable and non-renewable Earth's resources and how their extraction, use, consumption and disposal impact Earth's systems EES12-11

CONTENT

Possible depth studies:

Unit 3 Evolving Earth

- Examine the relationship between the supercycle and evolution and extinction events such as the beginning of multicellular life and the Permian-Triassic and Cretaceous-Tertiary extinctions.
- Use a primary or secondary source investigation to examine a fossil site, discussing factors such as:
  - time period
  - mode of fossilisation
  - diversity and abundance of organisms represented
  - contribution to our understanding of the evolution of life and changing ecosystems
  - technologies available to find and/or reconstruct fossils
  - changes in scientific knowledge as a result of this site

Unit 4 Living on Earth

- Investigate emerging technologies for more efficient resource use and/or extraction
- Visit a local waste management facility to determine the type of waste processed, scientific basis of management practices, possible improvements to efficiency and environmental impacts of the facility
- Analyse the traditional Aboriginal or Torres Strait Islander peoples' management practices in a selected Country or Place. How are traditional practices used for sustainable resource management?
- Examine the data and assumptions underlying sustainability models, for example:

- maximum sustainable yield of a fishery
- sustainable harvesting of kangaroos
- managed forests
- flora and fauna extinction rates in Australia since European colonisation

GLOSSARY

 for your information

The glossary explains terms that will assist teachers in the interpretation of the subject. The glossary will be based on the NSW Science K–10 glossary and the Australian curriculum senior secondary years Earth and Environmental Science glossary.

 consult

Glossary term	Definition
abiotic	The non-living components of the environment.
account	Account for: State reasons for, report on. Give an account of: narrate a series of event or transactions.
analyse	To consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.
anthropogenic climate change	Climate change that is caused or influenced by human activity.
apply	Use, utilise, employ in a particular situation.
assess	Make a judgement of value, quality, outcomes, results or size.
biota/biotic	All of the living organisms in a specific region or area including animals, plants, and microorganisms.
calculate	Ascertain/determine from given facts, figures or information.
clarify	Make a clear plain.
classify	Arrange or include in classes/categories.
compare	Show how things are similar or different.
conclusion	A judgement based on evidence.
construct	Make, build, put together items or arguments.
contrast	Show similarities or differences.
controlled variable	A variable that is kept constant (or changed in constant ways) during an investigation.
critically (analyse/evaluate)	Add a degree of accuracy or depth, knowledge and understanding, logic, questioning, reflection and quality to (analyse/evaluate).
cryosphere	The frozen water part of the Earth's system.

Glossary term	Definition
Country	An area that is traditionally owned and looked after by an Aboriginal language group or community or certain people within that group. The term may indicate more than simply a geographical area; it is also a concept that can encompass the spiritual meanings and feelings of attachment associated with that area.
deduce	Draw conclusions.
define	State meaning and identify essential qualities.
demonstrate	Show by example.
dendrochronology	Using the the annual rings of trees to gather evidence of past events.
dependent variable	A variable that changes in response to changes to the independent variable in an investigation.
design	To plan and evaluate the construction of a product or process, including an investigation
digital technologies	Systems that handle digital data, including hardware and software, for specific purposes.
discuss	Identify issues and provide points for and against.
distinguish	Recognise or note/indicate as being distinct or different from; to note differences between.
environment	All surroundings, both living and non-living.
evaluate	To examine and judge the merit or significance of something, including processes, events, descriptions, relationships or data.
examine	Inquire into.
explain	Relate cause and effect; make the relationship between things evident/provide why and/or how.
extract	Choose relevant and/or appropriate details.
extrapolate	Infer from what is known.
hypothesis	A tentative idea or explanation for an observation, which can be tested and either supported or refuted by investigation.
identify	Recognise and name.
independent variable	A variable that is changed in an investigation to see what effect it has on the dependent variable.
inquiry question	A driving question for an investigation.
interpret	Draw meaning from.

Glossary term	Definition
investigate	Plan, inquire into and draw conclusions about.
investigation	A scientific process of answering a question, exploring an idea or solving a problem that requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities.
justify	Support an argument or conclusion.
law	A general statement that describes a phenomena supported by repeated scientific investigations that always applies under the same conditions.
model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
outline	Sketch in general terms; indicate the main features of.
plan	Decide on and make arrangements for in advance.
Place	A space mapped out by physical or intangible boundaries that individuals or groups of Torres Strait Islander peoples occupy and regard as their own. It is a space with varying degrees of spirituality.
predict	Suggest what might happen based on available information.
primary sources	Information created by a person or persons directly involved in a study or observing an event.
propose	Put forward (for example a point of view, idea, argument, suggestion) for consideration or action.
recall	Present remembered ideas, facts or experiences.
recommend	Provide reasons in favour.
recount	Retell a series of events.
relate	To identify connections or associations between ideas or relationships or between components of systems and structures.
reliability	Data that have been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results for the same population.
secondary-sourced investigation	Information that has been compiled from primary sources by a person or persons not directly involved in the original study or event.
summarise	Express, concisely, the relevant details.
superposition	In layers of stratified sedimentary rocks, the lowest layer is the first to be deposited.

Glossary term	Definition
synthesise	Putting together various elements to make a whole.
technology	Anything that can help solve a human problem or satisfy a need or want. It includes all types of human-made systems, tools, machines and processes, not just modern computational and communication devices, used to solve that problem.
theory	An explanation of a set of observations that is based on one or more proven hypotheses, which has been accepted through consensus by a group of scientists.
uniformitarianism	The Earth's geologic processes acted in the same manner and with the same intensity in the past as they do at present.
validity	An extent to which tests measure what was intended; an extent to which data, inferences and actions produced from tests and other processes are accurate.
variable	A factor that can be changed, kept the same or measured in an investigation, for example, time, distance, light, temperature.