

**Science
Stage 6**

**Draft Sample Learning Unit for
Biology**

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 - distinction 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 mining should be approved - discuss why the environmental 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 terrestrial environment of the field site considered in the context of the project 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 – Biology

Module 8.3 Patterns in Nature

Contextual Outline

Detailed examination of one or two species of living things does not provide an overview of the general features of living things. By looking across the range of commonly occurring living organisms, patterns in structure and function can be identified. These patterns reflect the fundamental inputs and outputs of living things – the absorption of necessary chemicals and the release of wastes. At a microscopic level, there are patterns in the structure and function of cells. The fundamental structural similarities exist because the biochemical processes are similar. Some important differences between plant and animal cells reflect the fundamental differences between plants and animals – the process of photosynthesis in plants. Many living things have evolved complex and efficient systems with large surface areas to facilitate the intake and removal of wastes. Transport systems allow distribution and collection of nutrients and wastes. The processes of sexual reproduction also follow similar patterns in living things – these processes reflect the purpose of sexual reproduction as well as a common evolutionary origin for multicellular plants and animals.

This module increases students' understanding of the history, applications and uses of biology.

Assumed Knowledge

Domain: knowledge and understanding

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

- 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions
- 5.8.1a) explain that systems in multicellular organisms serve the needs of cells
- 5.8.1b) identify the role of cell division in growth, repair and reproduction in multicellular organisms
- 5.8.2c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves
- 5.8.2d) identify that genes are part of DNA.

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:

A student:

- P1 outlines the historical development of major biological principles, concepts and ideas
- P3 assesses the impact of particular technological advances in understanding in biology
- P6 explains how cell ultrastructure and the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms
- 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 biology
- P14 draws valid conclusions from gathered data and information
- P15 implements strategies to work effectively as an individual or as a team member

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 student's knowledge of the applicability, relevance and usefulness of biological concepts in understanding similarities and differences in the structure and function of living things (P3). The historical background to the development of the cell theory and how this progressive accumulation of knowledge changed the nature of scientific thinking (P1) is also a focus of learning and teaching in the 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: 8.3 Patterns in Nature

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 have 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. This activity is due for completion by the end of this module.

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).

8.3.1 Organisms are made of cells that have similar structural characteristics

8.3.1 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 first-hand information using a light microscope to observe cells in plants and animals and identify nucleus, cytoplasm, cell wall, chloroplast and vacuoles</p>		<p>Students:</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>14.2 solve problems by:</p> <p>a) identifying and explaining the nature of a problem</p> <p>11.3 choose equipment or resources by:</p> <p>a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation</p> <p>b) carrying out a risk assessment of intended experimental procedures and identifying and addressing potential hazards</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>b) efficiently undertaking the planned procedure to minimise hazards and wastage of resources</p> <p>d) identifying and using safe work practices during investigations</p>	<p>Introductory Activity: reviewing Prior Learning With teacher guidance, individually, students:</p> <ul style="list-style-type: none"> - review the purpose and construction of concept maps - develop a concept map to determine and clarify prior learning about cells and cell structure (4.8.1a–d). Students will add information to the concept map throughout the unit. <p>Teacher introduces the focus activity</p> <p>Practical Investigation: do animal and plant cells show patterns in their structure? Individually or in pairs, students:</p> <ul style="list-style-type: none"> - use a checklist and/or follow teacher modelling to revise the features, setting up and risks involved in the use of the light microscope, a method for determining magnification and an appropriate method for producing a biological drawing - identify and assess risks and develop a plan to minimise potential hazards and wastage in the preparation of a wet mount - with teacher guidance, prepare a wet mount of an appropriate plant tissue - recommend when modifications to the method for preparation of the wet mount may be needed and analyse the effect of making these adjustments. <p>Individually, students:</p> <ul style="list-style-type: none"> - examine wet mounts/prepared slides/photomicrographs of a range of plant and animal tissues to identify nucleus, cytoplasm, cell wall, chloroplast and vacuole - draw and label diagrams of cells and organelles observed, recording the magnification used - use secondary sources to identify the function of each of the organelles identified - with teacher guidance, construct a table comparing the structure of animal and plant cells as seen with the light microscope.

8.3.1 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: *describe evidence to support the cell theory</p> <p>*process information from secondary sources to analyse electron micrographs of cells and identify mitochondria, chloroplasts, Golgi bodies, lysosomes, endoplasmic reticulum, ribosomes, nucleus, nucleolus and cell membranes</p> <p>*identify cell organelles seen with current light and electron microscopes</p> <p>*describe the relationship between the structure of cell organelles and their function</p>		<p>Students:</p> <p>13.1 present information by:</p> <p>c) selecting and using appropriate formats to acknowledge sources of information</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>b) justify inferences and conclusions</p> <p>c) identify and explain how data supports or refutes an hypothesis, a prediction or a proposed solution to a problem</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>b) practising efficient data collection techniques to identify useful information in secondary sources</p> <p>d) summarising and collating information from a range of resources</p>	<p>Following a class discussion of the timelines and information gathered and collated, by the project teams, students:</p> <ul style="list-style-type: none"> - summarise what is meant by the cell theory - describe evidence to support the cell theory - make and justify a conclusion about the major factors that contributed to the development of the cell theory. <p>Individually, students:</p> <ul style="list-style-type: none"> - write a brief description that provides an overview of how the work of one scientist on the timeline contributed to and changed scientific understanding of cells and/or the cell theory. (P1, P6, P14) <p>Practical Investigation: how significant have advances in microscope technology been in the development of the cell theory?</p> <p>In teams or individually students:</p> <ul style="list-style-type: none"> - observe electron micrographs of cells/organelles and access appropriate texts, websites, CDROMS or DVDs to gather information to identify and outline the basic function of organelles including: mitochondria, chloroplasts, Golgi bodies, lysosomes, endoplasmic reticulum, ribosomes, nucleus, nucleolus and cell membranes - compare light and electron microscopes in terms of magnification and resolution - construct a table to summarise findings for each cell organelle identified including: <ul style="list-style-type: none"> o whether it is seen with a light or electron microscope or both o whether it is found in plant or animal cells or both o size o basic function - describe and record how the structure of each organelle identified is related to its function - revise their concept map (page 15) and include information about other organelles identified with the light and electron microscope in their investigations

8.3.1 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: *use available evidence to assess the impact of technology, including the development of the microscope on the development of the cell theory</p> <p>*discuss the significance of technological advances to developments in the cell theory</p>		<p>Students:</p> <p>14.1 analyse information to:</p> <p>b) justify inferences and conclusions c) identify and explain how data supports or refutes an hypothesis, a prediction or a proposed solution to a problem 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 present information clearly and succinctly</p> <p>14.2 solve problems by:</p> <p>a) identifying and explaining the nature of the problem 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>- propose a generalisation based on their investigations to account for similarities and differences in cells.</p> <p>With teacher guidance, students:</p> <p>- identify evidence to support the significance technological advances including the development of microscopes, in the accumulation of knowledge about cells and in the development of the cell theory.</p> <p>Individually, students:</p> <p><i>- revise their timeline to include technological advances that have contributed to the development of the cell theory</i> <i>- make and justify a conclusion about the impact on the development of the cell theory of advances in technology. (P1, P13, P14)</i></p> <p>Focus Activity Task 1 Working as a project team, students:</p> <p>- develop an appropriate project plan for undertaking the focus activity with timelines and identified team roles and responsibilities - review the collated and acknowledged data and information they have used in this section of the module - select and use an appropriate format to prepare a summary of the investigation methods used in this section and how these have contributed to their understanding of cells and the cell theory. (P15)</p> <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.3.2 Membranes around cells provide separation from and links with the external environment

8.3.2 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 there is movement of molecules into and out of cells</p> <p>*identify the major groups of substances found in living cells and their uses in cell activities</p> <p>*plan, choose equipment or resources and perform a first-hand investigation to gather information and use available evidence to identify the following substances in tissues:</p> <ul style="list-style-type: none"> – glucose – starch – lipids – proteins – chloride ions – lignin 		<p>Students:</p> <p>11.2 plan first-hand investigations to:</p> <p>d) design and trial procedures to undertake investigations and explain why a procedure, a sequence of procedures or repetition of procedures is appropriate</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>a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation</p> <p>b) carrying out a risk assessment of intended experimental procedures and identifying and addressing potential hazards</p>	<p>Introductory Activity: reviewing prior learning</p> <p>Individually or in pairs, students:</p> <ul style="list-style-type: none"> - use secondary sources to construct working definitions of the terms ‘tissue’, ‘atom’ and ‘molecule’ (5.7.2a), giving appropriate examples - brainstorm and list the substances required by multicellular organisms for the processes of respiration and photosynthesis (4.8.4d) - recall that molecules of required substances move into cells and molecules of waste substances move out of cells (4.8.1c). <p>Practical Investigation: identifying substances in living tissue</p> <p>In project teams, students:</p> <ul style="list-style-type: none"> - use teacher-selected secondary sources to identify and record: <ul style="list-style-type: none"> o the main groups of substances found in living cells and their uses in cell activities o examples of substances within these groups o procedures that could be used to identify glucose, starch, lipids, proteins, chloride ions and lignin - with teacher guidance, develop a plan for a first-hand investigation to identify these substances in tissues by: <ul style="list-style-type: none"> o identifying and assessing risks in order to minimise potential hazards in the procedures o identifying and setting up appropriate equipment o trialling the procedures o demonstrating the use of a control o predicting issues that may arise and identifying strategies to address these issues <p>- work efficiently as a team to:</p> <ul style="list-style-type: none"> o carry out the procedures safely making modifications where necessary, recording results and disposing of waste materials safely.

8.3.2 Module Content (Columns 2 and 3)	Reg.	8.1 Skills Content	Suggested Learning–Teaching Experiences and Evidence of Learning*
Students learn to/students:		<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>b) efficiently undertaking the planned procedure to minimise hazards and wastage of resources</p> <p>c) disposing carefully and safely of any waste materials produced during the investigation</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>e) assess the reliability of first-hand and secondary information and data by considering information from various sources</p> <p>14.1 analyse information to:</p> <p>d) predict outcomes and generate plausible explanations related to the observations</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>In project teams, students:</p> <ul style="list-style-type: none"> - construct a table to summarise the information and data collected during the investigation including: <ul style="list-style-type: none"> o name of the substance tested o outline of the procedure used in its identification o the result that indicates the presence of the substance o use of the substance in cell activities o organelles and tissues in which each substance is likely to be found. (P6, P11, P13. P14) <p>Individually or in teams, students:</p> <ul style="list-style-type: none"> - assess the reliability of the first-hand information/data gathered with other resources - summarise the uses and likely location in plant and/or animal cells of glucose, starch, lipids, proteins, chloride ions and lignin. <p>Introductory Activity: observing examples of diffusion</p> <p>In a class activity, students:</p> <ul style="list-style-type: none"> - observe demonstrations of the process of diffusion in liquids and in air to review their ideas about particle movement in fluids (4.7.1a) - list everyday examples of where diffusion occurs - draw a diagram to illustrate their understanding of diffusion in terms of increased particle movement as a result of a concentration gradient .

8.3.2 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: *perform a first-hand investigation to demonstrate the difference between osmosis and diffusion</p> <p>*compare the processes of diffusion and osmosis</p> <p>*perform a first-hand investigation to demonstrate the effect of surface area to volume ratio on rate of diffusion</p>		<p>Students: 12.1 perform first-hand investigations by: a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments d) identifying and using safe work practices during investigations 12.2 gather first-hand information by: b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate</p> <p>12.1 perform first-hand investigations by: b) efficiently undertaking the planned procedure to minimise hazards and wastage of resources d) identifying and using safe work practices during investigations 12.4 process information to: b) apply mathematical formulae and concepts 14.1 analyse information to: a) identify trends, patterns and relationships as well as contradictions in data and information b) justify inferences and conclusions</p>	<p>Practical Investigation: how are the processes of diffusion and osmosis similar or different? In pairs, with limited teacher guidance, students: - devise and use an appropriate procedure to demonstrate diffusion in a liquid and record observations - follow a procedure using dialysis tubing to demonstrate diffusion of water (osmosis) and other substances through a membrane - identify risks and use safe work practices during the investigations - make, record and compare observations and measurements over a number of trials - use information collected from demonstrations, discussion and investigations, to construct a table and/or written description to compare the processes of diffusion and osmosis.</p> <p>Practical Investigation: how does surface area-to-volume ratio effect rate of diffusion? In project teams, students: - review a teacher-selected and planned procedure to determine effect of surface area-to-volume ratio on the rate of diffusion - identify how hazards can be minimised and resources conserved - follow the recorded procedure and safely perform the investigation, gather data, make and record observations and measurements accurately using the correct units - write a report that includes the question being tested, the procedure used, the results collected and analysis of the results that includes: <ul style="list-style-type: none"> ○ identifying the trend in the data collected between surface area to volume ratio and rate of diffusion ○ an outline of the relationship between surface area to volume ratio and rate of diffusion, justifying the conclusion reached ○ a relationship between surface area to volume and rate of movement of substances into and out of cells ○ an appropriate mathematical model to make predictions about the surface area-to-volume ratio of objects and organisms of other shapes and sizes ○ a conclusion that relates to the question being tested. </p>

8.3.2 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>*explain how the surface area to volume ratio affects the rate of movement of substances into and out of cells</p>		<p>Students:</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: f) use models, including mathematical ones, to explain phenomena and/or make predictions h) identify examples of the interconnectedness of ideas or scientific principles</p> <p>14.3 use available evidence to: d) formulate cause and effect relationships</p> <p>14.2 solve problems by b) describing and selecting from different strategies those which could be used to solve a problem c) using identified strategies to develop a range of possible solutions to a particular 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>Individually, students:</p> <ul style="list-style-type: none"> - recall the size of cells (refer 8.3.1) and predict in general terms their relative surface area to volume ratio - select and use relevant data from their investigation to: - <i>present a written report that uses their understanding of the particle model of matter and surface area to volume ratio to explain the movement of substances (including water) into and out of cells by diffusion and relate this to the current model of membrane structure. (P3, P6, P14)</i> <p>Focus Activity Task 2</p> <p>Working as a project team, students:</p> <ul style="list-style-type: none"> - select and use an appropriate format to prepare a summary of the investigation methods they used in this section and how these have contributed to their understanding of cells and their functioning - monitor team progress towards completion of the project. (P15) <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.3.3 Plants and animals have specialised structures to obtain nutrients from their environment

8.3.3 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>*identify some examples that demonstrate the structural and functional relationships between cells, tissues, organs and organ systems in multicellular organisms</p> <p>*distinguish between autotrophs and heterotrophs in terms of nutrient requirements</p> <p>*identify the materials required for photosynthesis and its role in ecosystems</p> <p>*identify the general word equation for photosynthesis and outline this as a summary of a chain of biochemical reactions</p> <p>*explain the relationship between the shape of leaves, the distribution of tissues in them and their role</p>		<p>Students:</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>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>12.4 process information to:</p> <p>b) apply mathematical formulae and concepts</p>	<p>Introductory Activity: reviewing prior learning</p> <p>In pairs, using a range of secondary sources, students:</p> <ul style="list-style-type: none"> - recall examples of systems in multicellular organisms and identify the structural and functional relationships between cells, tissues and organs within that system (4.8.4d,e; 4.8.5a; 5.8.1a) - on the concept map started in 8.3.1 include information to show the relationships between cells, tissues, organs and organ systems in multicellular organisms, giving appropriate examples. <p>Individually or in pairs, students:</p> <ul style="list-style-type: none"> - select and use a range of resources to define the terms ‘nutrient’, ‘autotroph’ and ‘heterotroph’ - classify organisms within a list as autotroph or heterotroph - identify that the majority of autotrophs obtain nutrients through the process of photosynthesis - clarify the differences between autotrophs and heterotrophs in terms of nutrient requirements. <p>Practical Investigation: what is the relationship between the role of the leaf, its shape and tissue distribution?</p> <p>In a teacher-guided group or class discussion, students:</p> <ul style="list-style-type: none"> o recall the role of leaves as the main site of photosynthesis (4.8.4e) o recall the materials required by plants for photosynthesis and write the general word equation for photosynthesis o explain the importance of this process in ecosystems (4.10c; 5.10b). <p>With teacher guidance, students:</p> <ul style="list-style-type: none"> - recall the purpose of and review the features and construction of a flowchart - draw a flowchart to outline the chain of biochemical reactions that make up the process of photosynthesis - identify that glucose formed in photosynthesis is converted almost immediately into starch. <p>In project teams with teacher guidance, students:</p> <ul style="list-style-type: none"> - determine the surface area-to-volume ratio of a variety of leaves of different shapes, and relate the surface area-to-volume ratio to the role of the leaf in absorption of light and gases - use prepared slides, models and/or diagrams to examine the

8.3.3 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>*explain the relationship between the organisation of the structures used to obtain water and minerals in a range of plants and the need to increase the surface area available for absorption</p> <p>*perform a first-hand investigation to demonstrate the relationship between surface area and rate of reaction</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>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>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>b) best illustrate trends and patterns by selecting and using appropriate methods, including computer-assisted analysis</p>	<p>Practical Investigation: does surface area affect absorption of water and minerals in plants?</p> <p>Individually, students:</p> <ul style="list-style-type: none"> - recall the role of roots in absorption of water and minerals - describe the advantage of increased surface area of structures for absorption of materials - examine a variety of plant structures used to obtain water and minerals, eg fibrous roots, root hairs, moss ‘leaves’, Elodea leaves - construct a table or summary that explains the relationship between the organisation of the structures used in a range of plants and the surface area from which water and minerals can be absorbed. <p>Practical Investigation: what is the relationship between surface area and rate of reaction?</p> <p>In pairs, students:</p> <ul style="list-style-type: none"> - safely perform a teacher-planned procedure to determine the effect of increasing surface area on the rate of a chemical reaction (eg determining the rate of gas production from a reaction between hydrochloric acid and marble chips or water on Alka Seltzer tablets when the mass of the solid is kept the same but the surface area is increased) - gather data, accurately making and recording observations - graph the data to identify trends and patterns, if possible using computer-assisted analysis - analyse the results of the investigation and draw a valid conclusion.

8.3.3 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: *describe the role of teeth in increasing the surface area of complex foods for exposure to digestive chemicals</p> <p>*identify data sources, gather, process, analyse and present information from secondary sources and use available evidence to compare the digestive systems of mammals, including a grazing herbivore, carnivore and a predominantly nectar feeding animal</p>		<p>Students:</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>d) formulate cause and effect relationships</p> <p>11.1 identify data sources to</p> <p>a) analyse complex problems to determine appropriate ways in which each aspect may be researched</p> <p>12.3 gather information from secondary sources by:</p> <p>b) practising efficient data collection techniques to identify useful information in secondary sources</p> <p>12.4 process information to:</p> <p>d) evaluate the relevance 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>a) selecting and using appropriate text types, or combinations thereof, for oral and written presentations</p> <p>c) selecting and using appropriate formats to acknowledge sources of information</p>	<p>With teacher guidance, students:</p> <ul style="list-style-type: none"> - recall the role of the mammalian digestive system (4.8.5a) in physically and chemically breaking food down into small molecules that can be easily absorbed and made available to cells - observe a demonstration and/or use models to identify the role and the features of teeth that enable them to increase the surface area of complex foods - predict how increasing the surface area of complex foods would effect exposure to digestive chemicals. <p>Individual Research Activity: <i>prepare a written report from secondary sources to compare the digestive systems of some mammals, including a grazing herbivore, a carnivore and a predominantly nectar feeding animal.</i></p> <p>In a teacher-guided class activity, students:</p> <ul style="list-style-type: none"> - review the individual research activity and discuss possible strategies to determine the most appropriate ways in which each aspect could be approached. <p>Individually, students:</p> <ul style="list-style-type: none"> - <i>gather and evaluate the relevance of data and information collected from a range of teacher-identified resources about the digestive systems of the selected mammals</i> - <i>assess the reliability of the data gathered by comparing it with data from other sources</i> - <i>select and use an appropriate format to acknowledge useful information gathered</i> - <i>present a written report in an appropriate format which summarises the information gathered and includes the following:</i> <ul style="list-style-type: none"> ○ <i>outlines similarities and differences between the three different types of systems</i> ○ <i>identifies the chemical composition of the diet of a named vertebrate herbivore and a named vertebrate carnivore</i> ○ <i>identifies the main organs within the digestive system of each of the animals mentioned above and the functions of these organs</i> ○ <i>compares the length and overall complexity of these two</i>

8.3.3 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: *explain the relationship between the length and overall complexity of digestive systems of a vertebrate herbivore and a vertebrate carnivore with respect to: -the chemical composition of their diet -the functions of the structures involved</p>		<p>Students:</p> <p>14.1 analyse information to: g) use cause and effect relationships to explain phenomena h) identify examples of the interconnectedness of ideas or scientific principles</p> <p>14.2 solve problems by: c) using identified strategies to develop a range of possible solutions to a particular 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</p>	<p><i>digestive systems</i> - <i>explains the relationship between the length and overall complexity of the digestive systems of a vertebrate herbivore and a vertebrate carnivore with respect to:</i></p> <ul style="list-style-type: none"> ○ <i>the chemical composition of the diet</i> ○ <i>the functions of the structures involved.</i> (P3, P6, P12,P13, P14) <p>Focus Activity Task 3 Working as a project team, students: - prepare a summary of the methods they used in this section to gather, process, analyse and assess reliability of information and data and how the information has increased their understanding of cells in the functioning of a multicellular organism - monitor team progress towards completion of the project. (P15)</p> <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.3.4 Gaseous exchange and transport systems transfer chemicals through the internal and between the external environments of plants and animals

8.3.4 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>*compare the roles of respiratory, circulatory and excretory systems</p> <p>*explain the relationship between the requirements of cells and the need for transport systems in multicellular organisms</p> <p>*identify and compare the gaseous exchange surfaces in an insect, a fish, a frog and a mammal</p> <p>*outline the transport system in plants, including:</p> <ul style="list-style-type: none"> - root hair cells - xylem - phloem - stomates and lenticels 		<p>Students:</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>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: reviewing prior learning</p> <p>In a think–pair–share activity, using appropriate resources, students:</p> <ul style="list-style-type: none"> - recall the roles of the respiratory, circulatory and excretory systems (4.8.4b,c; 4.8.5a; 5.8.1a) - identify and tabulate similarities and differences between the roles of these three systems - recall the requirements of cells and propose reasons why transport systems are needed in most multicellular organisms - use notes taken during the discussion to prepare a summary that records the role of transport systems and explains the relationship between the requirements of cells and the need for transport systems in multicellular organisms. <p>Individually, students:</p> <ul style="list-style-type: none"> - use teacher-selected resources to identify the feature of gaseous exchange surfaces in an insect, a fish, a frog and a mammal - select and use an appropriate format to present a comparison of the gaseous exchange surfaces in an insect, a fish, a frog and a mammal. <p>Practical Investigations: observing the structure of plant transport systems</p> <p>With teacher guidance, students:</p> <ul style="list-style-type: none"> - recall the gaseous inputs and outputs from plants and animals, relating them to the processes of respiration and photosynthesis - identify the role of the root, stem and leaf in maintaining flowering plants as functioning organisms - draw labelled diagrams to show the identified features of root hair cells, xylem, phloem, stomates and lenticels using living material, prepared slides, photomicrographs, electron micrographs, models or diagrams - identify the roles of each of these structures in terms of gaseous exchange or transport in plants - prepare a written summary, table or pictorial representation that outlines the main features of transport systems in flowering plants, including mention of the structures observed.

8.3.4 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: *perform a first-hand investigation of the movement of materials in xylem or phloem</p> <p>*use available evidence to perform a first-hand investigation and gather first-hand data to identify and describe factors that affect the rate of transpiration</p> <p>*use available evidence to discuss, using examples, the role of technologies, such as the use of radioisotopes in tracing the path of elements through living plants and animals</p>		<p>Students: 12.1 perform first-hand investigations by: a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments d) identifying and using safe work practices during investigations 12.2 gather first-hand information by: b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate 14.1 analyse information to: b) justify inferences and conclusions</p> <p>12.3 gather information from secondary sources by: a) accessing information from a range of resources, including popular scientific journals, digital technologies and the internet b) practising efficient data collection techniques to identify useful information in secondary sources 12.4 process information to: e) assess the reliability of first-hand and secondary information and data by considering information from various sources</p>	<p>Practical Investigation: how do materials move in the transport system of plants? In project teams, students: - review a teacher-planned procedure to identify factors that affect the rate of transpiration of a flowering plant and identify potential hazards with the equipment - carry out the recorded procedure, using safe work practices, minimising hazards and wastage of resources - make measurements and observations and record results in a appropriate form that can be accessed by the class. Carry out repeat trials as appropriate. In a class discussion, students: - compare results and prepare a description of factors that affect the rate of transpiration of a flowering plant.</p> <p>In project teams, students: - access information from print and online resources to identify, with examples, the role of technologies, such as radioisotopes in tracing the path of elements through living plants and animals - assess the reliability of the secondary sources used by determining the origin of the sources and comparing information derived from them - compare the use of radioisotope tracers with the procedure used in their practical investigation to trace the movement of materials in xylem - summarise points for and against the use of radioisotopes as tracers in plants.</p>

8.3.4 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>*compare open and closed circulatory systems using one vertebrate and one invertebrate as examples</p>		<p>Students:</p> <p>11.3 choose equipment or resources by: d) recognising the difference between destructive and non-destructive testing of material and analysing the potentially different results of these two procedures</p> <p>13.1 present information by: a) selecting and using appropriate text types, or combinations thereof, for oral and written presentations</p> <p>14.1 analyse information to: b) justify inferences and conclusions e) make and justify generalisations h) identify examples of interconnectedness of ideas or scientific principles</p> <p>14.2 solve problems by: c) using identified strategies to develop a range of possible solutions to a particular 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 the consideration of predictions, hypotheses and the results of investigations</p>	<p>In a teacher-led class discussion, students:</p> <ul style="list-style-type: none"> - distinguish between destructive and non-destructive testing - suggest examples of some investigations in which non-destructive testing would be possible and appropriate - propose how the results of destructive and non-destructive testing would potentially differ. <p>Individually or in pairs, students:</p> <ul style="list-style-type: none"> - select and use an appropriate text type to write an account that distinguishes the features of open circulatory systems of a named invertebrate from those of the closed system of a named vertebrate <p>In an individual reflective activity, students:</p> <ul style="list-style-type: none"> - <i>construct an appropriate pictorial representation (eg flow chart, diagram or mind map) to illustrate the way in which gaseous exchange and transport systems transfer chemicals through the internal and between the internal and external environments of plants and animals</i> - <i>revise their concept map (8.3.1) to include information relating to plant and animal tissues, organs and systems. (P6, P13, P14)</i> <p>Focus Activity Task 4</p> <p>Working as a project team, students:</p> <ul style="list-style-type: none"> - prepare a summary of the methods they used in this section and how the information has increased their understanding of cells in the functioning of a multicellular organism - monitor team progress towards completion of the project. (P15) <p><i>*Suggested Evidence of Learning Activities are in italics.</i></p>

8.3.5 Maintenance of organisms requires growth and repair

8.3.5 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>*identify that nuclei, mitochondria and chloroplasts contain DNA</p> <p>*identify mitosis as a process of nuclear division and explain its role</p> <p>*identify the sites of mitosis in plants, insects and mammals</p> <p>*explain the need for cytokinesis in cell division</p> <p>*perform a first-hand investigation using a microscope to gather information from prepared slides to describe the sequence of changes in the nucleus of plant or animal cells undergoing mitosis</p>		<p>Students:</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>b) practising efficient data collection techniques to identify useful information in secondary sources</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>11.3 choose equipment or resources by:</p> <p>a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation</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>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: reviewing prior learning</p> <p>Individually, students:</p> <ul style="list-style-type: none"> - recall that information is transferred as DNA on chromosomes when cells divide (5.8.2) and draw a diagram to show the relationship between DNA, chromosomes and genes - outline the role of cell division in growth, repair and reproduction in multicellular organisms (5.8.1). <p>Using teacher-selected resources, students:</p> <ul style="list-style-type: none"> - identify that DNA is contained in the nuclei, mitochondria and chloroplasts - outline information about the research of a named Australian scientist working on mitochondrial or chloroplast DNA. <p>In a class activity, using audiovisual resources, students:</p> <ul style="list-style-type: none"> - summarise the sequence of changes in the nucleus of plant or animal cells undergoing mitosis - distinguish between mitosis and cytokinesis - identify sites of mitosis in plants, insects and mammals. <p>Practical Investigation: what changes can be observed in cells undergoing mitosis?</p> <p>Individually, students:</p> <ul style="list-style-type: none"> - <i>follow a teacher-provided procedure to set up and correctly use a light microscope to view prepared slides of plant and/or animal cells at different points of nuclear division by mitosis</i> - <i>use first-hand data and information gathered from secondary sources as a guide to identify, draw and correctly sequence labelled diagrams of cells at various points of division (no stage names are required)</i> - <i>prepare a summary that explains the role of mitosis and cytokinesis in cell division, including:</i> <ul style="list-style-type: none"> o <i>where, when and how each occur</i> o <i>the reason why cytokinesis occurs in cell division</i> o <i>their significance in growth, repair and reproduction.</i> <p>(P6, P12, P13, P14)</p>

8.3.5 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 which could be used to solve a problem d) evaluating the appropriateness of different strategies for solving an identified problem 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	Focus Activity Task 5 Working as a project team, students: - complete the production of their magazine article - submit the magazine article and their individual logbooks - give a short presentation that evaluates the process used by the team and the effectiveness of the team in completing the task. (P15) <i>*Suggested Evidence of Learning Activities are in italics.</i>

Overview of Skills Development Module 8.3 – Patterns in Nature

Knowledge and Understanding	Skill Development		Skills Content Reference
8.3.1 Organisms are made of cells that have similar structural characteristics	P11 identifies and implements improvements to investigation plans	L	11.1c,d; 11.3a,b
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	L/P	12.1a,b,d; 12.3a,b,c,d; 12.4e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science	L/P	13.1c,e
	P14 draws valid conclusions from gathered data and information	P	14.1b,c,h; 14.2a,b; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	L	
8.3.2 Membranes around cells provide separation from and links with the external environment	P11 identifies and implements improvements to investigation plans	P	11.2d,e; 11.3a,b
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P	12.1a,b,c,d; 12.2b; 12.3b;12.4b,e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Biology	P	13.1d,e
	P14 draws valid conclusions from gathered data and information	P	14.1a,b,d,f,g,h; 14.2b,c; 14.3c,d
	P15 implements strategies to work effectively as an individual or as a member of a team	L/P	
8.3.3: Plants and animals have specialised structures to obtain nutrients from their environment	P11 identifies and implements improvements to investigation plans	P	11.1a; 11.2a,b; 11.3a
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P	12.1a,d; 12.2b; 12.3a,b,d; 12.4b,d,e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Biology	P/A	13.1a,c,e
	P14 draws valid conclusions from gathered data and information	P	14.1g,h; 14.2c,d; 14.3c,d
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	
8.3.4: Gaseous exchange and transport systems transfer chemicals through the internal and between the external environments of plants and animals	P11 identifies and implements improvements to investigation plans	P/A	11.3d
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P/A	12.1a,d; 12.2a,b; 12.3a,b; 12.4e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Biology	P/A	13.1a,e
	P14 draws valid conclusions from gathered data and information	P/A	14.1a,b,e,h; 14.2c,d; 14.3c
	P15 implements strategies to work effectively as an individual or as a member of a team	P/A	

8.3.5: Maintenance of organisms requires growth and repair	P11 identifies and implements improvements to investigation plans	P/A	11.3a
	P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources	P/A	12.1a; 12.3a,b,e
	P13 identifies appropriate terminology and reporting styles to communicate information and understanding in Biology	P/A	13.1e
	P14 draws valid conclusions from gathered data and information	P/A	14.2b,d; 14.3a,b
	P15 implements strategies to work effectively as an individual or as a member of a team	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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