



Earth and Environmental Science Senior Years

Writing Brief

February 2016

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1. Introduction

In 2014, the Board of Studies, Teaching and Educational Standards NSW (BOSTES) commenced a review of NSW senior secondary syllabuses for English, Mathematics, Science and History learning areas to determine directions for the incorporation of the senior secondary Australian curriculum. BOSTES conducted consultation in August and September 2014 on proposed directions outlined in [NSW Senior Secondary Review & Evaluation: English, Mathematics, Science and History](#).

The broad directions for each learning area, developed following consultation, were endorsed by BOSTES in December 2014 and are available in Appendix I of this writing brief.

The development of the *Earth and Environmental Science Senior Years Writing Brief* takes account of the broad directions and feedback gathered through consultation conducted in October and November 2015.

The purpose of the writing brief is to inform the directions for draft syllabus development. The writing brief is structured according to the elements of a Senior Years syllabus. Each element includes proposed actions and key considerations for writers in the writing of the draft syllabus. These elements are:

- Rationale
- The place of the Earth and Environmental Science Senior Years syllabus in the K–12 curriculum
- Aim
- Objectives
- Outcomes
- Course structure
- Content, including how Australian curriculum content may be incorporated
- Glossary.

The draft syllabus package will include the elements of a syllabus and Australian curriculum content identified with codes, learning across the curriculum content identified by icons, further information about meeting the diversity of learners, and internal and external assessment.

The draft syllabus for Earth and Environmental Science will be developed and available for consultation during 2016.

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

Diversity of learners

NSW senior secondary syllabuses will be inclusive of the learning needs of all students. The draft syllabuses will be designed to accommodate teaching approaches that support student diversity under the sections 'Students with special education needs', 'Gifted and talented students' and 'Students learning English as an additional language or dialect (EAL/D)'.

For example:

Special education needs

All students with special education needs are entitled to participate in and progress through the curriculum. Some students may require additional support or adjustments to teaching, learning and assessment activities. 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.

Most students with special education needs will undertake regular Board Developed courses and/or Board Endorsed courses. Students with special education needs can access Years 11 and 12 outcomes and content in a range of ways. They should choose the most appropriate courses for the HSC in keeping with their goals, interests and learning needs.

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.

For some students with special education needs, the Years 11–12 Life Skills outcomes and content provided in the Senior Science Senior Years draft syllabus may provide learning more appropriate to their individual needs.

Australian curriculum

BOSTES began its syllabus development process for Stage 6 English, Mathematics, Science and History in 2014. This follows state and territory Education Ministers' endorsement of senior secondary Australian curriculum in these learning areas as the agreed and common base for development of state and territory senior secondary courses. It was also agreed that states and territories would have the flexibility to integrate the approved senior secondary Australian curriculum as appropriate. The Writing Brief determines how Australian curriculum content can be modified, reordered and supplemented in each learning area, while remaining compatible with the NSW Senior Years assessment and examinations structures.

2. Earth and Environmental Science key

i for your information

The following codes will be used in the Earth and Environmental Science Senior Years draft syllabus.

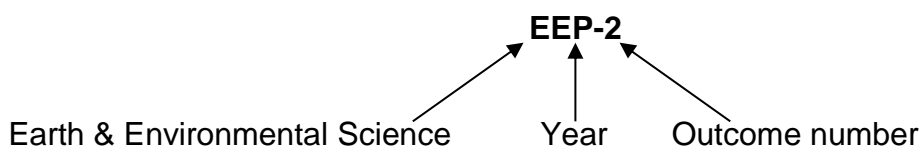
Outcome coding

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

Years of learning will be represented by the following codes:

Year	Code
Year 11	P
Year 12	H

In the Earth and Environmental Science syllabus, outcome codes indicate the subject, Year and outcome number. For example:



Coding of Australian curriculum content

Australian curriculum content descriptions included in the syllabus will be identified.

Actions for writers and key considerations

- Identify Australian curriculum content descriptions by using Australian curriculum codes.
- The codes should appear in brackets at the end of each relevant content description.

3. Rationale

i 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 Senior Years curriculum
- how it prepares students for post-school pathways.

Proposed rationale for Earth and Environmental Science Senior Years

Students of Earth and Environmental Science Senior Years will develop and utilise a range of skills including the ability to communicate succinctly and concisely, to think logically, to make evidence-based judgements and to think creatively and imaginatively. This subject provides a foundation for students to critically consider information and to make informed decisions about contemporary Earth and Environmental Science issues in their everyday lives.

The course is designed for students who have substantial achievement in Science Stage 5 including those who wish to continue with the study of science and specifically Earth and Environmental Science at tertiary level.

Scientific knowledge and understanding and methods of working scientifically have led Earth and environmental scientists to gain a better understanding of how natural and human systems interact. By working scientifically students design and conduct qualitative and quantitative investigations both individually and collaboratively. They investigate questions and hypotheses, manipulate variables, analyse data, evaluate claims, solve problems and develop and communicate evidence-based arguments and models.

Thinking in Earth and Environmental Science involves using differing scales, including macro-scales, micro-scales and nano-scales, using models, concepts and methods to represent the changing face of the Earth over time, and being creative, as when designing new technologies and innovations in order to study the Earth. The study of Earth and Environmental Science provides a foundation for undertaking investigations in a wide range of scientific fields and often provides the unifying link across interdisciplinary studies.


The application of Earth and environmental knowledge is required to tackle major global issues and challenges now and into the future. These include the dynamic interaction with the air, water and organisms that live on its surface, the evaluation of the impact that the Earth's processes can have upon humans and the impact of human activities on the Earth, the dynamic and interdependent nature of the Earth's processes, environments and resources, and the ways in which these processes,

environments and resources respond to change across a range of temporal and spatial scales.

Actions for writers and key considerations

- The rationale requires some revision to provide clarity and consistency of purpose in regard to the principles of earth and environmental science, and to complement the and better reflect the nature and characteristics of earth and environmental science.
- The use of terms, such as ‘nano-scales’ and ‘contemporary’ should be reviewed in relation to their appropriateness or need.
- The rationale should be reviewed to enhance the geological aspects of the course.
- Where appropriate the rationale should complement the aims and objectives of the syllabus.

4. The place of the of Earth and Environmental Science Senior Years syllabus in the K–12 curriculum

 for your information

NSW syllabuses will include a diagram that illustrates how the syllabus relates to the learning pathways K–12. This section places the Senior Years syllabus in the K–12 curriculum as a whole.

This diagram will be included in the draft syllabus.

5. Aim

i for your information

In NSW syllabuses, the aim provides a statement(s) 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.

Proposed aim for Earth and Environmental Science Senior Years

The aim of the Earth and Environmental Science Senior Years syllabus is to develop students’:

- appreciation of Earth and Environmental Science as an experimental science where models and theories are refined and new models and theories are developed through independent and collaborative research that continues to have significant impacts on society
- abilities to debate and critically evaluate scientific arguments and claims, communicate to a range of audiences Earth and Environmental Science understanding or findings and to propose possible solutions to problems
- understanding of the theories and models used to describe, explain and make predictions about earth and environmental systems, structures and properties by considering the factors that affect these and how they can be controlled to produce desired products or outcomes
- develop respect for all living things and the environment and develop an understanding of how Earth and Environmental Science and its practices are used and are integral to developments in many fields of human endeavour.

Actions for writers and key considerations

- The aim requires some revision to provide more consistency and clarity of purpose with regards to the principles, specific nature and characteristics of Earth and Environmental Science
- to complement and better reflect the amended rationale, objectives and outcomes.
- The aim will be reviewed to ensure consistency of length, detail and complexity with other Senior Years syllabuses.

6. Objectives

i 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.

Proposed objectives for Earth and Environmental Science Senior Years

Values and attitudes

Students:

- develop positive, informed values and attitudes towards earth and environmental sciences
- recognise the importance and relevance of Earth and Environmental Science in their lives now and for the future.

Skills

Students:

- develop skills in applying the processes of Working Scientifically.

Knowledge and understanding

Students:

- develop knowledge and understanding of the early Earth
- develop knowledge and understanding of the dynamic Earth
- develop knowledge and understanding of the evolving Earth
- develop knowledge and understanding of living on Earth.

Actions for writers and key considerations

- Review the objectives to ensure consistency with the amended rationale, aim and outcomes of the course, and to reflect the principles of Earth and Environmental Science.
- Enhance the concept of Science as a Human Endeavour in the values and attitudes objectives.

7. Outcomes

i for your information

In NSW syllabuses, outcomes provide detail about what students are expected to achieve at the end of each Stage 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.

Proposed outcomes for Earth and Environmental Science Senior Years

The following table presents a sample of some of the proposed outcomes.

Values and attitudes

<p>Objectives Students:</p> <ul style="list-style-type: none"> develop positive, informed values and attitudes towards Earth and Environmental Science recognise the importance and relevance of Earth and Environmental Science in their lives now and for the future.
--

Skills

<p>Objective Students:</p> <ul style="list-style-type: none"> develop skills in applying Working Scientifically 	
<p>Year 11 outcomes A student:</p>	<p>Year 12 outcomes A student:</p>
<p>EEP-1 proposes questions or hypotheses to be investigated scientifically and predicts outcomes</p>	<p>EEH-1 evaluates questions and/or hypotheses to be investigated scientifically and predicts evidence-based outcomes</p>
<p>EEP-2 designs investigations, considers risks, ethical issues and identifies appropriate materials and suggests related data for collection</p>	<p>EEH-2 justifies the design of risk assessed, ethical investigations, involving appropriate materials and selects and collects relevant primary and secondary sourced data</p>

Knowledge and understanding

<p>Year 11 Course Unit 1</p>	<p>Year 12 Course Unit 3</p>
<p>Objective Students:</p> <ul style="list-style-type: none"> develop knowledge and understanding of the early Earth 	<p>Objective Students:</p> <ul style="list-style-type: none"> develop knowledge and understanding the evolving Earth
<p>Year 11 outcomes A student:</p>	<p>Year 12 outcomes A student:</p>
<p>EEP-8 identifies and describes the formation, structures and availability of Earth’s resources both locally, regionally and globally</p>	<p>EEH-8 describes and evaluates how Earth’s evolution is modelled, and how the reliability of these models influences predictions of future events and changes</p>
<p>Year 11 Course Unit 2</p>	<p>Year 12 Course Unit 4</p>
<p>Objective Students:</p> <ul style="list-style-type: none"> develop knowledge and understanding of the dynamic Earth 	<p>Objective Students:</p> <ul style="list-style-type: none"> develop knowledge and understanding of living on Earth
<p>Year 11 outcomes A student:</p>	<p>Year 12 outcomes A student:</p>
<p>EEP-10 describes and analyses the factors that influence how energy is transferred and transformed in Earth systems</p>	<p>EEH-10 describes and evaluates the causes of atmospheric change and the ways in which they affect, and are affected by life on Earth</p>

Actions for writers and key considerations

- Develop up to 10–12 skills and knowledge and understanding outcomes to complement the existing outcomes and to ensure that core content areas and skills development in Earth and Environmental Science are addressed.
- Ensure there is a coherent and logical development from Year 11 to Year 12, and that the outcomes provide detail with regards to the knowledge, understanding and skills expected to be gained. The outcomes should be derived from the objectives.
- The outcomes should build on and extend the Science K–10 continuum of learning.

8. Course structure

i for your information

The following provides an outline of the Year 11 and Year 12 course structure for the Earth and Environmental Science Senior Years syllabus with indicative course hours and the arrangement of course content, along with outlining relationships between specific components and between core and options.

Proposed course structure for Earth and Environmental Science

Senior Years

	Earth and Environmental Science	Indicative hours	Depth Studies
Year 11 course (120 hours)	Unit 1 Early Earth	60	
	Unit 2 Dynamic Earth	45	15 hours for depth studies
Year 12 course (120 hours)	Unit 3 Evolving Earth	60/50*	10 hours for depth studies
	Unit 4 Living on Earth	60/50*	

* 10 hours of depth studies may be undertaken in either Unit 3 or Unit 4 or the time may be shared across both the units.

Actions for writers and key considerations

The course structure requires some revision to enhance coherence with the other courses and ensure a logical development of interrelated ideas.

Further information is to be included in the syllabus about the nature and structure of Depth Studies. They are intended to be flexible, non-prescriptive areas for further study, selected to meet the needs of individual students.

They should:

- represent contemporary issues in Earth and Environmental Science
- provide opportunities for the diversity of learners
- extend students in areas of particular interest
- provide access to specific areas of science not included in the core content
- promote student engagement
- provide students with opportunities to apply their knowledge and further develop the skills and understanding gained in the course.


Describe how area(s) of study are selected and investigated at depth either individually, in a group or as a whole-class activity. Information should include that a substantial component of first or second-hand investigative work and research is to be undertaken to assist students in applying the core content knowledge and skills.

Examples of activities that may be suitable for depth studies should be included. These include individual or group projects that may be chosen by students according to their interests and abilities. Examples of small and large-scale studies are to be provided along with recommended time allocations.

The examples should include a range of activities that result in a variety of outcomes. Some examples are:

- individually conducting a first-hand research investigation into one natural disaster and its impacts on a specific community
- researching the claims and counterclaims about the science of climate change.
- selection of an area of interest, eg the geology of Pluto, the positive and negative aspects of damming rivers or a specific geological process to study in depth.

9. Content

 for your information

In NSW syllabuses for Senior Years, 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.

Organisation of the content

The Earth and Environmental Science Senior Years draft syllabus will be organised in the following way:

Year 11 Earth and Environmental Science	
Unit 1 Early Earth	Earth's resources <ul style="list-style-type: none"> - Structure of the Earth and the early geosphere, atmosphere and hydrosphere - Geological timescale - Formation of minerals - Formation of rocks - The rock cycle
	Plate tectonics and energy <ul style="list-style-type: none"> - Development of the Theory of Plate Tectonics - Evidence for plate tectonics - Plate boundaries and tectonic processes
Unit 2 Dynamic Earth	Energy transformations <ul style="list-style-type: none"> - The role of energy in Earth's processes - Geological features: earthquakes, volcanoes and mountain ranges
	Human impacts <ul style="list-style-type: none"> - Water management - Salinity and erosion - Effects of introduced species

Year 12 Earth and Environmental Science	
Unit 3 Evolving Earth	Evolution of the Earth <ul style="list-style-type: none"> - Development of the biosphere - Changes in geosphere, atmosphere, hydrosphere - Plate tectonic super-cycle - Geological time and relative and absolute dating - Fossil formation and geological processes
	Hazards <ul style="list-style-type: none"> - Geological natural disasters - Impact of disasters on the biosphere
Unit 4 Living on Earth	Atmospheric change <ul style="list-style-type: none"> - Natural processes - Effect of human activities eg contamination, pollution - Evidence for climate change - Managing future change
	Resource management <ul style="list-style-type: none"> - Renewable/non-renewable resources - Extracting and using current resources - Future uses of resources - Waste management and sustainability

Sample content

The Early Earth: Earth's Resources

Structure of the Earth and the early geosphere

A student:

- designs investigations, considers risks, ethical issues and identifies appropriate materials and suggests related data for collection EEP - 2
- conducts investigations individually or in teams and methodically collects valid and reliable data from first-hand and secondary sources EEP - 3
- outlines and explains the models that show the structure and development of the Earth over its 4.5 billion year history EEP - 11

Content:

Understanding the processes that created the geosphere help us understand the structure and composition of the Earth.

Students:

- Describe the processes that created the geosphere during the formation of the solar system including accretion, melting and volcanism.
- Investigate evidences for the structure of the Earth using seismic wave velocities and meteorite evidence to demonstrate differences in density and composition. (ACSES009) ✨
- Describe the composition layers and thickness of Earth's layers including:
 - the Lithosphere
 - asthenosphere
 - crust mantle and core and their compositional layers (ACSES006) 🖥
- Conduct a first-hand 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 of 4.2 billion years, including:
 - the formation and age of zircon crystals
 - radioactive decay
 - meteorite evidence (ACSES009) ✨


Suggested depth studies

- Investigate the role volcanologists play in predicting future seismic events
- Investigate a current active volcano and form an opinion on the validity and reliability of predictions
- Analyse the technology being developed in emerging tsunami warning systems.

Actions for writers and key considerations

- The content needs to focus on students developing an understanding of fundamental concepts and skills in Earth and Environmental Science.
- The scope and depth of content should be reviewed and reduced to provide opportunities for depth of learning, learning by practical experiences, and include problem-solving while achieving an overall reduction.
- The content should maintain a contemporary nature and should not refer to specific technologies or processes that may become redundant.
- The content, knowledge, understanding and skills should build on and extend the continuum of learning from Stage 5 Science.
- Some important principles of geology should be strengthened.
- Analyse and select Australian curriculum content, and modify, reorder and supplement to align with and complement draft syllabus content as appropriate.
- Australian Curriculum – Science as a Human Endeavour – should be included and identified by the Australian curriculum coding.
- Identify, by underlining, specific terms for inclusion in and links to a glossary.
- Appropriate and authentic opportunities to develop knowledge, understanding, skills, values and attitudes specific to learning across the curriculum areas should be identified by icons.

10. 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 Senior Years 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 ⭐

Sample learning across the curriculum area for Earth and Environmental Science Senior Years


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. The Senior Years Earth and Environmental Science syllabus provides students with opportunities to develop ICT capability when they develop design ideas and solutions, research science concepts and applications, investigate science phenomena, and communicate their scientific and technological understandings. In particular, they learn to access information, collect, analyse and represent data, model and interpret concepts and relationships, and communicate scientific and technological ideas, processes and information. Digital technologies and aids, such as animations and simulations, provide opportunities to view phenomena and test predictions that cannot be investigated through practical experiences in the classroom, and may enhance students' understanding and engagement with science and technology.

Actions for writers and key considerations

- For each learning across the curriculum area develop a succinct statement that describes how the subject provides opportunities to develop knowledge, understanding, skills, values and attitudes related to the area and its relevance.

11. Glossary


 for your information

One glossary will be developed for each Senior Years learning area. The glossary to be developed for the Earth and Environmental Science Senior Years draft syllabus will explain terms that will assist teachers in the interpretation of the subject. The glossary will be based on the NSW K–10 Science glossary and Australian curriculum Senior Years Science glossary.

Actions for writers and key considerations

- Identify and underline words and/or terms additional to those in the K–10 Science glossary in the content for inclusion in the Senior Years glossary.

12. Assessment and reporting

 for your information

BOSTES continues to promote a standards-referenced approach to assessing and reporting student achievement in NSW, and the importance of assessment for, of and as learning as essential components of quality teaching and learning.

Information on assessment and reporting for the Year 11 and Year 12 courses will be reviewed and developed for draft syllabus consultation in 2016.

The information will include:

- mandatory components and weightings for school-based assessment of the Year 12 course
- HSC examination specifications which describe the format of the HSC examination program for Earth and Environmental Science.

13. Appendix I

Broad directions from consultation

The following broad directions for syllabus development have been informed through consultation with stakeholders. These broad directions will guide the development of the NSW Earth and Environmental Science Stage 6 syllabuses.

1. In the revision and development of the courses, consideration be given to how the courses provide flexibility to meet the needs of all students.
2. In the revision of the current content-heavy courses provision be made for the reduction and integration of content. This may be organised using the concept of Big Ideas of Science.
3. The nature and practice of Science is reflected in the inclusion of working scientifically using first-hand investigations, secondary sources, models and modelling.
4. The Science courses be reviewed to allow flexibility of pedagogy and delivery. This may include cross-disciplinary study, project based/research and STEM learning.
5. Opportunities be considered to extend students' learning in Science by revising each course's content and requirements.
6. The Senior Science course rationale, structure and assessment requirements be reviewed to focus on developing scientifically literate students.
7. The Senior Science course rationale, structure and assessment requirements be reviewed with a focus to support a range of post-school contexts.
8. Assessment and HSC examination specifications be reviewed to ensure appropriate opportunities for assessment of a wide range of student performance including assessing analytical and critical thinking, first-hand investigations, the use of secondary sources and research projects.
9. The Science syllabuses should provide for the continual inclusion of contemporary and relevant material.
10. The rationale, outcomes and content of the Stage 6 Science Life Skills course be reviewed to better meet the needs of the students for whom the course is intended, as well as provide an appropriate progression from Stage 5 Science Life Skills outcomes and content and alignment with the regular Stage 6 Science courses where appropriate.

14. Appendix II

Key matters raised during draft writing brief consultation and actions

Key matters	Actions
<p>There was equal support for Option 2 and Option 3 with its depth study component.</p>	<p>Aspects of Options 2 and 3, including depth studies will be incorporated.</p>
<p>The rationale, aim and objectives require some revision to provide greater consistency and clarity.</p>	<p>The rationale, aim and objectives will be reviewed to provide clarity and consistency.</p>
<p>The objectives should address the fundamental knowledge, understanding and skills of geology and geological processes, including Earth history.</p>	<p>The objectives will be reviewed to include the knowledge, understanding and skills of geology and geological processes.</p>
<p>Depth studies are supported. However, how they are assessed for the HSC requires clarification.</p>	<p>Depth studies will be included and details about their nature and structure including investigative projects and assessment requirements and processes will be provided.</p>
<p>The content requires reduction, and should be sequential, clear and less prescriptive.</p>	<p>Content will be reduced through a review of the scope and breadth of learning in each area of study.</p>
<p>Development of an Extension course(s) for Science should be considered.</p>	<p>An Extension course(s) in Science will be considered for development during syllabus development.</p>
<p>Senior Years assessment policies, procedures and requirements require clarification.</p>	<p>Senior Years assessment policies and procedures will be reviewed during syllabus development.</p>