

Science
Stage 6

Draft Sample Learning Unit for
Senior Science

Sample Learning Units/Units of Work

Introduction

In reviewing the *1999 Stage 6 Support Document* the sample programs were revised and changes have been made to incorporate:

- amendments to the syllabuses (2002)
- some of the learning–teaching activities
- a greater focus on assessment for learning in the learning units
- a continuum in the approach to programming and assessment that is consistent with [Science Years 7–10 Advice on Programming and Assessment](#)

Together with the [Stage 6 Support Document \(2007\)](#) the sample learning units/units of work are designed to assist teachers in implementing the Science Stage 6 *Syllabuses*. A learning unit for a Preliminary course module from each of Biology, Chemistry, Earth and Environmental Science, Physics and Senior Science is included.

The level of detail in the learning–teaching and assessment strategies is provided to illustrate one way in which the explicit integration and development of the 8.1 skills module content and PFA emphasis may be undertaken in developing a learning unit.

Overview of Planning and Programming Learning Units

Establishing a scope and sequence

The fundamental step in planning is establishing a scope and sequence plan (p 55 of the Support document) which contains the overview of the placement, sequence and duration of proposed learning units. The completed scope and sequence will also identify the outcomes targeted for each learning unit and any specific syllabus requirements including the open-ended investigation (p 35 of the Support document). Evaluation in relation to the Science Stage 6 Syllabus requirements of the scope and sequence and the developing units of work in the school's learning, teaching and assessment program for the course is essential.

Checklist: Syllabus Requirements

A school learning–teaching program for Stage 6 Preliminary and HSC science courses must include the following:

- all Prescribed Focus Area, Domain: knowledge, understanding, skills, values and attitudes outcomes
- the three syllabus content elements: Context, Prescribed Focus Areas (PFA) and Domain
- all the Domain: knowledge and understanding and skills content in the modules
- the integration of Modules 8.1 or 9.1 skills content within and across the learning units to develop the full range of skills by the end of the courses
- practical experiences with at least one open-ended investigation in both the Preliminary and HSC courses
- timetabling of 120 hours for each of the Preliminary and HSC courses
- evidence that 80 indicative hours of practical/field work during the Preliminary and HSC courses with no less than 35 hours of practical experiences in the HSC course have been completed
- compliance with:
 - mandatory safety requirements (p 44 of the Support document)
 - regulations related to the use of animals in teaching (p 46 of the Support document).

Planning and programming is a dynamic process involving a number of interrelated activities. In planning the school learning–teaching and assessment program for a course, teachers may choose to use the current units as the starting point, evaluate and revise some current units and design additional new ones, or devise completely new units for the whole program.

Gathering evidence of learning

The *Science Stage 6 Syllabuses* promote an approach to planning and programming that has outcomes as the focus. In the initial stage of the planning process a manageable number of outcomes for the learning unit/unit of work are identified. These targeted outcomes are central to decisions about the required evidence of learning to be observed through the learning, teaching and assessment experiences. Once specific evidence of learning has been identified, strategies to collect the required evidence are selected. Methods of gathering evidence could include informal teacher observation, questioning, peer and self-evaluation as well as more structured formal types of assessment activities.

Designing the unit

In planning the learning units a structure for presenting the teaching sequences needs to be decided. The design of the learning units should enable a clear link to be made between the targeted outcomes, the knowledge, understanding and skills content and the selected suggested integrated learning, teaching and assessment experiences. A [sample page from a learning unit](#) based on the sample learning unit proforma (p 57 of the Support document) identifies the basic elements of a learning unit/unit of work. The annotations show the characteristics of each part. Schools may choose to use or adapt the proforma provided to develop learning units that best meet their needs and circumstances.

Mapping the skills content

In Stage 6 the skills build on the essential content in the *Science Years 7–10 Syllabus*. During the Preliminary and HSC course, it is expected that students will further develop skills in planning and conducting investigations, communicating information and understanding, scientific thinking and problem-solving and working individually and in teams. Each syllabus module specifies content through which skill outcomes for the course can be achieved. Teachers should develop activities based on that content to provide students with opportunities to develop the full range of skills. The [skills content mapping grids](#) can be used as a planning tool by broadly classifying the skills learning experiences into one of three developmental levels. In the learning phase (L) the teacher establishes the student's skill level/prior learning and uses this as the basis for developing student understanding through explicit teaching of the relevant knowledge, understanding and skills components. In the practising phase (P) the student uses the knowledge, understanding and/or skills in tasks to achieve specific goals. The application phase (A) is when the student independently uses the knowledge, understanding and skills in the course of regular work and as a foundation for the development of learning.

Based on an analysis of all of the learning units/units of work the school program should be evaluated and modified to ensure that all the mandated 8.1 (Preliminary) or 9.1 (HSC) skills content is addressed and that there is a continuum in the development of skills content within the course.

During the planning and development of the learning units in the school program adjustments to the scope and sequence and skills content mapping grids will need to be made.

Programming the learning experiences

In the programming process, learning experiences are selected and sequenced to cater for the diversity of student learning needs. The lesson sequences in the units of work should highlight how students' knowledge, understanding and skills are developed through explicit, systematic teaching–learning that is clearly linked through the identified module and skill content to the syllabus outcomes for the course.

Assessment for learning (p 26 of the Support document) occurs as an integral part of learning and teaching and involves using a range of strategies to: enhance learning, clarify and promote deeper understanding, plan ways to remedy misconceptions, and develop and incorporate new knowledge, understanding and skills. Strategies should be supportive of the learning process, appropriate to the outcomes being assessed and provide students with feedback on what they have learned and what needs to be done to continue their learning. Assessment for learning encourages self-assessment and peer assessment with students developing and using a range of strategies to monitor and evaluate their own learning and the strategies they use.

The checklist provides a guide to developing learning experiences that are consistent with the requirements of the *Science Stage 6 Syllabuses*.

Checklist: Programming Learning Experiences

To meet syllabus requirements the range of learning experiences and strategies selected for a unit of work should:

- target and address an appropriate and manageable range of knowledge, understanding, skills, values and attitudes outcomes for the indicative time allocated to the module in the syllabus
- make explicit the contexts drawn from the module contextual outline, the selected Prescribed Focus Area (PFA) and the content statements in column 1 devised as the framework to assist students to use their current understanding to develop and apply more specialised scientific knowledge and skills
- relate explicitly the selected skills content from Module 8.1 (Preliminary) and 9.1 (HSC) to the specified module content ([skills content mapping grids](#))
- identify and extend students' prior learning using an appropriate range of strategies (Continuum of Learning on p 7 of the Support document)
- emphasise learning in the lesson sequences that specifically develop the targeted PFAs and values and attitudes outcomes selected for the unit
- integrate assessment for learning as part of the learning-teaching process
- identify specific evidence of learning to be observed through the teaching, learning and assessment (informal and formal) experiences
- provide sufficient variety to meet the needs of a range of student learning styles
- include a balance between informal and formal strategies to provide students with feedback on their learning.

Adjusting and amending the learning program

Teacher reflection and evaluation (p 49 of the Support document) and students' feedback during and following the teaching of lesson sequences and/or the unit of work will result in amendments to the scope and sequence, skills mapping grids and the learning units that together make up the school program.

Recording evidence of learning

The school learning, teaching and assessment program should provide a range of opportunities for students to develop and demonstrate progress towards achievement of the Stage 6 syllabus knowledge, understanding and skills outcomes for the course. By integrating learning and assessment, the teacher can choose which aspects of a student's performance to record.

Recording student performance needs to be manageable. Teachers should make decisions about which aspects of student performance in an activity are to be recorded and in what format.

All assessment activities can be used to support learning and to provide feedback to students that enables them to actively monitor and evaluate their own learning. Teachers can use the evidence of learning gathered to extend the process of assessment for learning into the assessment of learning. In a standards-referenced framework this involves teachers making professional judgements about student achievement at key points in the course. The sample HSC course assessment plan (p 51 of the Support document) identifies these key points and the internal assessment mark provides a summation of each student's achievements measured at these points throughout the course. In the assessment plan for the course a variety of tasks should be used to give students the opportunity to demonstrate outcomes in different ways and to improve the validity and reliability of the assessment.

1 This column 1 content point is examinable. It can also provide a contextual focus for teaching and learning.

Sample Page from a Learning Unit

Stage 6 Earth and Environmental Science Syllabus

8.3.3: The impact of humans on local aquatic and terrestrial environments will differ with locality

8.3.3 Module Content (column 2 and 3)	Reg	8.1 Skills Content	Suggested Learning–Teaching Experiences and Evidence of Learning*
<p>Students learn to/students:</p> <p>*explain why different groups in the local society have different views of the impact of human activity on the local environment</p> <p>2 Content related to the Prescribed Focus Area outcome (P4).</p> <p>3 These content points contain the mandatory knowledge and understanding content of the syllabus.</p> <p>*identify data, gather, process and analyse first-hand information and use available evidence to assess current human impact on the local biotic and abiotic environment.</p> <p>4 Key words identifying the module 8.1 skill content to be addressed.</p>		<p>Students:</p> <p>12.3 gather information from secondary sources by:</p> <p>d) summarising and collating information from a range of sources</p> <p>13.1 present information by:</p> <p>a) selecting and using appropriate media or combinations thereof, for presentations</p> <p>e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly</p> <p>14.1 analyse information to:</p> <p>e) make and justify generalisations</p> <p>g) use cause-and-effect relationships to explain phenomena</p> <p>h) identify examples of the interconnectedness of ideas or scientific principles</p> <p>13.1 present information by:</p> <p>e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly</p> <p>14.1 analyse information to:</p> <p>e) make and justify generalisations.</p> <p>5 Module 8.1 skills content with a specific focus in the Suggested Learning–Teaching Experiences.</p>	<p>In a class activity, students:</p> <ul style="list-style-type: none"> - use a teacher-developed strip mine for coal in the local environment to distinguish between an exploration licence, a mineral claim and a mining lease - consider how land use changes over time, eg many mining operations only last for ten years - prepare an outline of the possible views of the different community groups such as residents, Aboriginal peoples, tourists, developers, environmentalists and local government - debate whether the coal mine should be approved, considering the different views held by the community of the impacted environment - discuss why the environmental impact of the coal mine land use should be regulated <p>Individually, students</p> <ul style="list-style-type: none"> - produce a summary table of the different viewpoints of each community group and the main arguments for and against the proposed coal mine that they identified (P4, P13, P14). <p>Focus Activity Task 3</p> <p>Working as a project team, students:</p> <ul style="list-style-type: none"> - discuss the impact of past human activity on the local terrestrial environment of the field site considered in the context of the proposed coal mine development - monitor the team’s progress towards the completion of the activity (P15). *Suggested Evidence of Learning activities are in italics <p>6 Explicit learning–teaching sequences that provide opportunity for students to develop the knowledge, understanding, skills values and attitudes to demonstrate evidence of learning in relation to the targeted outcomes.</p> <p>7 Experience that can be used to provide observable evidence resulting from learning–teaching that will allow judgements to be made in relation to the progress towards achievement of the target outcomes. Suggested Evidence of Learning activities are indicated by the use of italics.</p> <p>8 Problem-solving, contextually based, team activity undertaken throughout the unit. It integrates the skill and module content and develops students’ understanding of the targeted Prescribed Focus Area outcome(s).</p>

About the Sample Learning Units

The sample learning units have been designed to assist teachers in implementing the *Science Stage 6 Syllabuses*. Schools may choose to use or adapt these sample units in planning and developing units of work that will best meet the needs of the range of learning styles, abilities, circumstances and expectations of their students.

The sample units provide examples of how a manageable range of targeted knowledge, understanding, and values and attitude outcomes can be addressed. The lesson sequences within the units demonstrate ways that teachers can build on the foundation of scientific knowledge and skills in working scientifically that students have gained from their learning experiences based on the *Science Years 7–10 Syllabus*. The detail described in the Suggested Learning–Teaching Experiences column is provided to show how the targeted outcomes for the unit can be addressed through explicit and systematic learning. The sample learning units also model how an appropriate balance between student-centred and teacher-directed learning can be achieved in the suggested learning-teaching experiences.

In the Stage 6 syllabuses the Prescribed Focus Area (PFA) emphasis is embedded in the module content. The selected learning, teaching and assessment experiences within each unit provide examples that demonstrate how the identified module contexts and the intent of one or more targeted Prescribed Focus Area outcomes (Stage 6 syllabuses pages 12 and 13) are made explicit.

A syllabus requirement is that the module 8.1 skills content is integrated within and across the learning units of the school teaching program so that students have opportunities to develop the full range of skills by the end of the course. The sample units model how this skills content can be explicitly integrated within the specified content of each module. To assist teachers in developing the skills content continuum across all the units in the school program a suggested planning tool is to broadly classify the skills learning experiences into one of three developmental phases: learn (L), practise (P) and apply (A). In each of the sample units, the learning experiences provide opportunities for students to engage in learning, practising and/or applying the skill content for the targeted outcomes. At the end of each sample learning unit an overview is provided that shows the targeted skill outcomes with the skill content coded and mapped to the developmental levels of the learning experiences in each section of the unit.

For consistency with the focus on assessment for learning in Years 7–10, a range of specific evidence of learning experiences have been identified in italics within the Suggested Learning–Teaching Experiences column of the learning unit. These provide examples of evidence of learning that could be used to make judgements about students' progress towards the achievement of the outcomes targeted in the unit. The marking criteria and guidelines ([HSC Assessment in a standards-referenced framework – A guide to best practice](#)) developed by teachers for these experiences could be used to provide students with constructive and meaningful feedback in relation to their achievement of the targeted outcomes of the unit.

Focus activity

In developing each of the sample units of work, a focus activity has been incorporated which involves students in undertaking and managing a project throughout the unit. The focus activity models how the integrated module and skills content can be used to develop students understanding of the ideas embedded in the targeted Prescribed Focus Area outcome(s). The activity has been designed so that the core knowledge, understanding and skills required for the project are systematically addressed within the content of each section of the module and the project should therefore be able to be completed within the time allocation for the unit. An [overview](#) is provided to show for each focus activity the PFA emphasis explicitly applied through the learning–teaching

experiences in the learning unit provided for each course.

The focus activity in each of the learning units is based around the students using a real world setting of the project management process to create a specific product. By actively engaging in applying their learning in an authentic workplace context students can be encouraged to recognise and use their current understanding to further develop and apply more specialised knowledge and skills. In undertaking and managing the project students develop knowledge of and skills in working individually and in teams (P15) and have the opportunity to learn through problem-solving (P14). In the role of facilitator and advisor, the teacher assists in monitoring the progress of each team.

Project management necessitates the use of tools and techniques to organise activities for a specific purpose and requires the use of effective communication and interpersonal skills. In introducing the activity, and while students are undertaking the focus activity, opportunities may need to be provided for them to review their prior understanding and develop the communication and interpersonal skills – such as active listening, conflict resolution, negotiation skills and team building – that are needed to work effectively with others.

Students may need an introduction to project management methodology. A project can be basically organised into four phases: defining, planning, implementing and reviewing. The table provides an overview of each phase and how the main components of the process can clearly contribute to providing evidence of learning relating to the syllabus outcomes of problem-solving and working in teams.

Checklist: Project Management for the Focus Activities

Defining the project includes:

- clarifying the project brief by identifying, analysing and explaining the nature of a problem
- establishing the main elements of the project
- setting the goals that are key to the success of the project
- identifying the timing and deadlines (key dates) to be met
- determining tasks and resources
- assessing constraints and risk including social and ethical concerns
- defining individual and team roles and responsibilities
- showing flexibility and responsiveness to ideas and evidence.

Planning the project includes:

- identifying, and describing different strategies that could be used to solve the problem
- choosing the most appropriate strategies to solve the problem
- agreeing on tasks, resources and timelines
- evaluating potential risk factors that could impact on the completion of the project
- identifying the specific roles needed and matching team members to tasks according to the requirements of the task
- negotiating and allocating individual roles and responsibilities
- respecting differing opinions and viewpoints about the issues being considered.

Implementing the project includes:

- conducting the investigation using the identified strategies
- modifying the plan and processes where issues are identified or arise during the investigation
- gathering data and communicating information and understanding
- completing progress reports which evaluate the appropriateness of strategies, processes and modifications used in solving the problem
- working effectively in individual roles and as a team to meet timelines and goals
- monitoring team progress to completion of the task
- demonstrating confidence and a willingness to make decisions and to take responsible actions.

Reviewing the project includes:

- presenting the product using an appropriate medium
- evaluating the plan, strategies and processes used by the team
- evaluating the effectiveness of the team in completing the task
- acknowledging the role of science in providing information and understanding about issues being considered and the impact of science on aspects of everyday life.

If the focus activity is to be used to gather evidence of student learning the students need to be informed of the criteria that will be used to assess their learning. The [sample feedback template](#) provides an example of one model that could be used with the focus activity to inform students what they need to do to demonstrate evidence of learning in relation to working in a team. It could also be used to provide effective student feedback that enables them to recognise their strengths and areas for development.

Sample feedback template – Working in a team

Teamwork criteria	Low	Satisfactory	High
Defines team responsibilities	With teacher guidance outlines individual and/or team responsibilities	Defines individual and/or team responsibilities	Demonstrates confidence in describing individual and/or team responsibilities
Identifies and accepts roles	With teacher guidance identifies and accepts specific individual and/or team roles	Identifies and accepts individual and/or team roles specific to the task	Matches team members to roles according to the specific requirements of the task and accepts roles based on the skills of the individual
Sets goals and timelines	With teacher guidance identifies goals and set timelines for the task	Identifies goals and sets timelines	Demonstrates high-level skills in setting realistic goals and timelines
Communicates opinions/ideas	With teacher guidance expresses opinions and ideas	Clearly expresses opinions and ideas	Communicates opinions and ideas succinctly and logically
Uses listening and negotiation skills	With teacher guidance uses active listening and negotiation skills	Demonstrates some skills in active listening and negotiation	Demonstrates high level active listening and negotiation skills
Engages in teamwork	With teacher guidance uses a limited number of strategies to work within the team to complete the task	Identifies and uses a range of cooperative learning strategies to work efficiently as a team member to complete the task	Demonstrates a sound understanding of cooperative learning strategies and uses these to work collaboratively to complete the task
Makes decisions and takes responsible actions	With teacher guidance takes responsibility in a negotiated role to follow a plan to meet goals and timelines	Takes responsibility for roles within the team and works with others to meet goals, timelines and monitor progress of the task	Demonstrates responsibility in a number of roles and in decision-making so that goals and timelines are met and the progress of the task is monitored
Team effectively completes the task	With teacher guidance identifies some processes which assisted the team to complete the task	Describes the effectiveness of some parts of the plan and some processes used by the team to complete the task	Evaluates the effectiveness of the plan and processes used by the team in completing the task

Overview of Sample Learning Units

Stage 6 Syllabus Module	Unit Target Outcomes	Prescribed Focus Area Emphasis	Focus Activity
Biology 8.3 Patterns in Nature	P1 P3 P6 P11 P12 P13 P14 P15 P16	The PFA emphasis in this unit is on developing students' knowledge and understanding of: - biology as an ever-developing body of knowledge - the relevance, usefulness and applicability of biological concepts and principles.	Your team of four is involved in major research investigating the structure and function of cells. Your manager requests that the team submit an article about your research projects for the magazine produced by your company. The magazine is read widely by the general public and it is also an important resource used by Years 11 and 12 Biology students. The article must be informative, scientifically accurate, interestingly written and be no longer than 4000 words. It must include a brief outline of the investigation methods used by the team and how the findings from this research has increased understanding of the relationship between cells, organs and organ systems in the functioning of multicellular plants and/or animals. You will work as a team to produce the article, with each member negotiating to prepare and present specific investigation methods and findings for inclusion in the article.
Chemistry 8.4 Water	P2 P4 P6 P10 P11 P12 P13 P14 P15 P16	The PFA emphasis in this unit is on developing students' knowledge and understanding of: - the process and methods of exploring, generating, testing and relating ideas - the impact and the role of chemistry in society and the environment - skills in decision-making about issues concerning chemistry, society and the environment	Your chemistry class has been contracted as chemical consultants to undertake an environmental impact study on the development of a desalination plant on the shore of a coastal bay. Your team will prepare part of the report that describes the key scientific principles being applied in the operation of the plant (eg how energy is supplied, how pure water is separated, how the properties of water and water solutions are applied in the separation process), possible social and environmental impacts of the desalination plant, including the possible forms and impact of pollution that may occur, key considerations that will influence where the plant is located and the arrangements for returning wastewater to the bay. You will work in a small team, with each member negotiating to prepare and present specific aspects of the final environmental impact assessment report.
Earth and Environmental Science 8.3 The Local Environment	P2 P4 P7 P11 P12 P13 P14 P15 P16	The PFA emphasis in this unit, through a field study investigation, is on developing students': - knowledge and understanding of the process and methods of exploring, generating, testing and relating ideas - skills in decision-making about issues concerning society and the environment - awareness of science that relate to distinctively Australian environments.	You are part of a team of environmental scientists undertaking an environmental impact assessment of an area which has been selected as a potential site for a major residential development. The team will need to investigate the relationship between geology, landscape, soils, climate, plants and animals with a particular focus on the impact of humans on the local environment. You will work as a project team with each member negotiating to research, report and present a specific part of the final environmental impact assessment report.

Stage 6 Syllabus Module	Unit Target Outcomes	Prescribed Focus Area Emphasis	Focus Activity
Physics 8.2 The World Communicates	P2 P3 P5 P7 P8 P11 P12 P13 P14 P15 P16	The PFA emphasis in this unit is on developing students' knowledge and understanding of: - the process and methods of exploring, generating, testing and relating ideas - how increases in our understanding in physics have led to the development of useful technologies and systems - the contributions physics has made to society, with a particular emphasis on Australian achievements	You are a member of a project team of telecommunications experts whose task is to develop a plan for a safe, energy efficient and sustainable communications system for a mining community in an isolated area of Australia. You will present a short, creative and scientifically accurate presentation on your plan to a local community forum. The report you prepare should include the plan, an outline of how increases in our understanding in physics and the application of present-day understanding of the electromagnetic spectrum have led to the development of useful communication technologies and an evaluation of the social and environmental impacts of the proposed communications system. You will work as a project team with each member negotiating to research, report and present one or two specific technological aspects for the team.
Senior Science 8.2 Water for Living	P2 P4 P7 P9 P11 P12 P13 P14 P15 P16	The PFA emphasis in this unit is on developing students: - understanding of the interrelatedness of people and their surrounds - skills in decision making about water resource management - awareness of science that relate to distinctively Australian environments.	Your Senior Science class has been contracted as consultants by a local government organisation to research and prepare a series of short, creative and scientifically accurate presentations to inform the community about strategies to maintain the quality and sustainability of the local water supplies. The presentation must be no longer than 4 minutes and must include relevant information on the issues and strategies to reduce the impacts and consequences of human activity on water usage and pollution in the local catchment area. You will work as a project team with each member negotiating to research, report and present information for a specific part of the team presentation.

Science
Stage 6
Draft Sample Learning Unit – Senior Science
Module 8.2 Water for Living

Sample Stage 6 Senior Science Course Module 8.2 Water for Living (30 indicative hours)

Contextual Outline

The Earth's water budget was essentially fixed as it cooled when gaseous water condensed and settled on the cooling planet. Free water exists in liquid form as surface and groundwater and it is this water that is available for living things. It is also in the atmosphere as the main gas that absorbs back-radiation from the Earth to assist in stabilising the Earth's surface temperatures and climatic conditions.

The terrain and climate determine the amount of water available for an individual continent. Australia has an arid environment because its water budget is limited in most areas due to a combination of factors, such as the Great Dividing Range which limits rain coming in from the east coast, the Papua New Guinea Highlands which limit rain entering inland from the north and very cold atmospheric and ocean currents coming in from Antarctica which limit rain entering Australia from the south.

The NSW river systems have been disturbed by many factors, including run-off from pastoral systems and the damming and rerouting of others. There are now limits regulating the discharge permitted into the river systems and the health of these systems is continuing to improve.

Large areas of land have been set aside as catchment regions for dams supplying urban environments and experience has shown that care of these catchments is essential for clean, pollution-free drinking water.

This module increases students' understanding of the nature and practice, the applications and uses of science, and the implications for society and the environment.

Assumed Knowledge

Refer to the *Science 7–10 Syllabus* for the following:

- 4.7.5b) identify, using examples, the importance of water as a solvent
- 4.7.5c) describe aqueous mixtures in terms of solute, solvent and solution
- 4.8.1a) identify that living things are made of cells
- 4.9.5a) describe the water cycle in terms of the physical processes involved.

This unit of work builds on the essential content of the Prescribed Focus Area and the Skills described in the *Science Years 7–10 Syllabus*.

Targeted Outcomes

- P2 applies the processes that are used to test and validate models, theories and laws of science, with particular emphasis on first-hand investigations
- P4 identifies applications of science which affect society or the environment
- P7 explains relationships between organisms in the environment
- P9 describes the structure of body organs and systems
- P11 identifies and implements improvements to investigation plans
- P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources
- P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Science
- P14 draws valid conclusions from gathered data and information
- P15 implements strategies to work effectively as an individual or as a member of a team
- P16 demonstrates positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for critical evaluation of the consequences of the applications of science

Focus Activity

Throughout this unit the emphasis of learning is on developing students' understanding of the processes and methods of exploring, generating, testing and relating ideas (P2) their skills in decision-making about issues concerning society and the environment, and their awareness of areas of science that relate to the distinctive Australian environment (P4). In developing this sample unit of work, a focus activity has been incorporated to model how these targeted Prescribed Focus Area outcomes can be developed through the module knowledge, understanding content and Module 8.1 skills content.

The focus activity in this learning unit is based around the students using a [project management](#) process to create a specific product. This approach provides an example of how, by actively engaging in an authentic strategy applied in a real-world setting, students can be encouraged to recognise and use their current understanding to further develop and apply more specialised knowledge and skills. In undertaking and managing the project students have the opportunity to work individually and in teams (P15) and to learn through problem-solving (P14).

Students will need access to the internet and a range of software applications including word processors, spreadsheets, databases and presentation and multimedia players to enable them to process, analyse and present information. Throughout the unit, and in undertaking the project, students will need to have access to individual and shared files for collecting, organising, storing and retrieving data.

Each student will keep an individual logbook/journal that records a summary of what they did each time they worked on the project. It would include ideas, planning, summaries of research information, appropriately acknowledged relevant references, resources with annotations and evaluation of strategies and solutions.

Focus Activity: 8.2 Water for Living

Your Senior Science class has been contracted as consultants by a local government organisation to research and prepare a series of short, creative and scientifically accurate presentations to inform the community about strategies to maintain the quality and sustainability of local water supplies. The presentation must be no longer than four minutes and must include relevant information on the issues and strategies to reduce the impacts and consequences of human activity on water usage and pollution in the local catchment area.

You will work as a project team with each member negotiating to research, report and present information for a specific part of the team presentation. This activity is due for completion by the end of this unit of work.

Resources:

Examples would include:

- texts, references, scientific journals, library resources and mass media articles
- current websites (eg Department of Environment and Climate Change NSW, *WaterWise* NSW, Sydney Water, Local Council sites) and digital, audio and visual technologies
- guest speakers and incursions/excursions
- specific materials, resources and equipment (including safety equipment).

8.2.1 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* identify the relative amount of water in a variety of living things</p> <p>Students learn to/students:</p>		<p>Students:</p> <p>11.2 plan first-hand investigations to:</p> <p>b) identify variables that need to be kept constant, develop strategies to ensure that these variables are kept constant and demonstrate the use of a control</p> <p>c) design investigations that allow valid and reliable data and information to be collected</p> <p>d) describe and trial procedures to undertake investigations and explain why a procedure, a sequence of procedures or the repetition of procedures is appropriate</p> <p>12.1 perform first-hand investigations by:</p> <p>a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments</p> <p>d) identifying and using safe work practices during investigations</p> <p>12.2 gather first-hand information by:</p> <p>b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate</p> <p>12.4 process information to:</p> <p>c) select and use appropriate methods, including computer-assisted analysis, to best illustrate trends and patterns</p> <p>13.1 present information by:</p> <p>a) selecting and using appropriate text types or combinations thereof, for oral and written presentations</p> <p>f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately</p> <p>14.1 analyse information:</p> <p>e) make and justify generalisations</p>	<p>In project teams, students:</p> <ul style="list-style-type: none"> - plan and record a first-hand investigation, to measure the percentages of water in a variety of fresh fruit, vegetables and meat - identify the types of data that need to be collected, how the data will be recorded and the qualitative and quantitative analysis required for this data to be useful - allocate the data collection relating to each food used in this activity among the teams so that tests for each food are replicated - identify an appropriate range of materials, the quantities to be use, and techniques that will dry the foods - outline the techniques that will be used to dry the foods and whether they involve destructive or non-destructive testing - identify appropriate equipment (include the use of an incubator and balance) needed to undertake the investigation - carry out a risk assessment of the intended procedures. <p>Following teacher review of the teams’ planned procedure, students:</p> <ul style="list-style-type: none"> - perform the planned investigation using safe work practices and minimising hazards and wastage of resources -gather and record their results using an agreed format so they can be collated with those of other teams - identify where and when modifications to the procedure were needed. <p>In a class activity, with teacher guidance, students:</p> <ul style="list-style-type: none"> - collate the data collected by all teams from their investigation - generate, with teacher assistance, a spreadsheet of this data and use it to generate graphs showing the relationships, if any, between the foods and their water content - analyse the data to identify patterns, relationships and/or contradictions - make generalisations from these graphs about the relative amount of water in a variety of living things.

8.2.1 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* perform a first-hand investigation to identify adaptations of some plants that assist in reducing water loss</p> <p>* discuss ways, using examples, that plants reduce water loss such as:</p> <ul style="list-style-type: none"> – thick outer coating (cuticle) on leaves – reduced leaves – dropping leaves in times of drought <p>* discuss ways in which plants optimise water uptake</p>		<p>Students:</p> <p>12.2 gather first-hand information by:</p> <p>a) using appropriate data collection techniques, employing appropriate technologies including data loggers and sensors</p> <p>b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate</p> <p>12.4 process information to:</p> <p>e) assess the reliability of first-hand and secondary information and data by considering information from various sources</p>	<p><i>Individually, students:</i> <i>Present a practical report on their team’s investigation, with a discussion that includes an analysis of the team’s results and suggested explanations for any variations with the class data. (P2, P13, P14)</i></p> <p>Practical Investigation: why do some plants survive better than others in dry conditions? In pairs students:</p> <ul style="list-style-type: none"> - use a teacher-selected procedure using some examples of tube stock, an incursion around the school grounds and/or excursion to botanical gardens or nearby park to observe and describe adaptations of some Australian native and non-indigenous plants that assist in reducing water loss - use appropriate technology to record their observations, eg using the macro function of a digital camera for close-up photographs of leaves and roots of tube stock - refer to a range of teacher-selected resources, including a visiting botanist or horticulturalist to identify plants and their features observed during the investigation, using the correct botanical terminology - summarise in a table descriptions of plant characteristics and how each reduces water loss and/or optimises water uptake. <p>In a class activity, through a teacher-led discussion, students:</p> <ul style="list-style-type: none"> - collate and discuss the data collected, annotating their tables with relevant information about the adaptations identified by other students and illustrate with photographs taken during the investigation - review their ideas on why it is important to assess the reliability of first-hand and secondary information and suggest some of the strategies that could be used to determine the reliability of data/information (4/5.17).

8.2.1 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <ul style="list-style-type: none"> * gather, process and analyse information to identify the different ways in which a range of terrestrial animals reduce water loss * discuss ways, using examples, that animals reduce water loss such as: <ul style="list-style-type: none"> – excrete uric acid instead of urea – nocturnal behaviour – reduced activity – lying in the shade – burrowing underground 		<p>Students:</p> <p>12.3 gather information from secondary sources by:</p> <ul style="list-style-type: none"> b) practising efficient data collection techniques to identify useful information in secondary sources d) summarising and collating information from a range of resources <p>12.4 process information to:</p> <ul style="list-style-type: none"> e) assess the reliability of first-hand and secondary information and data by considering information from various sources <p>13.1 present information by:</p> <ul style="list-style-type: none"> a) selecting and using appropriate text types or combinations thereof, for oral and written presentations b) selecting and using appropriate media to present data and information c) selecting and using appropriate methods to acknowledge sources of information <p>14.1 analyse information:</p> <ul style="list-style-type: none"> a) to identify trends, patterns and relationships as well as contradictions in data and information e) to justify inferences and conclusions g) to use cause and effect relationships to explain phenomena h) to identify examples of the interconnectedness of ideas or scientific principles 	<p>Practical Investigation: how do terrestrial animals reduce water loss?</p> <p>In a class activity, using a variety of teacher-selected resources, students:</p> <ul style="list-style-type: none"> - identify the features of the terrestrial environment and describe how they cause water loss problems for land-dwelling organisms - construct a list that names a variety of native Australian terrestrial animals from a range of groups that live in areas of low water availability. <p>In pairs, students:</p> <ul style="list-style-type: none"> - select two animals from the list, gather information from a range of sources about the two selected animals focusing on features/ adaptations by which these animals reduce water loss to their environment - outline in a summary cause and effect relationships to explain how some features reduce water loss from the animal to the environment - assess the reliability of secondary sources used by determining the origin of these sources and comparing information derived from them - use an appropriate format to record the selected reliable sources of information used - select an appropriate medium (eg PowerPoint, poster, video, fact sheet) to use in a short oral presentation that explains the ways in which the animals researched reduce water loss to their environment. <p>In a class activity, each pair of students:</p> <ul style="list-style-type: none"> - develops, with teacher guidance, a simple classification system and summarises under broad groupings of features (eg structural, functional, behavioural) features of the animals researched by the class and a description of how the feature reduces the animals' water loss. <p>Individually, students:</p> <ul style="list-style-type: none"> - use the summary and two teacher-supplied examples of terrestrial animals (not researched in the activity) to prepare a one-page report which includes: <ul style="list-style-type: none"> o predictions of how the identified features of the

8.2.1 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
		<p>Students:</p> <p>11.2 plan first-hand investigations to: e) predict possible issues that may arise during the course of an investigation and identify strategies to address these issues if necessary</p> <p>14.2 solve problems by: d) evaluating the appropriateness of different strategies for solving an identified problem</p> <p>14.3 use available evidence to: c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations</p>	<p>animals reduce water loss</p> <ul style="list-style-type: none"> ○ explanations for their predictions and suggest further evidence that would need to be gathered and tested to support their ideas. <p>Through teacher-modelling and explanation, students:</p> <ul style="list-style-type: none"> - revise the construction and use of a concept map as a way of summarising and presenting the information from their learning about water for living in this section of the module. <p>In project teams, with teacher assistance, students:</p> <ul style="list-style-type: none"> - discuss gathered information and their observations about the question that is being tested in their investigation - evaluate their plan and procedure for the investigation of the effect of concentration of fertiliser on plant growth (refer to 8.2.3) - describe and record the features of the planned investigation that allow valid and reliable data and information to be collected - identify strategies to address issues that may arise during the course of the investigation - identify, negotiate and accept specific roles needed in planning and conducting the investigation into the effect of concentration of fertiliser on plant growth. <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.2.2: Water is an important factor in the maintenance of Australian environments

8.2.2 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>*outline types of surface and groundwaters in the hydrological cycle such as:</p> <ul style="list-style-type: none"> – bore water – artesian water – the water table – dams – rivers – lakes – wetlands – cave environments <p>* process information from secondary sources to map the location and type of surface and groundwater in the local area</p> <p>* analyse information from secondary sources to outline the relationships between rainfall and types of Australian ecosystems</p>		<p>Students:</p> <p>12.3 gather information from secondary sources by:</p> <p>c) extracting information from numerical data in graphs and tables as well as from written and spoken material in all its forms</p> <p>d) summarising and collating information from a range of resources</p> <p>13.1 present information by:</p> <p>e) using a variety of pictorial representations to show relationships and present information clearly and succinctly</p>	<p>Introductory Activity:</p> <p>In a class activity, with teacher guidance, students:</p> <ul style="list-style-type: none"> - examine their ideas about the water cycle and natural factors influencing the availability of water in the Australian environment - make and justify inferences about the role and importance of water in maintaining the Australian environment after viewing a teacher-prepared PowerPoint presentation. Images that could be included are Earth from space, a variety of Australian ecosystems showing the effects of climatic influences related to water and/or water in different phases of the water cycle - collate the ideas and information in a format accessible to the class. <p>Practical Investigation: what factors influence water availability in the local area?</p> <p>Individually or in pairs, students:</p> <ul style="list-style-type: none"> - use teacher-selected resources, including maps, to list and define the terms used to describe a range of types of surface and groundwaters that are part of the hydrological cycle - identify commonly used symbols for these features on topographical maps, and locate features found in maps of the local area - compare a range of Australian ecosystems with data showing average annual rainfall and outline the relationship between rainfall and the ecosystems - <i>summarise the information collected into maps of the local area and collate by overlaying rainfall, ecosystem, surface and groundwater symbols</i> - <i>annotate their maps to record other relevant information relating to factors influencing water availability in the local area. (P7, P13)</i> <p>Teacher introduces the focus activity</p>

8.2.2 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* process, analyse and present information from secondary sources to assess human impact on one aquatic ecosystem or water source in Australia and identify some consequences of this impact and one possible rehabilitation technique</p>		<p>Students:</p> <p>11.1 identify data sources to: b) determine the type of data that needs to be collected and explain the qualitative or quantitative analysis that will be required for this data to be useful</p> <p>12.3 gather information from secondary sources by: e) identifying practising male and female Australian scientists, the areas in which they are currently working and information about their research</p> <p>14.1 analyse information: b) to justify inferences and conclusions c) to identify and explain how data supports or refutes an hypothesis, a prediction or a proposed solution to a problem g) to use cause and effect relationships to explain phenomena</p> <p>13.1 present information by: b) selecting and using appropriate media to present information</p> <p>12.4 process information to: e) assess the reliability of first-hand and secondary information and data by considering information from various sources f) assess the accuracy of scientific information presented in mass media by comparison with similar information presented in scientific journals</p>	<p>Practical Investigation: what are the impacts and the consequences of human activities on an Australian aquatic ecosystem or water source? In a class activity, with teacher guidance, students: - use their collected information to discuss issues concerning environmental and societal consequences of human impact on a selected aquatic environment or water source (eg Murray–Darling river system) - nominate a single issue to be researched by the team - determine the type of data that needs to be collected and select appropriate strategies to gather and collate the information in a form accessible to the class.</p> <p>In project teams, students: - assess the reliability of the information gathered from a range of secondary sources including teacher-selected internet sites about the chosen issue relating to the impact of human activity and its consequences for the aquatic environment or water source - investigate current research by Australian scientists on one rehabilitation technique that could/is being used to address the issue researched - analyse the information relating to the selected issue using cause and effect relationships and justify conclusions based on their findings - select and use an appropriate medium to present their assessment of the impacts and consequences of the issue researched and the implications of the use of one possible rehabilitation technique.</p> <p>In a class activity, students: - use a jigsaw activity to share and discuss their research and assessment of the human impacts and some consequences for the aquatic environment and/or society - present the findings from their research with a bibliography which uses an appropriate format to acknowledge the selected sources of information used - assess and compare the accuracy of the information presented in the mass media and scientific reports - discuss the incidence of conflicting information in the</p>

8.2.2 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* discuss the effects of water pollution and ground salinity on the continued supply of fresh water to living things and provide examples of these occurring in Australian environments</p> <p>* identify possible solutions to environmental problems associated with the use of groundwater</p> <p>* outline one local, State or Federal Government policy on water-related issues in relation to increasing problems with water supplies across NSW</p>		<p>Students:</p> <p>14.1 analyse information:</p> <p>c) to identify and explain how data supports or refutes an hypothesis, a prediction or proposed solution to a problem</p> <p>g) to use cause and effect relationships to explain phenomena</p> <p>h) to identify examples of the interconnectedness of ideas of scientific principles</p>	<p>resources, and consider the different ways these conflicts in reliability and accuracy might be resolved</p> <ul style="list-style-type: none"> - develop a set of criteria that can be used when considering the accuracy and reliability of information/data from secondary sources. <p>Practical Investigation: what strategies are available to maintain a continued supply of fresh water to living things?</p> <p>Individually or in pairs, students:</p> <ul style="list-style-type: none"> - access a range of secondary sources that they have collected including mass media and scientific reports to identify examples in Australian environments of the effects of water pollution and ground salinity on the continued supply of fresh water to living things - assess accuracy of the scientific information presented in the mass media compared to scientific reports using the criteria previously developed by the class - use teacher-provided sources to identify and record some examples of current research into possible solutions to the environmental problems associated with the use of groundwater in Australian ecosystems - select and use appropriate secondary sources to identify one local, State or Federal Government policy on water-related issues - indicate the main features of the policy that relates to the increasing problems with water supplies across NSW. <p>Individually, students:</p> <ul style="list-style-type: none"> - review and update their concept map (page 16) to include further information from their learning about water in the Australian environment in this section of the module.

8.2.2 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
		Students: 14.2 solve problems by: b) describing and selecting from different strategies those that could be used to solve the problem d) evaluating the appropriateness of different strategies for solving an identified problem 14.3 use available evidence to: b) propose ideas that demonstrate coherence and logical progression and include the correct use of scientific principles and ideas d) formulate cause and effect relationships	Focus Activity Task 1: In project teams, students: - review the relevant, reliable and acknowledged data and information relating to one local water supply issue collected in sections 8.2.1 and 8.2.2 of the module - select and use an appropriate format to prepare a overview of one local area water supply issue identifying natural causes, consequences of human activity, impacts on the quality and/or sustainability, and implications for the community of possible solutions or strategies to address the issue - develop an appropriate project plan for the focus activity with timelines and identified team roles and responsibilities for designing and producing the presentation. <i>*Suggested Evidence of Learning Activities are in italics.</i>

8.2.3 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* assess the impact on water systems of the release of substances produced or used by households, such as:</p> <ul style="list-style-type: none"> – oils – detergents – bleaches and toilet cleaners – insoluble materials – sewage <p>* identify the use of and impact on water systems of substances such as:</p> <ul style="list-style-type: none"> – heavy metals (lead and mercury) – phosphates – nitrates <p>* identify the impact on aquatic ecosystems of factors such as</p> <ul style="list-style-type: none"> – accumulated sediment – leaching from tips – bioaccumulation 		<p>Students:</p> <p>12.4 process information to:</p> <p>d) evaluate the validity of first-hand and secondary information and data in relation to the area of investigation</p> <p>e) assess the reliability of first-hand and secondary information and data by considering information from various sources</p> <p>13.1 present information by:</p> <p>b) selecting and using appropriate media to present information</p>	<ul style="list-style-type: none"> ○ at least two conditions under which fertilisers and pesticides may be carried into water systems. <p>In a class activity, with teacher guidance students:</p> <ul style="list-style-type: none"> - review the information gathered in 8.2.2 relating to the impact of human activities on Australian aquatic environments and/or water sources - evaluate the validity and assess the reliability of information gathered from a variety of secondary sources including digital technologies and internet to construct a list of the types of substances used and produced by human activities that are released into water systems - negotiate using a teacher-devised method to allocate the research of the substances among the teams - identify the type of data that need to be collected relating to how these released materials that are used and/or produced by humans impact on water systems - negotiate and agree on a scaffold to be used to collect, summarise and present this data including an appropriate format for acknowledging information sources. <p>In project teams, students:</p> <ul style="list-style-type: none"> - use the agreed scaffold to collate and record information about the impact on water systems of one substance produced or used in households and to identify the use of substances such as heavy metals (lead, mercury), phosphates or nitrates and their impact on water systems - collate the data in the summaries into a form accessible to the class - prepare a summary that describes the interrelationship between the impact on water systems of chemicals and the human activities that use/release these substances into the aquatic environment. <p>Individually, students:</p> <ul style="list-style-type: none"> - annotate their summary about the impact on aquatic ecosystems of factors such as accumulated sediment, leaching from tips and bioaccumulation, with information gathered and teacher-supplied notes - select information from teacher-supplied resources that

8.2.3 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students: * process information from secondary sources on methods of bioassay for water purity</p>		<p>Students:</p> <p>14.2 solve problems by: b) describing and selecting from different strategies those that could be used to solve the problem d) evaluating the appropriateness of different strategies for solving an identified problem</p> <p>14.3 use available evidence to: b) propose ideas that demonstrate coherence and logical progression and include the correct use of scientific principles and ideas</p>	<p>describes at least two methods of bioassay for water purity and further annotate their summaries with the salient points (refer to 8.2.4).</p> <p>Focus Activity, Task 2: In project teams, students:</p> <ul style="list-style-type: none"> - review collected information to identify factors and a range of chemicals being used/produced and released into the local aquatic environment by human activity and how these impact on the water quality of the local environment - select and use an appropriate format to prepare an overview of the gathered information of a range of possible strategies that could be used to solve these problems of the water quality and/or sustainability in the local environment - use their plan and prepared materials to further develop the team presentation - monitor team progress towards completion of the project. <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.2.4: Strategies to reduce water pollution can be a result of personal initiative or government legislation

8.2.4 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* perform a first-hand investigation to determine the amount of water used per household for one activity such as</p> <ul style="list-style-type: none"> – water used per toilet flush – water used per shower – water used per washing machine cycle <p>and identify ways in which it can be reduced</p>		<p>Students:</p> <p>11.1 identify data sources to:</p> <p>c) identify the orders of magnitude that will be appropriate and the uncertainty that may be present in the measurement of data</p> <p>d) identify and use the correct units for data that will be collected</p> <p>12.1 perform first-hand investigations by:</p> <p>a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments</p> <p>d) identifying and using safe work practices during investigations</p> <p>12.2 gather first-hand information by:</p> <p>b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate</p> <p>12.3 gather information from secondary sources by:</p> <p>a) accessing information from a range of resources including popular scientific journals, digital technologies and the internet</p>	<p>Practical Investigation: how can the daily use of water in households be reduced?</p> <p>In a teacher-led discussion, students:</p> <ul style="list-style-type: none"> - identify and record the ways that water is used by households - suggest sources and types of information and data that could be collected and recorded to determine the daily household water use - agree on the measurements to be made, units to be used and how the data collected from each household will be recorded so that the class information can be compared. <p>Individually, students:</p> <ul style="list-style-type: none"> - select and carry out one procedure from several supplied by the teacher to collect first-hand data for their household over the agreed period (some adjustments may need to be made in homes using recycled greywater to cover safety or health-related issues) - collect data about water usage for a range of household devices from a variety of secondary sources such as household water accounts, water meters, instruction/information booklets supplied with devices or available through internet sites, and compare with information supplied by their relevant local water authority or consumer magazines - record data and information and acknowledge sources in the agreed format so that it can be accessed by the class - compare their first-hand data collected with that of others in the class and suggest strategies to reduce the use of household water. <p>In a teacher-led class activity, students:</p> <ul style="list-style-type: none"> - identify from the information collected from secondary sources some government and commercial strategies currently in use to save or recycle household water - describe a range of strategies currently used to maintain the quality and sustainability of local water supplies - discuss the scientific evidence supporting the use of the strategies.

<p>Students learn to/students:</p> <p>* describe some of the strategies that households can use to reduce water pollution</p> <p>* gather, process and present information from secondary sources on the latest technologies being used to purify and treat water</p> <p>* identify an example of technology being used and developed to reduce water pollution and discuss possible long-term effects of this strategy</p> <p>* identify conditions under which algal blooms may occur in the rivers of New South Wales</p> <p>* describe impacts of algal blooms in rivers</p> <p>* gather information from secondary sources to identify causes and impacts of algal blooms in waterways in NSW</p> <p>* discuss alternative strategies to the use of chemicals in agriculture to reduce water pollution</p>		<p>Students:</p> <p>13.1 present information by:</p> <p>a) selecting and using appropriate text types or combinations thereof, for oral and written presentations</p> <p>c) selecting and using appropriate methods to acknowledge sources of information</p> <p>12.3 gather information from secondary sources by:</p> <p>d) summarising and collating information from a range of resources</p> <p>e) identifying practising male and female Australian scientists, the areas in which they are currently working and information about their research</p>	<p>Individually, students:</p> <p>- write a report on their investigation that:</p> <ul style="list-style-type: none"> o outlines proposed strategies for the reduction of their water usage for discussion with members of their household o presents proposals and justify with supporting scientific evidence how individuals can and why they should take responsibility for maintaining the quality and sustainability of the local water supplies. (P4, P13, P14) <p>Practical Investigation: how can water pollution be reduced?</p> <p>In project teams, students:</p> <ul style="list-style-type: none"> - review the information from the investigation of substances released into water systems (refer to 8.2.2 and 8.2.3) and other selected secondary sources to identify how households can reduce water pollution - locate and gather relevant information from a range of reliable secondary sources on the latest technologies being used to purify and treat water - prepare a brief summary and/or deliver a short oral presentation to the class on one example of technology being used and developed to reduce water pollution and the possible long-term effects of this strategy - collate the summaries into a form that is accessible to all teams. <p>Individually, students:</p> <ul style="list-style-type: none"> - review the collected information on fertilisers and agriculture (8.2.2 and 8.2.3) and gather information from a variety of teacher-selected resources (including a guest speaker with expertise in the area) - prepare a summary that identifies conditions under which algal blooms may occur and describe the causes and impact of algal blooms in NSW waterways - use a teacher-provided scaffold to present points for and against alternative strategies to the use of chemicals in agriculture to reduce water pollution.
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		<p>Students:</p> <p>14.2 solve problems by:</p> <p>b) describing and selecting from different strategies those that could be used to solve the problem</p> <p>d) evaluating the appropriateness of different strategies for solving an identified problem</p> <p>14.3 use available evidence to:</p> <p>c) apply critical thinking in consideration of predictions, hypotheses and the results of investigations</p>	<p>Individually, students:</p> <ul style="list-style-type: none"> - review and update their concept map (page 16) to include further information about the impacts and consequences of human activities on water systems from their learning in sections 8.2.3 and 8.2.4 of the module. <p>Focus Activity, Task 3:</p> <p>In project teams, students:</p> <ul style="list-style-type: none"> - prepare a review of a range of information collated by the class on personal and government strategies for maintain the quality and sustainability of local water supplies by reducing water pollution resulting from human activities - use the plan and prepared materials to further develop their team presentation - monitor team progress towards completion of the project. <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>
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8.2.5: Water pollution at the local level impacts on global water quality

8.2.5 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <ul style="list-style-type: none"> * define what is meant by a catchment area * identify a local catchment area and the sources of water feeding into this catchment * gather information on the source of water feeding into the local catchment area using maps or field trips * gather information from secondary sources concerning the use and treatment of local water * describe possible sources of contamination that may enter catchments * explain how water quality in one area can impact on the water quality in other areas * describe the types of tests that are used to monitor and assess local water quality 		<p>Students:</p> <p>12.3 gather information from secondary sources by:</p> <ul style="list-style-type: none"> c) extracting information from numerical data in graphs and tables as well as from written and spoken material in all its forms d) summarising and collating information from a range of resources e) identifying practising male and female Australian scientists, the areas in which they are currently working and information about their research 	<p>Practical Investigation: what factors affect water quality in the local catchment?</p> <p>In a class activity, with teacher guidance, students:</p> <ul style="list-style-type: none"> - access teacher-provided secondary sources to define the term ‘catchment area’ and identify from maps or field trips the extent of the local catchment area for the school - identify using maps the sources of water feeding into the local catchment and possible sources of contamination that may enter the catchment - prepare a set of questions to collect data about the use, treatment and testing of water in the local water catchment area during a field trip to a local water treatment facility. <p>In a class activity, in project teams, students:</p> <ul style="list-style-type: none"> - undertake a field trip to a local water treatment facility to observe the methods used to monitor and assess local water quality, including the identification of indicator organisms found in safe and polluted water - discuss with experts at the local water treatment facility their work and the types of test used to monitor and assess the quality of water in the local catchment area - record information gathered relating to the prepared questions - participate in a teacher-led discussion to review and collate the information collected during the field trip relating to testing used in monitoring and treatment of local water, about how water quality in one area can impact on that in other areas, and the methods used to avoid contamination of water in the local catchment area - include appropriate annotations of relevant detail presented by other students and the teacher.

8.2.5 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* discuss types of indicator organisms that are found in safe water supplies and those found in polluted water</p> <p>* plan, choose equipment or resources for, and perform a first-hand investigation to determine the indicator organisms present in a local catchment area and from these deduce the chemical purity of water</p>		<p>Students:</p> <p>14.1 analyse information:</p> <p>c) to identify and explain how data supports or refutes an hypothesis, prediction or a proposed solution to a problem</p> <p>g) to use cause and effect relationships to explain phenomena</p> <p>h) to identify examples of the interconnectedness of ideas or scientific principles</p> <p>11.2 plan first-hand investigations to:</p> <p>c) design investigations that allow valid and reliable data and information to be collected</p> <p>e) predict possible issues that may arise during the course of an investigation and identify strategies to address these issues if necessary</p> <p>11.3 choose equipment or resources by:</p> <p>b) carrying out a risk assessment of intended experimental procedures and identifying and addressing potential hazards</p> <p>c) identifying technology that could be used during investigations and determining its suitability and effectiveness for its potential role in the procedure or investigations</p> <p>12.2 gather first-hand information by:</p> <p>a) using appropriate data collection techniques, employing appropriate technologies including data loggers and sensors</p> <p>14.1 analyse information:</p> <p>a) to identify trends, patterns and relationships as well as contradictions in data and information</p> <p>b) to justify inferences and conclusions</p>	<p>In project teams, students:</p> <p>- use their collected, annotated information to prepare a report which includes:</p> <ul style="list-style-type: none"> ○ the purpose, procedure used and the collected results of the field trip to a local water treatment facility ○ predictions of how water quality in one area could impact on the water quality in other area of the local catchment ○ an assessment of the impact of the application of science in protecting, conserving and maintaining the quality of water in the local catchment area. (P4, P7, P13, P14) <p>Practical Investigation: how are indicator organisms present in a local catchment area used to determine the quality of water?</p> <p>In a class activity, with teacher guidance, students:</p> <p>- review teacher-provided examples of water sampling methods and technology that could be used to collect first-hand data about indicator organisms in the local catchment area</p> <p>- use an agreed, appropriate method and plan a safe water sampling procedure for identified sites in the local catchment area using school equipment</p> <p>- include a risk assessment for the planned procedure</p> <p>- identify possible data recording procedures, negotiate and agree on a scaffold to be used by all teams to collect, summarise and present the first-hand data collected in their sampling.</p> <p>In pairs, students:</p> <p>- safely collect samples from a range of identified sites within the local catchment area</p> <p>- use appropriate techniques (in the school laboratory or on site) and teacher-provided secondary sources to identify the indicator species present in the samples collected</p> <p>- record observations and results using the agreed procedure and data recording sheets</p> <p>- select and use appropriate secondary sources and the class</p>

8.2.5 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning*</i>
<p>Students learn to/students:</p> <p>* gather, process and present information from secondary sources to identify some major disasters involving water pollution</p>		<p>Students:</p> <p>12.4 process information to: e) assess the reliability of first-hand and secondary information and data in relation to the area of investigation</p> <p>13.1 present information by: c) selecting and using appropriate methods to acknowledge sources of information</p> <p>14.2 solve problems by: b) describing and selecting from different strategies those that could be used to solve a problem d) evaluating the appropriateness of different strategies for solving an identified problem</p> <p>14.3 use available evidence to: c) apply critical thinking in consideration of predictions, hypotheses and the results of investigations d) formulate cause and effect relationships</p>	<p>data on the indicator organisms to determine the quality of the water</p> <ul style="list-style-type: none"> - present a report of the investigation which includes an hypothesis, procedure, team and class results, a discussion of the findings and evidence about the water quality of the samples from the local catchment area and a conclusion related to the hypothesis. <p>Individually or in project teams, students:</p> <ul style="list-style-type: none"> - undertake a library research task investigating a different disaster involving water pollution - select and gather information from a range of secondary sources about the disaster - use a teacher-provided scaffold to summarise information on the water pollution disaster researched and display the summary in a format that can be accessed by all students - assess the reliability of the selected information sources and uses an appropriate format to acknowledge the sources - generate a summary based on the information prepared by the class to present the main features of the major disasters involving water pollution. <p>Focus Activity, Task 4: In a teacher-guided discussion, students:</p> <ul style="list-style-type: none"> - review the causes and consequences of the water pollution disasters researched by the class - make and justify inferences about the environmental, societal and economic consequences of the identified water pollution disasters - make and support generalisations relating to the possibility of some types of water pollution disasters occurring in the local catchment - discuss the implications of increased knowledge, skills and improvements in technology in preventing similar types of water pollution disasters in the local catchment.

8.2.5 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and <i>Evidence of Learning</i> *
			<p>In project teams, students:</p> <ul style="list-style-type: none"> - <i>complete the preparation of the short presentation and deliver it to the selected audience</i> - <i>submit individual focus activity log books</i> - <i>present a short written report that evaluates the process used by the team and the effectiveness of the team in completing the task. (P4, P13, P14, P15)</i> <p>Optional class activity: In a teacher-guided discussion forum students share their ideas/understanding with Year 12 Chemistry students (refer to Chemistry Stage 6 Syllabus Chemical Monitoring and Management 9.4.5) on issues relating to the impacts of human activity on waterways and how chemical monitoring and management assists in providing safe water for human use and protects aquatic habitats for other organisms.</p> <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

Overview of Skills Development Module 8.2 Water for Living

Knowledge & Understanding	Skill Development		Skills Content Reference
8.2.1: Water is essential for the health of humans and other living things	P11 identifies and implements improvements to investigation plans	L	11.1b; 11.2b-e; 11.3b,d
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L	12.1a-d; 12.2a,b; 12.3b,d; 12.4c,e,
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	L	13.1a,b,c, f
	P14 draws valid conclusions from gathered data and information	L	14.1a,b,e,g,h; 14.2d; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	L	
8.2.2 Water is an important factor in the maintenance of Australian environments	P11 identifies and implements improvements to investigation plans	L	11.1b
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L/P	12.3c,d,e; 12.4e,f
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	L/P	13.1b,e
	P14 draws valid conclusions from gathered data and information	L/P	14.1b,c,g,h; 14.2b,d; 14.3b,d
	P15 implements strategies to work effectively as an individual or as a member of a team	P	
8.2.3: A wide range of chemicals used in human activity may impact on water systems	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P	12.1a; 12.2b; 12.3a,b; 12.4a,d,e;
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	P	13.1b
	P14 draws valid conclusions from gathered data and information	P	14.1a,b,d; 14.2b,d; 14.3b
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	
8.2.4: Strategies to reduce water pollution can be a result of personal initiative or government legislation	P11 identifies and implements improvements to investigation plans	L/P	11.1c,d; 11.2c,e; 11.3b,c
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P/A	12.1a,d; 12.2b; 12.3a,d,e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	P	13.1a,c
	P14 draws valid conclusions from gathered data and information	P/A	14.2b,d; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	
8.2.5: Water pollution at the local level impacts on global water quality	P11 identifies and implements improvements to investigation plans	P/A	11.2c,e; 11.3b,c
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P/A	12.2a; 12.3c,d,e; 12.4e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	P	13.1c
	P14 draws valid conclusions from gathered data and information	P/A	14.1a,b,c,g,h; 14.2b,d; 14.3c,d
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	

Draft Sample Learning Unit Feedback

Please respond to the following statements by **circling** the appropriate response.

Which Preliminary Course Draft Sample Learning Unit did you teach?

Biology Chemistry Earth and Environmental Science

Physics Senior Science

School: Government Non-government

Other (please specify) _____

Location: Metropolitan Non-metropolitan

Size of school: less than 100 students 100–299 300–499

500–1000 more than 1000 students

Total years teaching Stage 6 Science: 0–5 6–10 11–20 more than 20

Number of years teaching this Preliminary course: 0–4 more than 4

For the Draft Sample Learning Unit you taught please provide comments for each of the following questions:

1. Was the unit able to be completed in the allocated indicative time? YES NO

If NO, please comment.

2. Did the Suggested Learning–Teaching Experiences provide sufficient flexibility to adjust the program during the unit to address your student learning needs? YES NO

3. Which of the Suggested Learning–Teaching Experiences did you modify or change? Please provide reasons for these amendments.

You may provide comments and annotations on a copy of the sample learning unit.

4. Did the learning strategies provide sufficient detail on how to explicitly develop the targeted module 8.1 skills content in the unit? YES NO

5. Did the Suggested Learning–Teaching Experiences provide appropriate guidance on how to:

- develop the targeted Prescribed Focus Area (PFA) outcomes YES NO
- emphasise the values and attitudes outcome? YES NO

6. Could the *Evidence of Learning* activities (assessment **for** learning) be modified or further developed to:

- focus more clearly on syllabus outcomes YES NO
- provide clearer communication to students on the task requirements and/or ways in which they could improve their level of achievement? YES NO

7. Was there an appropriate balance in the unit Suggested Learning–Teaching Experiences between student-centred and teacher-directed learning? YES NO

If NO, please comment.

8. Did the organisation of the Focus Activity into smaller tasks in each section provide sufficient opportunity for you to guide and monitor student learning throughout the unit?

YES NO

9. Did the Focus Activity provide students with a scaffold to structure the development of the targeted thinking/problem solving skills? YES NO

10. Please comment on the effectiveness of the project management strategy for the Focus Activity in:

- engaging students in learning
- consolidating the ideas and understanding within and across the sections of the unit
- developing students' skills in teamwork.

Other comments/suggestions:

Thank you for taking the time to comment on the Draft Sample Learning Unit. Your feedback and suggestions are appreciated. Please send your feedback comments by:

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