

**Science
Stage 6**

**Draft Sample Learning Unit for
Physics**

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 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 fossicking, or o find information on the distinction between an exploration licence, a mineral claim and a mining lease o consider how land use changes over time, eg many mining operations only last for ten years o prepare an outline of the possible views of the different community groups such as residents, Aboriginal peoples, tourists, developers, environmentalists and local government o debate whether the community of the environment o discuss why the land use should be regulated <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>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 terrestrial environment of the field considered in the context of the development - monitor the team’s progress towards the completion of the activity (P15). *Suggested Evidence of Learning activities are in italics <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> <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>

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 – Physics
Module 8.2 The World Communicates

Sample Stage 6 Physics Course Module 8.2 The World Communicates (30 indicative hours)

Contextual Outline

Humans are social animals and have successfully communicated through the spoken word, and then, as the use of written codes developed, through increasingly sophisticated graphic symbols. The use of a hard copy medium to transfer information in coded form meant that communication was able to cross greater distances with improved accuracy of information transfer. A messenger was required to carry the information in hard copy form and this carrier could have been a vehicle or person. There was, however, still a time limit and several days were needed to get hard-copy information from one side of the world to the other.

The discovery of electricity and then the electromagnetic spectrum has led to the rapid increase in the number of communication devices throughout the twentieth century. The carrier of the information is no longer a vehicle or person – rather, an increasing range of energy waves is used to transfer the message. The delay in relaying signals around the world is determined only by the speed of the wave, and the speed and efficiency of the coding and decoding devices at the departure and arrival points of the message. The time between sending and receiving messages through telecommunications networks is measured in fractions of a second allowing almost instantaneous delivery of messages, in spoken and coded forms, around the world.

This module increases students' understanding of the nature, practice, application and uses of physics, and current issues, research and developments in physics.

Assumed Knowledge

Domain: knowledge and understanding:

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

- 5.6.1a) identify waves as carriers of energy
- 5.6.1b) qualitatively describe features of waves including frequency, wavelength and speed
- 5.6.1c) give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses
- 5.6.4a) distinguish between the absorption, reflection and refraction of light and identify everyday situations where each occurs
- 5.9.1b) identify that some types of electromagnetic radiation are used to provide information about the universe
- 5.12a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology.

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*.

Target 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 in physics
- P3 assesses the impact of particular technological advances on understanding in physics
- P5 describes the scientific principles employed in particular areas of research in physics

- P7 describes the effects of energy transfers and energy transformations
- P8 explains wave motions in terms of energy sources and the oscillations produced
- 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 physics
- 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 attitude towards, both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science

Focus Activity

Throughout this unit the emphasis applied to learning focuses on developing students' understanding of the contribution that physics has made to society through the development of useful technologies and systems (P3) and their awareness of the impact of these on society and the environment (P4). Increasing students' knowledge of how the process and methods of exploring, generating, testing and relating ideas (P2) is also a focus of learning and teaching in this unit. 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 The World Communicates

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. This activity is due for completion by the end of this unit of work.

Resources

Examples would include:

- texts, references, scientific journals and library resources
- current websites, digital, audio and visual technologies
- specific materials, resources and equipment (including safety equipment).

8.2.1: The wave model can be used to explain how current technologies transfer information

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>*describe the energy transformations required in one of the following:</p> <ul style="list-style-type: none"> – mobile telephone – fax/modem – radio and television 		<p>Students:</p> <p>13.1 present information by: e) using a variety of pictorial representations to show relationships and present information clearly and succinctly</p> <p>13.1 present information by: d) using symbols and formulae to express relationships and using appropriate units for physical quantities</p> <p>13.1 present information by: b) selecting and using appropriate media to present data and information</p>	<p>Introductory Activity:</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - discuss the question “How has the development of communication technologies affected society?” <p>In pairs, students:</p> <ul style="list-style-type: none"> - examine a range of teacher-provided images showing a variety of forms of communication from different eras eg papyrus/ hieroglyphics, Aboriginal cave paintings, messenger pigeon, semaphore, morse code, telegram, radio, TV, mobile phone, fax, internet - discuss the similarities and differences between these forms of communication - discuss the major development in the culture or technology required for each new form of communication - summarise how each communication technology has affected society. <p>Focus Activity:</p> <p>Teacher introduces the focus activity</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - discuss the question ‘How do energy transformations and transfer occur in modern communication systems?’ <p>Individually, students:</p> <ul style="list-style-type: none"> - recall some everyday uses and effects of electromagnetic radiation, including applications in communication technology - extract information from teacher-identified resources to confirm the energy transformations taking place in either the mobile phone, fax/modem or radio and television. - develop a flow chart with teacher guidance, of energy transformations taking place in the transmission of a voice or text message in their chosen communication system.

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 observe and gather information about the transmission of waves in:</p> <ul style="list-style-type: none"> – slinky springs – water surfaces – ropes <p>or use appropriate computer simulations</p> <p>*describe waves as a transfer of energy disturbance that may occur in one, two or three dimensions, depending on the nature of the wave and the medium</p> <p>*identify that mechanical waves require a medium for propagation while electromagnetic waves do not</p> <p>*define and apply the following terms to the wave model: medium, displacement, amplitude, period, compression, rarefaction, crest, trough, transverse waves, longitudinal waves, frequency, wavelength, velocity</p> <p>*present diagrammatic information about transverse and longitudinal waves, direction of particle movement and the direction of propagation</p> <p>*describe the relationship between particle motion and the direction of energy propagation in transverse and longitudinal waves</p>		<p>Students:</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>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>13.1 present information by:</p> <p>d) using symbols and formulae to express relationships and using appropriate units for physical quantities</p>	<p>Practical Investigation: what happens when energy is transferred through different media, either as a single pulse or continuous energy?</p> <p>With teacher guidance, in pairs, students:</p> <ul style="list-style-type: none"> - review their understanding about the processes for planning and undertaking first-hand investigations and gathering first-hand information (<i>Science 7–10 Syllabus</i> Essential Content 4/5.13.2, 4/5.13.3, 4/5.14, 4/5.15) - observe and record descriptions of a single pulse and continuous pulses using ropes, slinky springs and water waves in a ripple tank. <p>Individually, students:</p> <ul style="list-style-type: none"> - recall that waves are carriers of energy - note the direction of energy transmission relative to the motion of the coils of the spring for both longitudinal and transverse waves - present results in a variety of diagrammatic forms to show relationships, with labels showing pulses, wave fronts and direction of transmission of energy. <p>In pairs, students:</p> <ul style="list-style-type: none"> - discuss whether the energy disturbance of each of the waves occurs in one, two or three dimensions - apply the terms ‘medium’, ‘displacement’, ‘compression’, ‘rarefaction’, ‘crest’, ‘trough’, ‘frequency’ and ‘velocity’ to the observed behaviour of waves in the rope, slinky spring and water - repeat the investigations with slinky springs to observe the movement of particles in these waves - compare the compressions and rarefactions produced by a longitudinal wave with the crests and troughs produced by a transverse wave in the slinky. - identify that mechanical waves require a medium for propagation while electromagnetic waves do not. <p>Individually, students:</p> <ul style="list-style-type: none"> - draw diagrams, using symbols and appropriate units, which express relationships between the wavefront, direction of particle movement and direction of energy propagation, for transverse and longitudinal waves.

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 gather information about the frequency and amplitude of waves using an oscilloscope or electronic data-logging equipment</p> <p>*present and analyse information from displacement-time graphs for transverse wave motion</p>		<p>Students:</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>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>13.1 present information by:</p> <p>d) using symbols and formulae to express relationships and using appropriate units for physical quantities</p> <p>e) using a variety of pictorial representations to show relationships and present information clearly and succinctly</p>	<p>Practical Investigation: are there any relationships between amplitude, frequency and wavelength of a wave?</p> <p>In project teams with teacher guidance, students:</p> <ul style="list-style-type: none"> - use a CRO (Cathode Ray Oscilloscope) and frequency generator or electronic data-logging equipment to observe or estimate the characteristics of a wave, including (relative) amplitude, wavelength and period - identify safe work practices for the use of the CRO and explain potential hazards - perform a first-hand investigation using ripple tanks, slinky springs and CRO or an electronic data logger to identify the relationships between the properties of a wave - recognise where and when modifications are needed and analyse the effect of these adjustments - observe and record information about period, amplitude and velocity of waves - carry out repeat trials as appropriate - use the gathered data to establish any relationships between frequency, period, amplitude, wavelength and velocity. <p>Individually, students:</p> <ul style="list-style-type: none"> - present observations from the above investigations on displacement–time graphs - analyse information from teacher-provided displacement–time graphs of transverse wave motion.

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: *plan, choose equipment for and perform a first-hand investigation to gather information to identify the relationship between the frequency and wavelength of a sound wave travelling at a constant velocity</p>		<p>Students: 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 e) recommend the use of an appropriate technology or strategy for data collection or information gathering that will assist efficient future analysis 11.2 plan first-hand investigations to: a) demonstrate the use of the terms ‘dependent’ and ‘independent’ to describe variables involved in the investigation 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 c) design investigations that allow valid and reliable data and information to be collected 11.3 choose equipment or resources by: a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation c) identifying technology that could be used during investigations and determining its suitability and effectiveness for its potential role in the procedure or investigation 12.2 gather first-hand information by: a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors</p>	<p>Practical Investigation: what are the differences between sound waves produced by tuning forks of different frequencies? In project teams, students: - plan a first-hand investigation to allow valid and reliable data to be collected - recommend the use of an appropriate technology for data collection - explain the terms ‘dependent variable’ and ‘independent variable’ with reference to the collection of first-hand data using the CRO - identify the variables being kept constant during each part of their investigation - carry out the planned procedure using the CRO, microphone and tuning forks - observe and record results for period and frequency in recognisable forms - repeat procedure where necessary - present diagrams to show the wavelengths of the sound produced by tuning forks of different frequency.</p> <p>Individually, students: - interpret teacher-supplied graphs of both transverse and longitudinal waves.</p>

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>*quantify the relationship between velocity, frequency and wavelength for a wave:</p> $v = f\lambda$ <p>* solve problems and analyse information by applying the mathematical model of</p> $v = f\lambda$ <p>to a range of situations</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>b) identify and apply appropriate mathematical formulae and concepts</p> <p>14.1 analyse information to:</p> <p>a) identify trends, patterns and relationships as well as contradictions in data and information</p> <p>f) use models, including mathematical ones, to explain phenomena and/or make predictions</p> <p>14.2 solve problems by:</p> <p>a) identifying and explaining the nature of a problem</p> <p>14.2 solve problems by:</p> <p>a) identifying and explaining the nature of the problem</p> <p>b) describing and selecting from different strategies those which could be used to solve a problem</p> <p>14.3 use available evidence to:</p> <p>c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations</p>	<p>In a class activity, with teacher guidance, students:</p> <ul style="list-style-type: none"> - are introduced to the concept of a ‘model’ - use data gathered from first-hand investigations and graphical models to quantify the relationship $v = f\lambda$ - solve problems and analyse information by applying the mathematical model of $v = f\lambda$ to a range of situations. <p><i>Individually, students:</i></p> <ul style="list-style-type: none"> - analyse teacher-supplied graphs of period, frequency, wavelength and amplitude to identify trends, patterns and relationships - use diagrams to describe the relationship between particle motion and the direction of energy propagation in transverse and longitudinal waves - solve problems and analyse information by applying the mathematical model of $v = f\lambda$ to a range of situations. (P8, P13, P14) <p>Focus Activity Task 1: Working as a project team, students:</p> <ul style="list-style-type: none"> - identify and explain the nature of the problem presented in the focus activity - describe and select from different strategies, those which could be used to solve the problem - develop an appropriate project plan with time lines and identified team roles and responsibilities - prepare a summary table of the physics concepts covered in 8.2.1 that relate to the development of useful technologies for the transfer of information, such as the mobile phone, fax/modem, radio and television - describe one or more social and environmental impacts of the use of each of these technologies. (P3, P4, P7, P8, P13, P14, P15) <p><i>*Suggested Evidence of Learning Activities are shown in italics.</i></p>

8.2.2: Features of a wave model can be used to account for the properties of sound

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>*identify that sound waves are vibrations or oscillations of particles in a medium</p> <p>* relate compressions and rarefactions of sound waves to the crests and troughs of transverse waves used to represent them</p> <p>*perform a first-hand investigation and gather information to analyse sound waves from a variety of sources using the Cathode Ray Oscilloscope (CRO) or an alternate computer technology</p> <p>*explain qualitatively that pitch is related to frequency and volume to amplitude of sound waves</p>		<p>Students:</p> <p>14.1 analyse information to: f) use models, including mathematical ones, to explain phenomena and/or make predictions</p> <p>12.2 gather first-hand information by: a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate</p> <p>14.1 analyse information to: a) identify trends, patterns and relationships as well as contradictions in data and information</p>	<p>In project teams, students:</p> <ul style="list-style-type: none"> - construct a summary of their knowledge and understanding of sound energy and its propagation - list the modern communication technologies that require the transmission of sound in the form of electromagnetic radiation. <p>In a teacher-directed activity, students:</p> <ul style="list-style-type: none"> - explain the properties of sound in terms of the wave model - observe using the CRO, audio oscillator and loudspeaker, the relationship between compressions and rarefactions in sound waves and crests and troughs in the transverse wave model. <p>Individually, students:</p> <ul style="list-style-type: none"> - analyse teacher-provided diagrams of longitudinal waves, labelling wavelength, amplitude, crests and troughs. <p>Practical Investigation: what are the similarities and differences between the sound waves produced by different musical instruments? In a class activity, students:</p> <ul style="list-style-type: none"> - use a CRO connected to an amplifier or an alternative computer technology to observe and record the wave patterns produced by a variety of student supplied (and played) musical instruments - compare the wave patterns produced by the human voice to those produced by the musical instruments. <p>Individually, students:</p> <ul style="list-style-type: none"> - analyse the sound waves observed in the investigation, in terms of the wave model - clarify the relationship between pitch and frequency and volume and amplitude in sound waves.

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: *explain an echo as a reflection of a sound wave</p> <p>*perform a first-hand investigation, gather, process and present information using a CRO or computer to demonstrate the principle of superposition for two waves travelling in the same medium</p> <p>*present graphical information, solve problems and analyse information involving superposition of sound waves</p> <p>*describe the principle of superposition and compare the resulting waves to the original waves in sound</p>		<p>Students: 14.3 use available evidence to: a) design and produce creative solutions to problems b) propose ideas that demonstrate coherence and logical progression and include correct use of principles and ideas</p> <p>12.4 process information to: c) best illustrate trends and patterns by selecting and using appropriate methods, including computer assisted analysis</p> <p>13.1 present information by: d) using symbols and formulae to express relationships and using appropriate units for physical quantities</p> <p>14.1 analyse information to: d) predict outcomes and generate plausible explanations related to the observations f) use models, including mathematical ones, to explain phenomena and/or make predictions g) use cause and effect relationships to explain phenomena</p>	<p>In project teams, students: - develop an analogy that could be used with a Stage 3 student to explain the concept of an echo - present their analogy to the class - analyse the analogies in terms of the correct use of scientific principles and ideas.</p> <p>As a class activity with teacher guidance, students: - use a Sonic Ranger to show how the reflection of ultrasound waves can be used to determine the speed of a moving object.</p> <p>Individually, students: - research the use of radar in speed traps and/or ultrasound in medical imaging and/or the use of sonar in depth measurements in the ocean - report findings to class for discussion.</p> <p>Practical Investigation: what happens when two sine waves interact? In pairs, students: - make predictions about what might happen when two similar sound waves interact - test their predictions using slinky springs.</p> <p>In a class activity, students: - demonstrate the superposition of waves using two audio oscillators and a CRO or using a computer program - discuss the concept of superposition of waves by comparing original and resulting waves in a variety of situations.</p> <p>Individually, students: - use teacher-developed graphical information to solve superposition problems - use an Excel spreadsheet to add sine curves - practise solving superposition of waves problems using both graphical and quantitative information - research the role of superposition of waves in the transfer of information - use cause and effect relationships to solve problems and analyse information involving superposition of waves.</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>
		Students: 14.2 solve problems by: a) identifying and explaining the nature of a problem 14.3 use available evidence to: b) propose ideas that demonstrate coherence and logical progression and include correct use of scientific principles and ideas	Focus Activity Task 2: In a class discussion, students: - review their ideas about the provisional nature of explanations and the complex relationship between physical views, the evidence supporting these and the process and methods of exploring, testing and relating ideas Working as a project team, students: - <i>develop a flow chart which demonstrates the significance of the wave model of superposition to the transfer of sound and information in modern communication technologies.</i> (P2, P3, P14, P15) <i>*Suggested Evidence of Learning Activities are shown in italics.</i>

8.2.3: Recent technological developments have allowed greater use of the electromagnetic spectrum

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>*describe electromagnetic waves in terms of their speed in space and their lack of requirement of a medium for propagation</p> <p>*identify methods for the detection of various wavebands in the electromagnetic spectrum</p> <p>*identify the electromagnetic wavebands filtered out by the atmosphere, especially UV, X-rays and gamma rays</p>		<p>Students:</p> <p>13.1 present information by:</p> <p>b) selecting and using appropriate media to present data and information</p> <p>d) using symbols and formulae to express relationships and using appropriate units for physical quantities</p> <p>e) using a variety of pictorial representations to show relationships and present information clearly and succinctly</p>	<p>In project teams, students:</p> <ul style="list-style-type: none"> - use teacher-provided materials to: <ul style="list-style-type: none"> ○ research the different types of waves that make up the electromagnetic spectrum, their speed, their lack of requirement of a medium for propagation and the properties of the different wavelengths ○ investigate safety issues associated with the use of different wavelengths of the electromagnetic spectrum ○ discuss two desirable and two undesirable applications of the electromagnetic spectrum ○ consider the issue of ownership of electromagnetic bandwidths (with governments selling off rights) and problems associated with future technologies and available bandwidths ○ discuss privacy issues associated with electromagnetic broadcasts ○ prepare an appropriate visual presentation to describe the EM spectrum and some of the technological applications of the different wavebands. <p>In a class activity, students:</p> <ul style="list-style-type: none"> - list methods for the detection of the different wavebands - use microwave apparatus to investigate the transmission, penetration and reflection of microwaves - discuss the importance of microwaves in practical technologies - discuss and present visual information about the role of the atmosphere in filtering out electromagnetic waves especially UV, X-rays and gamma rays.

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>*plan, choose equipment or resources for and perform a first-hand investigation and gather information to model the inverse square law for light intensity and distance from the source</p> <p>*explain that the relationship between the intensity of electromagnetic radiation and distance from a source is an example of the inverse square law:</p> $I \propto \frac{1}{d^2}$		<p>Students:</p> <p>11.1 identify data sources to:</p> <p>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>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 correct units for data that will be collected</p> <p>e) recommend the use of an appropriate technology or strategy for data collection or information gathering that will assist efficient future analysis</p> <p>11.2 plan first-hand investigations to:</p> <p>a) demonstrate the use of the terms ‘dependent’ and ‘independent’ to describe variables involved in the investigation</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>Practical Investigation: how does light intensity vary with distance from a light source?</p> <p>In project teams with teacher guidance, students:</p> <ul style="list-style-type: none"> - review their understanding of how, through scientific investigation, explanations are tested against the evidence gathered (4/5.2) - recall their ideas about devising questions or hypotheses to be tested and the processes used in carrying out scientific investigations to test these (4/5.13) - discuss an hypothesis for this investigation - plan a first-hand investigation to allow valid and reliable data to be collected - choose the appropriate technology, such as a data logger or light meter - identify the correct units, order of magnitude and uncertainties in their measurements - identify the independent and dependent variables - identify the variables that need to be kept constant - develop strategies to ensure that these variables are kept constant - carry out the planned procedure - observe and record results - carry out repeat trials and explain why the repetition of procedures is appropriate - graph results and construct a curve of best fit - justify inferences and conclusions. <p>Practical Investigation: how can the inverse square law for light intensity be modelled?</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - are introduced to the balloon analogy in which the inflating surface of a balloon mimics the expanding sphere of light a single pulse would produce in three dimensions - imagine that a light globe is always in the centre of the balloon with the inflating balloon surface representing a pulsed-light wavefront travelling in 3 dimensions from the light globe - draw a 1 cm square on the partially inflated balloon (10 cm diameter – record as radius 1) - inflate the balloon until it has a diameter of 15 cm, measure the size of the square and record results - repeat at 20 cm, 25 cm and 30 cm diameter

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>*outline how the modulation of amplitude or frequency of visible light, microwaves and/or radio waves can be used to transmit information</p> <p>*analyse information to identify the waves involved in the transfer of energy that occurs during the use of one of the following:</p> <ul style="list-style-type: none"> • mobile phone • television • radar <p>Students learn to/students:</p> <p>*analyse information to identify the electromagnetic spectrum range utilised in modern communication technologies</p> <p>*discuss problems produced by the limited range of the electromagnetic spectrum available for communication purposes</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>13.1 present information by:</p> <p>f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately</p> <p>g) identifying situations where use of a curve of best fit is appropriate to present graphical information</p> <p>14.1 analyse information to:</p> <p>a) identify trends, patterns and relationships as well as contradictions in data and information</p> <p>b) justify inferences and conclusions</p> <p>e) make and justify generalisations</p> <p>f) use models, including mathematical ones, to explain phenomena and/or make predictions</p> <p>g) use cause and effect relationships to explain phenomena</p> <p>14.2 solve problems by:</p> <p>a) identifying and explaining the nature of a 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>- graph the inverse of the area (proportional to I) against $1/(\text{balloon radius})^2$</p> <p>- analyse the graph to infer the relationship between the area of the square and the inverse of the square of the distance from the centre of the balloon</p> <p>- assess the strengths and weaknesses of the use of a model such as this one to help understand physical relationships.</p> <p><i>Individually, students:</i></p> <p>- analyse teacher-supplied examples to explain the inverse square law for electromagnetic radiation.</p> <p>In a class activity, students:</p> <p>- are introduced to the concept of modulation, the process of adding signal information to an electromagnetic wave</p> <p>- discuss the difference between amplitude modulation and frequency modulation.</p> <p>Focus Activity Task 3:</p> <p>Working as a project team, students:</p> <p>- extract and summarise information from a variety of teacher-provided secondary sources on the different amplitudes and frequencies modulated for use in communications technologies, such as radar, television and mobile phone transmission</p> <p>- prepare a one page outline for class discussion which:</p> <ul style="list-style-type: none"> o compares the advantages and disadvantages of FM and AM for broadcasting o investigates the advantages of microwaves in the transmission of modulated signals <p>- add the types of waves involved in the energy transfer to the flow chart (8.2.1)</p> <p>- use the internet to research factors that may limit the range of available frequencies for use by modern communication technologies</p> <p>- consider whether this limited range has implications to their plan for a communications system for the mining community</p> <p>- annotate all resources used</p> <p>- clearly identify the responsibilities of each member of the team and monitor the team's progress towards the completion of the activity (P15).</p>

8.2.4: Many communication technologies use applications of reflection and refraction of electromagnetic waves

8.2.4 Module Content (column 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 first-hand investigations and gather information to observe the path of light rays and construct diagrams indicating both the direction of travel of the light rays and a wave front</p> <p>*present information using ray diagrams to show the path of waves reflected from:</p> <ul style="list-style-type: none"> – plane surfaces – concave surfaces – convex surface - the ionosphere <p>*describe and apply the law of reflection and explain the effect of reflection from a plane surface on waves</p> <p>*describe ways in which applications of reflection of light, radio waves and microwaves have assisted in information transfer</p> <p>*describe one application of reflection for each of the following:</p> <ul style="list-style-type: none"> – plane surfaces – concave surfaces – convex surfaces - radio waves being reflected by the ionosphere 		<p>Students:</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>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>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>14.1 analyse information to:</p> <p>a) identify trends, patterns and relationships as well as contradictions in data and information</p> <p>f) use models, including mathematical ones, to explain phenomena and/or make predictions</p> <p>g) use cause and effect relationships to explain phenomena</p>	<p>Practical Investigation: how is light reflected from plane, concave and convex surfaces?</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - brainstorm to recall their ideas about reflection and refraction of light based on prior understanding of <i>Science Years 7–10 Syllabus</i> (5.6.4a) - examine a teacher-supplied diagram of a wave to identify the wave front, ray, normal, incident ray and reflected ray - write definitions of each of these. <p>In pairs, students:</p> <ul style="list-style-type: none"> - undertake a teacher-planned procedure using a ray box and plane mirror and a range of incident angles to verify the law of reflection - discuss the terms ‘angle of incidence’, ‘angle of reflection’, ‘plane’ (same plane and plane mirror) and apply these terms to their findings - construct diagrams indicating both the direction of travel of the light rays and a wave front - use the ray box to observe and record diagrammatically the reflection of parallel rays of light from concave and convex reflectors - identify qualitatively any trends or patterns evident in the reflection of light - use a mathematical model to explain the trends - use cause and effect relationships to explain the reflection of light rays at the three different surfaces. <p>In project teams, students:</p> <ul style="list-style-type: none"> - develop a summary of the ways in which applications of reflection of light, radio waves and microwaves have assisted in information transfer - describe one application of reflection for each of the following: – plane surfaces, concave surfaces, convex surfaces, radio waves being reflected by the ionosphere

<p>Students learn to/students: *identify the conditions necessary for total internal reflection with reference to the critical angle</p> <p>*outline how total internal reflection is used in optical fibres</p>	<p>Students:</p> <p>13.1 present information by: e) using a variety of pictorial representations to show relationships and present information clearly and succinctly</p> <p>14.1 analyse information to: e) make and justify generalisations h) identify examples of the interconnectedness of ideas or scientific principles</p> <p>14.2 solve problems by: a) identifying and explaining the nature of a 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>Practical Investigation: what is total internal reflection and what are the conditions necessary for it to occur?</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - define total internal reflection - cite examples of total internal reflection in glass and objects other than mirrors - observe total internal reflection of laser light in an optical fibre - discuss how total internal reflection in optical fibres is used in communication technologies - summarise the implications for society of the development of optical fibres. <p>In pairs, students:</p> <ul style="list-style-type: none"> - use ray boxes to quantitatively investigate total internal reflection in a semi-circular perspex slab - use a series of diagrams to describe how the internally reflected ray and the escaping refracted ray vary as the internal angle of incidence on the linear surface of the prism increases towards the critical angle - estimate the refractive index of the semi-circular prism from a measurement of the critical angle. <p>Focus Activity Task 4: Working as a project team, students:</p> <ul style="list-style-type: none"> - develop an overview of how reflection and refraction of electromagnetic waves are used in communication technologies - assess the impact of increases in our understanding in physics and the application of the electromagnetic spectrum on the development of useful communication technologies - evaluate the role of the scientist in bringing information, understanding and analytical skills in matters of public concern such as social and environmental impacts of technologies and systems (P15). <p><i>*Suggested Evidence of Learning Activities are shown in italics.</i></p>
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8.2.5: Electromagnetic waves have potential for future communication technologies and data storage technologies

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"> *identify types of communication data that are stored or transmitted in digital form *identify data sources, gather, process and present information from secondary sources to identify areas of current research and use the available evidence to discuss some of the underlying physical principles used in one application of physics related to waves, such as: <ul style="list-style-type: none"> – Global Positioning System – CD technology – the internet (digital process) – DVD technology 		<p>Students:</p> <p>12.3 gather information from secondary sources by:</p> <ol style="list-style-type: none"> a) accessing information from a range of resources, including popular scientific journals, digital technologies and the internet 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 <p>12.4 process information to:</p> <ol style="list-style-type: none"> d) evaluate the validity of first-hand and secondary information and data in relation to the area of investigation 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>13.1 present information by:</p> <ol 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 d) using symbols and formulae to express relationships and using appropriate units for physical quantities 	<p>In project teams, students:</p> <ul style="list-style-type: none"> - identify areas of current research such as Global Positioning System, CD technology, the internet (digital process), DVD technology - each select one communication technology - research this technology using a range of secondary sources including scientific journals and the internet - discuss the underlying physical principles related to waves - summarise their findings including three predisposing technologies required for the development of this technology - use a variety of pictorial representations to explain the technology - assess the impact of being able to store a variety of data in digital form on the development of this technology - discuss the importance of coding and decoding devices - include a bibliography of their sources using a teacher-provided format - review their ideas on why it is important to assess the reliability of secondary information and suggest some of the strategies that could be used to determine the reliability data/information - assess the reliability of secondary information and data by considering information from various sources - assess the accuracy of scientific information presented in mass media by comparison with similar information presented in scientific journals - present their findings to the team.

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:</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: a) design and produce creative solutions to problems b) propose ideas that demonstrate coherence and logical progression and include correct use of scientific principles and ideas</p>	<p>Focus Activity Task 5: In project teams, students:</p> <ul style="list-style-type: none"> - complete their report and short oral presentation - generate a summary to accompany their presentation to the local community forum which outlines their plan for the proposed communications system and how it will address the issues of safety, energy efficiency and sustainability including any social and/or environmental concerns - submit the report and their individual logbooks with a brief evaluation of the process used by the team and the effectiveness of the team in completing the task. (P2, P3, P7, P8, P13, P14, P15)

Overview of Skills Development Module 8.2 The World Communicates

Knowledge & Understanding	Skill Development		Skills Content Reference
8.2.1: The wave model can be used to explain how current technologies transfer information	P11 identifies and implements improvements to investigation plans	L	11.1b,e; 11.2a,b,c; 11.3a,c
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L/P	12.1a,d; 12.2a,b; 12.4b,
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science	L/P	13.1b,d,e
	P14 draws valid conclusions from gathered data and information	L	14.1a,f; 14.2a,b; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	L	
8.2.2 Features of a wave model can be used to account for the properties of sound	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L/P	12.2a,b; 12.4c
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science	P	13.1d
	P14 draws valid conclusions from gathered data and information	L/P	14.1a,d,f,g; 14.2a; 14.3a,b
	P15 implements strategies to work effectively as an individual or as a member of a team	L/P	
8.2.3: Recent technological developments have allowed greater use of the electromagnetic spectrum	P11 identifies and implements improvements to investigation plans	L/P	11.1b,c,d,e; 11.2a,b,c,d
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P	12.1a; 12.2a,b
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science	L/P	13.1b,d,e,f,g
	P14 draws valid conclusions from gathered data and information	L/P	14.1a,b,e,f,g; 14.2a; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	
8.2.4: Many communication technologies use applications of reflection and refraction of electromagnetic waves	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	A	12.1a; 12.2b
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science	P	13.1d,e,f,g
	P14 draws valid conclusions from gathered data and information	L/P	14.1a,b,e,f,g,h; 14.2a,b; 14.3c,d
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	
8.2.5: Electromagnetic waves have potential for future communication technologies and data storage technologies	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L	12.3a,c,d; 12.4d,e,f
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in science	L/P/A	13.1a,b,c,d
	P14 draws valid conclusions from gathered data and information	P	14.2d; 14.3a,b
	P15 implements strategies to work effectively as an individual or as a member of a team	A	

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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