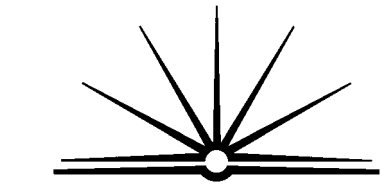

Science
Years 7–10

Advice on Programming and Assessment

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1 Introduction

This support document has been designed to help teachers understand key aspects of the new *Science Years 7–10 Syllabus* (Nov 2003) and to provide guidance for implementation. The document shows how these aspects can be incorporated in teaching and learning programs, and how these programs are underpinned by the principles of *assessment for learning* (*Science Years 7–10 Syllabus*, p 70).

The document provides advice about constructing a program that will cover the scope of Science for a stage. It sets out a process for planning and sequencing units of work, and developing teaching and learning activities.

The sample stage scope and sequence plans and sample lesson sequences in this document demonstrate ways in which teachers can build a teaching and learning program and develop units of work to ensure coverage of the scope of the syllabus.

The document contains sample lesson sequences from two units of work:

Stage 4 unit: Living Things
This lesson sequence focuses on developing students' knowledge and understanding of the characteristics of vertebrates through gathering, processing and presenting information from first-hand investigations and secondary sources.

Stage 5 unit: Our Changing Earth
This lesson sequence demonstrates how students develop their knowledge and understanding of fossil formation and interpretation of fossil evidence through their application of research skills.

These sample lesson sequences can be used as models for planning units of work. They include:

- relevant outcomes and content
- assessment activities that have been designed and integrated into the units of work
- different types of possible feedback
- a variety of teaching and learning experiences
- information about opportunities for student reflection.

An *assessment for learning* activity from each unit has been selected to show how assessment can fit into teaching and learning sequences. They are described in some detail to illustrate the process of *assessment for learning*. Teachers would not provide this level of detail in day-to-day classroom situations. The lesson sequences and activities may be modified or amended to suit the needs, interests and abilities of students.

For a small percentage of students with special education needs who are undertaking Life Skills outcomes and content, support materials will be provided which will assist in the development of a meaningful and relevant program of study related to the *Science Years 7–10 Syllabus*. Units of work adapted for students undertaking Science Life Skills will be included in a consolidated document that is expected to be in schools during Semester 2, 2004.

2 Establishing a Scope and Sequence Plan

The fundamental step in the design of effective teaching and learning programs is the establishment of a program overview with a scope and sequence plan. When developing this plan teachers should consider the following:

Syllabus requirements
The *Science Years 7–10 Syllabus* has been designed to be realistically addressed by typical students in an indicative time of 400 hours. When developing a draft scope and sequence the following syllabus requirements need to be met:

- each unit of work must include content related to Contexts, Prescribed Focus Areas and Domain
- all Prescribed Focus Areas must be addressed each year
- each unit of work must address at least one Prescribed Focus Area
- all knowledge and understanding outcomes and essential content is addressed within the appropriate stage
- the selected Prescribed Focus Area and skills essential content is appropriate to achieve the relevant Stage 4 or Stage 5 outcomes
- a minimum of 50% of course time must be allocated to practical experiences
- students are required to undertake at least one substantial research project during each of Stage 4 and Stage 5. At least one Stage 5 project will be an individual task.

Flexibility
To best meet students' specific needs and circumstances programs should be designed to:

- include contexts that are relevant to the needs and interests of their students and are sensitive and appropriate to community expectations
- integrate Prescribed Focus Area and skills content across stages at a developmentally appropriate time for students. The essential content in the Prescribed Focus Areas and skills reflects the knowledge, understanding and skills students should be able to demonstrate by the end of Stage 5
- where appropriate, draw on additional content from the syllabus or content developed by schools to reflect local needs and interests.

Further considerations
When developing a unit sufficient information should be provided to allow:

- a range of contexts to be used across the stage including those that build on relevant school events such as Australian Science in Schools Week
- opportunities within and across units of work for students to integrate and apply concepts from more than one science discipline
- the explicit and ongoing development of Prescribed Focus Area and skills content within and across Stage 4 and Stage 5
- OHS regulations and guidelines, eg Chemical Safety in Schools and Animal Welfare Guidelines for Teachers to be addressed.

Planning the teaching-learning program involves a number of interrelated activities including:

Drafting a program overview
An example of a program overview for Years 7–10 is provided in section 2.1. It details the placement, sequence and duration of possible units.

Identifying the possible outcomes for each proposed unit
The sample scope and sequence plans presented in sections 2.2.1 and 2.2.2 provide examples of ways in which outcomes could be mapped for each unit of work in a Stage 4 and Stage 5 program.

Mapping the essential content for the outcomes in each proposed unit
The content mapping grids provided in sections 2.3.1 and 2.3.2 show only a sample of essential content within and across units of work in Stage 4 and Stage 5, to demonstrate:

- the integration of essential content from Prescribed Focus Area, knowledge, understanding and skills
- the developmental nature of knowledge, understanding and skills content of the Prescribed Focus Area and skills outcomes within and across Stage 4 and 5
- a process for recording how explicit and systematic teaching-learning experiences would be used in each unit of work to develop the skills content.

On the content mapping grids the Prescribed Focus Area and skills learning experiences are broadly classified into one of three developmental levels. In the learning phase (L) the teacher establishes the students 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 units of work the learning experiences in programs can be evaluated and modified to ensure that in addressing the essential content of the syllabus there is a continuum in the development of the Prescribed Focus Areas and skills content within and across stages.

Programming units of work
Teachers will choose to develop the teaching-learning units in different ways. These could include:

- using units written for the current syllabus as the starting points, evaluating and revising them in relation to the requirements of the *Science Years 7–10 Syllabus*
- evaluating and revising some current units and designing other new units
- designing completely new units for the whole program.

Programming is discussed in more detail in section 4.

Adjusting and amending the teaching-learning program
Planning and programming is a dynamic process. During the development of the teaching-learning units there needs to be some flexibility for making adjustments to the content mapping grids. Teacher reflection and evaluation of student learning during and following teaching of lesson sequences and/or a unit of work will not only result in amendments to the program but also to the scope and sequence plan and content mapping grids.

Together, the program overview, scope and sequence plans and the content mapping grids provide a means by which teachers can ensure that the teaching-learning program established by the school addresses all syllabus requirements.

2.1 Program Overview

This overview provides a key for mapping the unit numbers against the following sample scope and sequence plans and content mapping grids. The shaded areas on the overview and the following mapping grids identify the units for which sample lesson sequences have been developed in this document.

<table>
<tr><th></th><th>Term 1</th><th>Term 2</th><th>Term 3</th><th>Term 4</th></tr>
<tr><td>Year 7</td><td>1
Scientists at Work</td><td>2
Living Things</td><td>3
Energy Changes Things</td><td>4
Planet Earth</td></tr>
<tr><td rowspan="2">Year 8</td><td>1
Our Local Environment</td><td>2
Forces</td><td>3
Changing Matter</td><td>4
Plants</td><td>5
The Solar System</td></tr>
<tr><td colspan="3"></td><td colspan="2">Student Research Project</td></tr>
<tr><td rowspan="2">Year 9</td><td colspan="2" rowspan="2">1
Our Changing Earth</td><td>2
Chemical Reactions</td><td>3
Electrical Energy</td><td rowspan="2">4
Cells and Life</td></tr>
<tr><td colspan="2">Student Research Project</td></tr>
<tr><td>Year 10</td><td colspan="2">1
Atomic Theory</td><td>2
Evolution</td><td>3
Energy, Force and Motion</td><td>4
The Universe</td></tr>
</table>

2.2 Sample Stage Scope and Sequence Plans

2.2.1 Sample Stage 4 Scope and Sequence Plan

The following scope and sequence plans model how syllabus outcomes can be mapped for units of work across a stage. By mapping all units of work schools would ensure that teaching-learning programs meet the mandatory requirements of the syllabus. Templates for these grids including the Values and Attitudes outcomes will be provided in electronic form on the Science Years 7–10 support CD-ROM, *Assessment for Learning in a Standards-referenced Framework.*

Stage 4 Outcome		A student: Unit	Year 7				Year 8				
			1	2	3	4	1	2	3	4	5
Prescribed Focus Area	4.1	identifies historical examples of how scientific knowledge has changed people's understanding of the world		✓		✓					✓
	4.2	uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena	✓	✓	✓			✓		✓	✓
	4.3	identifies areas of everyday life that have been affected by scientific developments	✓								✓
	4.4	identifies choices made by people with regard to scientific developments			✓		✓				
	4.5	describes areas of current scientific research	✓			✓			✓		
Domain: Knowledge and Understanding	4.6	identifies and describes energy changes and the action of forces in common situations			✓			✓			✓
	4.7	describes observed properties of substances using scientific models and theories	✓		✓				✓		
	4.8	describes features of living things		✓			✓			✓	
	4.9	describes the dynamic structure of Earth and its relationship to other parts of our solar system and the universe				✓					✓
	4.10	identifies factors affecting survival of organisms in an ecosystem					✓			✓	
	4.11	identifies where resources are found, and describes ways in which they are used by humans	✓		✓	✓			✓		
	4.12	identifies, using examples, common simple devices and explains why they are used		✓	✓			✓			
Domain: Skills	4.13	clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem	✓		✓			✓	✓	✓	
	4.14	follows a sequence of instructions to undertake a first-hand investigation	✓	✓	✓		✓	✓	✓		
	4.15	uses given criteria to gather first-hand data	✓		✓	✓	✓	✓	✓	✓	
	4.16	accesses information from identified secondary sources		✓		✓	✓			✓	✓
	4.17	evaluates the relevance of data and information		✓		✓	✓		✓		✓
	4.18	with guidance, presents information to an audience to achieve a particular purpose		✓		✓	✓				✓
	4.19	draws conclusions based on information available		✓	✓	✓		✓	✓		✓
	4.20	uses an identified strategy to solve problems	✓		✓		✓	✓		✓	
	4.21	uses creativity and imagination to suggest plausible solutions to familiar problems		✓	✓		✓		✓	✓	
	4.22	undertakes a variety of individual and team tasks with guidance	✓		✓		✓	✓		✓	

2.2.2 Sample Stage 5 Scope and Sequence Plan

Stage 5 Outcome		A student: Unit	Year 9				Year 10			
			1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Prescribed Focus Area	5.1	explains how social factors influence the development and acceptance of scientific ideas	✓				✓			✓
	5.2	describes the processes that are applied to test and validate models, theories and laws	✓	✓					✓	✓
	5.3	evaluates the impact of applications of science on society and the environment			✓		✓	✓	✓	
	5.4	discusses evidence supporting different viewpoints			✓	✓	✓	✓		
	5.5	analyses how current research might affect people's lives				✓		✓		
Domain: Knowledge and Understanding	5.6	applies models, theories and laws to situations involving energy, force and motion			✓				✓	✓
	5.7	relates properties of elements, compounds and mixtures to scientific models, theories and laws		✓			✓			
	5.8	relates the structure and function of living things to models, theories and laws	✓			✓		✓		
	5.9	relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time	✓							✓
	5.10	assesses human impacts on the interaction of biotic and abiotic features of the environment	✓		✓			✓		
	5.11	analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources			✓			✓		
	5.12	relates the interactions involved in using some common technologies to their underlying scientific principles		✓		✓	✓		✓	✓
Domain: Skills	5.13	identifies a problem and independently produces an appropriate investigation plan		✓	✓				✓	✓
	5.14	undertakes first-hand investigations independently with safety and competence			✓		✓		✓	
	5.15	gathers first-hand data accurately		✓	✓		✓		✓	
	5.16	accesses information from a wide variety of secondary sources	✓			✓		✓		✓
	5.17	explains trends, patterns and relationships in data and/or information from a variety of sources	✓	✓	✓			✓	✓	✓
	5.18	selects and uses appropriate forms of communication to present information to an audience	✓			✓	✓	✓		✓
	5.19	uses critical thinking skills in evaluating information and drawing conclusions	✓		✓	✓		✓	✓	✓
	5.20	selects and uses appropriate strategies to solve problems		✓	✓				✓	
	5.21	uses creativity and imagination in the analysis of problems and the development of possible solutions			✓				✓	
	5.22	plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member		✓		✓	✓		✓	

2.3 Sample Stage Content Mapping Grids

2.3.1 Sample Stage 4 Content Mapping Grid

The following content mapping grids demonstrate the development of student 'learn about' and 'learn to' content across a stage in relation to the identified scope and sequence. By mapping all essential content across the stage schools would ensure that teaching-learning programs address all essential knowledge and understanding content in the stage and present a comprehensive and balanced development of the skills and Prescribed Focus Area content. Templates for these grids will be provided in electronic form on the Science Years 7–10 support CD-ROM, *Assessment for Learning in a Standards-referenced Framework.*

Stage 4 *Unit*		**Year 7**				**Year 8**				
Outcome		**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**
4.2 A student uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena										
Essential Content										
4/5.2	Students learn about the nature and practice of science									
e)	Students learn to: use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these	L		L			L/P		L/P	P
f)	give examples that demonstrate the benefits and limitations of using models	L		L	L					L
4.8 A student describes features of living things										
4.8.2	Students learn about classification									
a)	Students learn to: classify living things according to structural features and identify that they have patterns of similarities and differences		✓						✓	
b)	identify a range of plants and animals using simple keys		✓			✓			✓	
4.8.3	Students learn about unicellular organisms									
a)	Students learn to: identify the beneficial and harmful effects that micro-organisms can have on living things and the environment					✓				
4.10 A student identifies factors affecting survival of organisms in an ecosystem										
4.10	Students learn about ecosystems									
a)	Students learn to: describe some adaptations of living things to factors in their environment					✓			✓	
b)	describe, using examples of food chains and food webs from Australian ecosystems, how producers, consumers and decomposers are related					✓				
c)	describe the roles of photosynthesis and respiration in ecosystems								✓	
4.17 A student evaluates the relevance of data and information										
4/5.17	Students learn about processing information									
a)	Students learn to: collate information from a number of sources		L		L/P	P				P
b)	distinguish between relevant and irrelevant information		L		L/P			P		P
c)	check the reliability of gathered data and information by comparing them with observations or information from other sources	L				L/P				P
d)	organise data using a variety of methods including diagrams, tables, spreadsheets and databases	L		L/P	L/P			P		P

Learning → **Practising**

L – Learning P – Practising A – Applying (able to use the skill in unfamiliar contexts) ✓ – Addressed

2.3.2 Sample Stage 5 Content Mapping Grid

Stage 5 *Unit*		**Year 9**				**Year 10**			
Outcome		**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
5.2 A student describes the processes that are applied to test and validate models, theories and laws									
Essential Content									
4/5.2	Students learn about the nature and practice of science								
	Students learn to:								
e)	use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these	P/A	P						A
f)	give examples that demonstrate the benefits and limitations of using models		P					A	A
g)	identify that the nature of observations made depends upon the understanding that the observer brings to the situation	P						A	
5.9 A student relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time									
5.9.4	Students learn about natural events								
	Students learn to:								
a)	identify that geological history can be interpreted from the formation, by sediments, of horizontal layers in which the oldest are at the base and the youngest at the top	✓							
b)	describe conditions under which fossils form	✓							
c)	relate the fossil record to the age of Earth and the time over which life has been evolving	✓							
d)	relate movements of Earth's plates to convection currents in the mantle and to gravitational forces	✓							
e)	explain how interactions at plate boundaries may result in earthquakes, volcanic activity and new landforms	✓							
5.10 A student assesses human impacts on the interaction of biotic and abiotic features of the environment									
5.10	Students learn about ecosystems								
	Students learn to:								
a)	distinguish between biotic and abiotic features of the local environment								
b)	describe the importance of cycles of materials in ecosystems	✓					✓		
c)	describe some impacts of human activities on ecosystems			✓					
5.17 A student explains trends, patterns and relationships in data and/or information from a variety of sources									
4/5.17	Students learn about processing information								
	Students learn to:								
a)	collate information from a number of sources				P/A	A	A		A
b)	distinguish between relevant and irrelevant information			P			A		
c)	check the reliability of gathered data and information by comparing them with observations or information from other sources	P		A		A	A		A
d)	organise data using a variety of methods including diagrams, tables, spreadsheets and databases	P	P	A		A		A	A
e)	critically analyse the accuracy of scientific information presented in mass media				P/A		A		A
f)	identify trends, patterns, relationships and contradictions in data and information	P	P			A		A	

Practising → **Applying**

L – Learning P – Practising A – Applying (able to use the skill in unfamiliar contexts) ✓ – Addressed

3 Advice on Assessment

3.1 Assessment for Learning

The Board's revised syllabuses advocate *assessment for learning*. Assessment that enhances learning recognises that learners use their current understanding to discover, develop and incorporate new knowledge, understanding and skills. *Assessment for learning* helps teachers and students to know if that current understanding is a suitable basis for future learning.

Assessment occurs as an integral part of teaching and learning. Teacher instruction and assessment influence student learning and learning processes. This involves using assessment activities to clarify student understanding of concepts, and planning ways to remedy misconceptions and promote deeper understanding.

Assessment for learning encourages self-assessment and peer assessment. Students can develop and use a range of strategies to actively monitor and evaluate their own learning and the learning strategies they use.

The feedback that students receive from completing assessment activities will help teachers and students decide whether they are ready for the next phase of learning or whether they need further learning experiences to consolidate their knowledge, understanding and skills. Teachers should consider the effect that assessment and feedback have on student motivation and self-esteem, and the importance of the active involvement of students in their own learning.

By integrating learning and assessment, the teacher can choose which aspects of a student's performance to record. These records can be used to monitor the student's progress, determine what to teach next and decide the level of detail to be covered. At key points, such as the end of the year, this information is also available for the teacher to use to form a judgement of the student's performance against levels of achievement. This judgement can be used to inform parents, the next teacher and especially the student, of the student's progress. Consequently, teachers using their professional judgement in a standards-referenced framework are able to extend the process of *assessment for learning* into the assessment of learning.

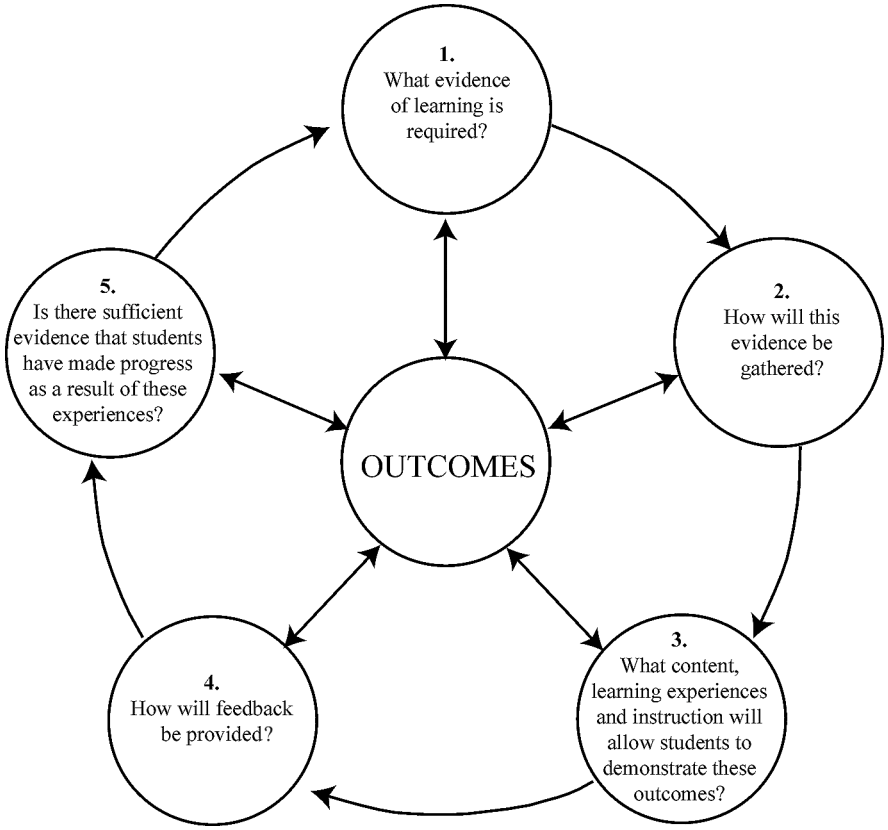
Principles of assessment for learning
Assessment for learning:

AP1 emphasises the interactions between learning and manageable assessment strategies that promote learning
AP2 clearly expresses for the student and teacher the goals of the learning activity
AP3 reflects a view of learning in which assessment helps students learn better, rather than just achieve a better mark
AP4 provides ways for students to use feedback from assessment
AP5 helps students take responsibility for their own learning
AP6 is inclusive of all learners.

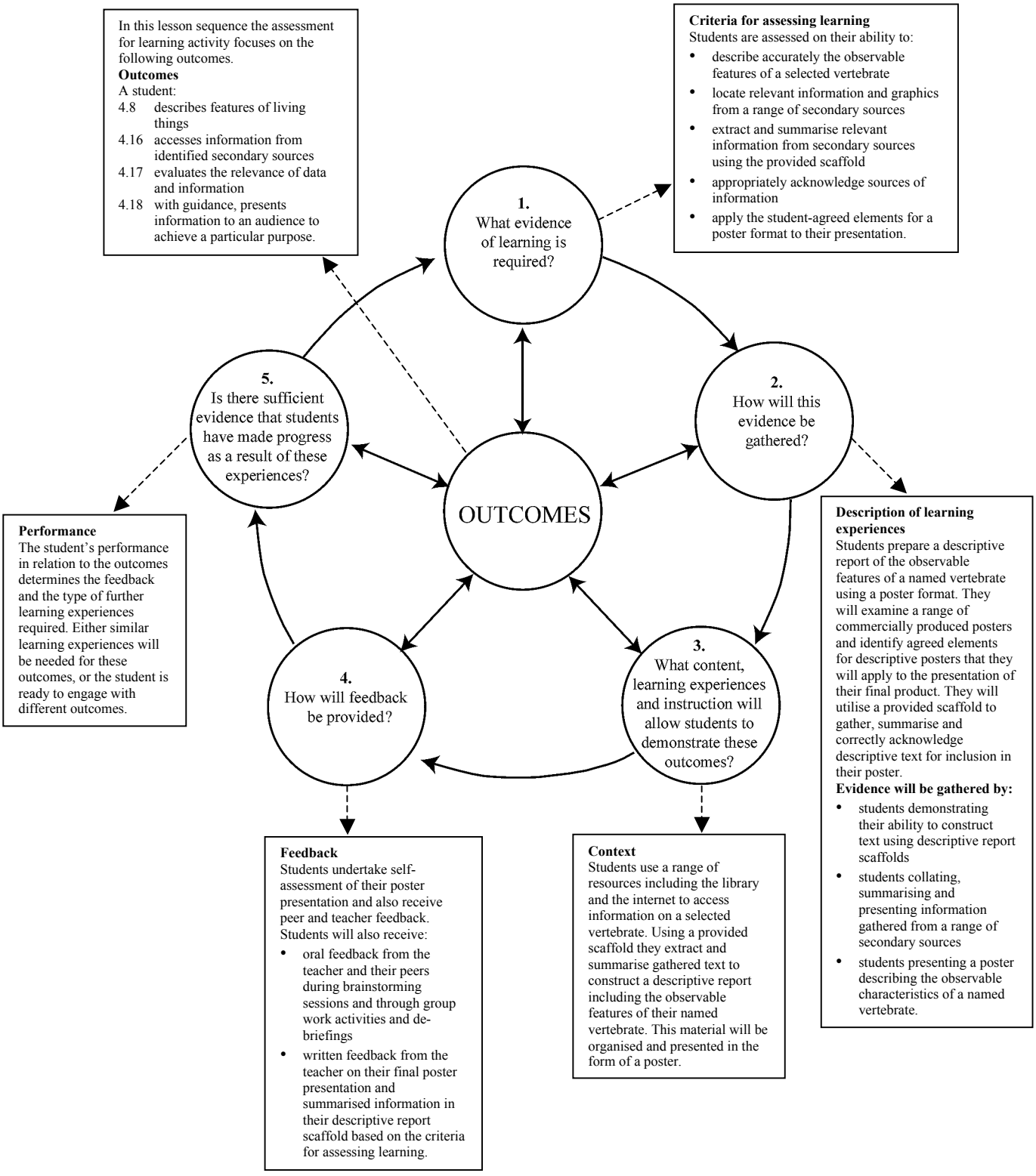
Details on how these principles translate in practice can be found on page 70 of the *Science Years 7–10 Syllabus.* One activity in this document has been annotated to show how the principles of *assessment for learning* feature in that activity. It can be found on page 17.

3.2 Planning for Effective Learning and Assessment

The diagram below summarises a model for integrating learning and assessment. It emphasises that outcomes are central to the decisions teachers make about the learning to be undertaken and the evidence of learning that needs to be collected. This evidence enables teachers to determine how well students are achieving in relation to the outcomes and to provide students with feedback on their learning. Evidence of learning assists teachers and students to decide if students are ready for the next phase of learning or if teachers need to adapt programs to provide further learning experiences to consolidate students' knowledge, understanding and skills.



The diagram below shows how this process has been applied in the design of the sample activity 'Vertebrate Poster' and the sample lesson sequence from the unit Living Things (pages 26–35).



3.3 Designing Effective Learning and Assessment

Designing effective learning experiences requires the selection of activities that develop students' knowledge, understanding and skills and that allow evidence of learning to be gathered. Methods of gathering evidence could include informal teacher observation, questioning, peer evaluation and self-evaluation, as well as more structured assessment activities. Assessment should be an integral part of each unit of work and should support student learning.

When designing assessment activities, teachers should consider whether the activity:

- has explicitly stated purposes that address the outcomes
- is integral to the teaching and learning program
- shows a clear relationship between the outcomes and content being assessed
- allows students to demonstrate the extent of their knowledge, understanding and skills
- focuses on what was taught in class and what students were informed would be assessed
- provides opportunities to gather information about what further teaching and learning is required for students to succeed
- provides valid and reliable evidence of student learning and is fair.

3.4 Annotated Assessment for Learning Activity

The *Assessment for Learning Principles* provide the criteria for judging the quality of assessment materials and practices. The Stage 4 sample assessment activity, 'Vertebrate Poster', has been annotated to show these principles (see page 17).

Sample assessment for learning activity: Vertebrate Poster

Context

In the Year 7 unit Living Things students are introduced to Biology as a branch of science. The unit builds on students' knowledge, understanding
designing, making and using technology. It uses ex
understanding of how historical developments in sc
about cell structure, microscopic and macroscopic
also introduced through their first-hand experience
investigations of making accurate and objective obs

AP 1	The activity forms part of the learning and has clear links to learning goals
AP 1	The activity shows the knowledge, skills and understanding that are being built on
AP 2	The activity clearly indicates the knowledge, skills and/or understanding to be developed
AP 3	The activity models an approach that has the activity as an integral component of the learning

As a component of a unit of work on the classification of living things students learn and practise research skills through gathering and processing information from a range of secondary sources on a selected vertebrate. Using a provided scaffold they summarise gathered text to construct a descriptive report that includes the observable features of their animal. Students will present their collated and summarised descriptive text in a poster. The poster elements have been identified and agreed to by the students based on their observations and discussion around the features of a range of those available commercially.

Outcomes

A student:

4.8 describes features of living things
4.16 accesses information from identified second
4.17 evaluates the relevance of data and information
4.18 with guidance, presents information to an audience to achieve a particular purpose.

AP 1	The activity lists the outcome(s) to be addressed
AP 1	The activity is appropriate for the outcomes being assessed
AP 3	The activity has been designed to target skills and understandings that lead to deeper learning as well as knowledge

Description of activity

Students are to prepare a descriptive report of the observable features of a named vertebrate using a poster format. They will examine a range of commercially produced posters and identify agreed elements for descriptive posters that they will apply to the presentation of their final product. They will utilise a provided descriptive r
correctly acknowledge text for inclusion in their poster

In summarising the information that will form the final
will access information from text and graphics from a
library resources and the internet.

AP 3	The activity models an approach that has the activity as an integral component of the learning
AP 6	The guided nature of the activity allows for a range of student skill levels and is inclusive of all learners

Criteria for assessing learning

(These criteria would normally be communicated to students with the activity.)

Students will be assessed on their ability to:

- describe accurately the observable features of a selected vertebrate
- locate relevant information and graphics from a range of secondary sources
- extract and summarise relevant information from secondary sources using the provided scaffold
- appropriately acknowledge sources of information
- apply the student-agreed elements for a poster format

AP 2	The link between the marking guidelines and/or criteria for judging performance and the outcomes is clear and explicit
AP 2	The activity clearly indicates the knowledge, skills and/or understanding to be developed

Guidelines for marking

The following guidelines for marking show one approach to assigning a value to a student's work. Other approaches may be used that better suit the reporting process of the school. Categories, marks, grades, visual representations or individual comments/notations may all be useful.

Range	A student in this range:
High	• describes accurately the observ… from a variety of sources • uses and correctly acknowledge… the internet, CD-ROM, books, … • presents summarised informati… format
Satisfactory	• describes some observable feat… extracted from sources • uses and acknowledges informa… CD-ROM, print • presents descriptive information… poster format
Progressing	• states some features of a named vertebrate • uses and acknowledges a source of information • with guidance presents information using some of the student-agreed elements for the poster format.

AP 2 The link between the marking guidelines and/or criteria for judging performance and the outcomes is clear and explicit

AP 2 The language of the marking guidelines and/or criteria for judging performance and the outcomes is clear and explicit

AP 2 The activity clearly indicates the knowledge, skills and/or understanding to be developed

AP 4 Marking guidelines and/or criteria for judging performance reflect the nature and intention of the activity and will be expressed in terms of the knowledge and skills demanded by the activity relative to the outcomes, to be gathered and reported

Feedback

Students will undertake self-assessment of their poster presentation and also receive peer and teacher feedback through … the teaching-learning experiences leading to the … ceive oral and/or teacher feedback in relation to:

AP 5 The activity models ways that self-assessment and peer assessment can be used as valid means of assessment

- identification and use of appropriate sources of secondary information relating to the named vertebrate
- techniques for summarising gathered information into a concise description of vertebrate characteristics for the named animal
- their use of the provided report scaffold in gathering relevant information from a range of secondary sources
- methods used to acknowledge sources of information gathered
- use of student-agreed elements for the poster f…

AP 4 Marking guidelines and/or criteria for judging performance enable meaningful and useful information on performance, relative to the outcomes, to be gathered and reported

Future directions

Students will use the posters produced by the class … knowledge and understanding of the variety of ver… and the use of observable characteristics in developing a system of classification of these animals. Through future activities students will, in increasingly unguided situations, practise and apply their skills in extracting and summarising information from secondary sources. Students would apply their skills in identifying data sources, gathering, processing and presenting first-hand information when undertaking the mandatory Student Research Project in Stage 4.

Assessment for Learning Principles

The following table shows some of the criteria that have been used to annotate the *assessment for learning* activity in this document. This list of criteria is not exhaustive, it has been included to provide support in understanding the *assessment for learning* principles. It is not envisaged that teachers will use this table as a checklist each time an assessment activity is developed. However, this could be a valuable tool for use in staff development activities.

Assessment principle 1	Related criteria
The activity emphasises the interactions between learning and manageable assessment strategies that promote learning	• The activity has a clear statement of purpose • The activity lists the outcome(s) to be addressed • The activity is appropriate for the outcomes being assessed • The activity forms part of the learning and has clear links to learning goals • The activity shows the knowledge, skills and understanding that are being built on

Assessment principle 2	Related criteria
The activity clearly expresses for the student and teacher the goals of the learning activity	• The link between the marking guidelines and/or criteria for judging performance and the outcomes is clear and explicit • The language of the marking guidelines and/or criteria for judging performance and the outcomes is clear and explicit • The activity clearly indicates the knowledge, skills and/or understanding to be developed

Assessment principle 3	Related criteria
The activity reflects a view of learning in which assessment helps students learn better, rather than just achieve a better mark	• The activity has the capacity to engage the learner • The activity has been designed to target skills and understandings that lead to deeper learning as well as knowledge • The activity models an approach that has the activity as an integral component of the learning

Assessment principle 4	Related criteria
The activity provides ways for students to use feedback from assessment	• Marking guidelines and/or criteria for judging performance reflect the nature and intention of the activity and will be expressed in terms of the knowledge and skills demanded by the activity • Marking guidelines and/or criteria for judging performance enable meaningful and useful information on performance, relative to the outcomes, to be gathered and reported

Assessment principle 5	Related criteria
The activity helps students take responsibility for their own learning	• The activity models ways that self-assessment and peer assessment can be used as valid means of assessment

Assessment principle 6	Related criteria
The activity is inclusive of all learners	• The activity is inclusive of gender, ethnicity, and a variety of socioeconomic and geographical groupings

3.5 Sharing Learning and Assessment Intentions

Students must be aware of what they need to do to demonstrate evidence of learning. This information could be conveyed informally or formally by the teacher, as appropriate for the learning activity. Students should be informed of the criteria that will be used to assess their learning. They should be clear about the meaning of the language used, and the subject-specific terminology. They also need to be clear about any sources or stimulus material that are appropriate to the activity.

It may be helpful to give students models of good responses and templates, or procedures to help them demonstrate the extent of their knowledge, understanding and skills.

3.6 Effective Feedback to Students

The aim of feedback is to communicate to students how well their knowledge, understanding and skills are developing in relation to the outcomes. Feedback enables students to recognise their strengths and areas for development, and to plan with their teacher the next steps in their learning. They are then given opportunities to improve and further develop their knowledge, understanding and skills.

Teacher feedback about student work is essential for students and is integral to the teaching and learning process. Student self-reflection and peer evaluation can also provide valuable feedback to students. Students should be provided with regular opportunities to reflect on their learning.

Feedback should:
- focus on the activity and what was expected
- be constructive, providing meaningful information to students about their learning
- correct misunderstandings
- identify and reinforce students' strengths and state clearly how students can improve.

Forms of feedback include:
- oral discussion with class, groups or individual students
- written annotations
- general comments to the class about those aspects of the activity in which students excelled and those aspects that still need to be addressed
- examples of good responses
- peer evaluation and self-evaluation.

3.7 Recording Evidence for Assessment

Recording student performance needs to be manageable. Teachers should make decisions about which aspects of student performance in an activity should be recorded, and in what format. The teacher can use this information to ascertain students' progress, what needs to be taught next and to what level of detail, and to form a judgement of student achievement at key points.

Record-keeping should reflect the reporting processes of the school and may take the form of individual comments or notations, marks, grades or visual representations for the activities.

A scale such as the one below may be a useful way to summarise the extent of students' learning. This example shows how individual students performed on the same assessment activity.

Student	Activity – Vertebrate Poster		
A			x
B	x		
C		x	
D	x		
E		x	
F	x		
	Progressing	Satisfactory	High

This method can be adapted to capture evidence of an individual student's strengths and the areas for improvement on various elements of one activity, or the performance of a particular student, class, group or cohort of students, across a range of assessment activities.

4 Programming Units of Work

Programming is the process of selecting and sequencing learning experiences that cater for the diversity of student learning needs in a particular stage. The program should enable students to achieve the outcomes of the *Science Years 7–10 Syllabus*.

The *Science Years 7–10 Syllabus* promotes an approach to programming that has outcomes as the focus. During the planning process a manageable number of outcomes for each unit are identified, and inform the selection of essential content for the units. The outcomes are also central to the decisions on the required evidence of learning.

The lesson sequences provided in the sample units of work have been developed using the following process:

1 Identifying what evidence of learning will be required
It is necessary to identify specific evidence of learning to be observed through the teaching, learning and assessment activities for the unit outcomes. The evidence of learning provides a basis for informing and adjusting the teaching-learning program. It should also enable teachers to make judgements about student achievement in relation to the outcomes and content and provide feedback to students on how to enhance their learning.

2 Determining how evidence of learning will be gathered
In order to collect the desired evidence of learning a range of strategies are selected that will:
- provide valid and reliable evidence of student learning
- enable students to demonstrate the extent of their knowledge, understanding and skills
- provide a balance between informal and formal evidence gathering
- support the learning process and will be manageable within the time allocated to the unit.

3 Designing the learning experiences
Based on the scope and sequence plan, content mapping grids and consideration of factors such as local resources, students' interests, learning history and cultural backgrounds teachers design learning experiences/activities that:
- identify and build upon prior learning to determine future directions for developing students' knowledge, understanding and skills
- are appropriate for the context and content selected for the unit
- are student-centred, meaningful and stimulating, and cater for differing learning styles
- integrate the chosen content from Prescribed Focus Areas, knowledge, understanding and skills
- provide opportunities for explicit and ongoing teaching-learning of Prescribed Focus Area and Domain content
- allow students to provide the required evidence of learning in relation to the outcome being addressed
- integrate *assessment for learning* as part of the teaching-learning process
- provide opportunities for creativity and independent learning.

Each unit of work must include the three elements: Context, Prescribed Focus Area and Domain. The Contexts chosen by the teacher should provide frameworks to assist students to make meaning of the Prescribed Focus Area and Domain. The syllabus identifies that the purpose for which contexts may be chosen include increasing students' motivation, conceptual meaning, scientific literacy, communication skills and personal and societal power.

4 Planning how feedback will be provided

Feedback about student work in relation to the outcomes is integral to the teaching and learning process. A balanced approach to informal and formal feedback occurs normally through good teaching practice. In designing learning and assessment experiences, consider how the proposed feedback strategies will focus on what is expected in the activity, provide students with constructive and meaningful information and opportunities for reflection on their learning.

Feedback should:

- communicate clearly to students how well their knowledge, understanding and skills are developing in relation to the outcomes
- include opportunities for peer evaluation and self-evaluation
- enable students to reflect on and plan with the teacher the next steps in their learning.

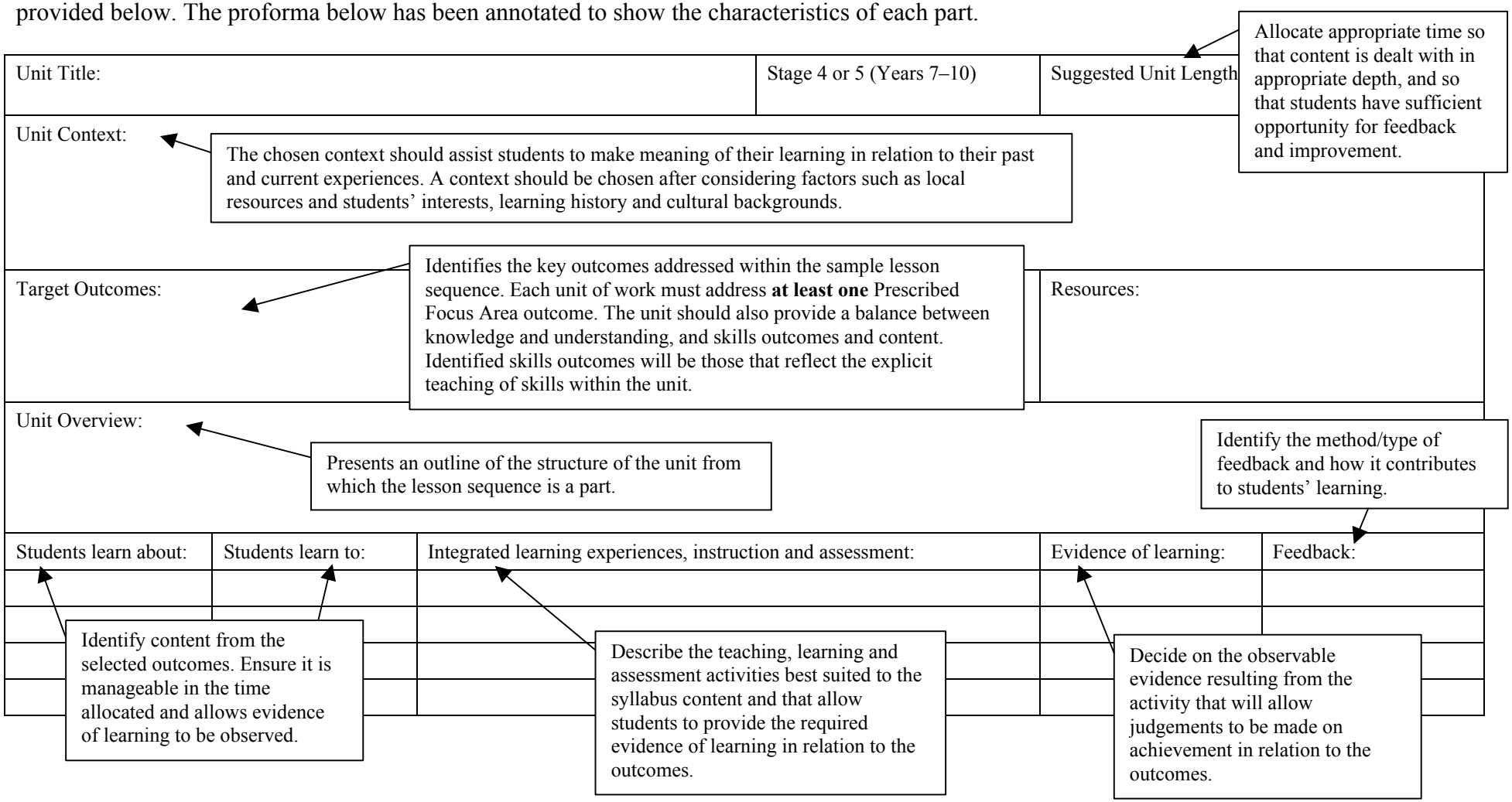
5 Providing opportunities and strategies for teacher reflection and evaluation

Working collaboratively leads teachers to develop shared understanding of the syllabus and supports them in making consistent and comparable judgements about student learning. Throughout planning and programming it is important to reflect individually and collaboratively on the process and to evaluate the extent to which:

- the context has focused the unit on the outcomes and assisted the students to make meaning of the content
- evidence gathered enables teachers to make judgements about student achievement in relation to the outcomes
- feedback strategies enable students to improve their learning
- the selected content and learning experiences are manageable in the time allocated to the unit
- learning experiences and/or the unit should be modified to enhance teaching and improve learning.

4.1 Sample Unit Proforma

Schools should design unit proformas that best meet their needs and circumstances. Schools may choose to use or adapt the proforma style provided below. The proforma below has been annotated to show the characteristics of each part.



5 Sample Units of Work

The sample lesson sequences that follow are designed to assist teachers in planning for the implementation of the *Science Years 7–10 Syllabus*. The lesson sequences provide programming ideas for selected syllabus content and have been developed using the process outlined in section 4.

The lesson sequences presented in this section demonstrate how essential content from Prescribed Focus Areas, Domain: knowledge, understanding and skills can be integrated. Each sequence highlights how students' knowledge and understanding are developed through explicit and systematic teaching-learning that focuses on selected Prescribed Focus Area and skills content. When the lesson sequences are considered together with the scope and sequence and content mapping grids they provide an example that demonstrates how specific Prescribed Focus Area and skills content could be developed within and across Stages 4 and 5.

The detail in the lesson sequences is provided to illustrate the process of assessment for learning. This level of detail reflects the planning that may be undertaken by a teacher in developing their individual lesson plans. It would also assist a beginning teacher in planning, programming and developing classroom experiences that integrate learning, instruction and assessment.

The sample lesson sequences show ways in which teachers can meet the needs, interests and abilities of their students, while assessing their progress towards a demonstration of outcomes. The sample lesson sequences also illustrate ways in which assessment activities may be integrated into the teaching and learning sequence. They will assist teachers to understand the importance of:

- being explicit about the outcomes and content they are addressing
- being explicit about the evidence required to demonstrate student learning
- providing meaningful feedback to students
- adapting teaching and learning programs to students' demonstrated needs
- having a sound basis for modifying future teaching and learning programs (in light of students' demonstrated needs).

Note that the assessment activities are described in some detail to illustrate the process of *assessment for learning*. Teachers would not provide this level of detail in day-to-day classroom situations.

5.1 Stage 4 Sample Lesson Sequence: Living Things

Title: Living Things	**Stage 4 (Year 7)**	**Suggested Unit Length: 8–9 Weeks**

Unit Context:
In the Year 7 unit Living Things students are introduced to Biology as a branch of science. The unit builds on students' knowledge, understanding and skills from Stage 3 in investigating, designing, making and using technology. It uses examples to enable students to gain an understanding of how historical developments in science and technology have changed ideas about cell structure, microscopic and macroscopic organisms and classification. Students are also introduced through their first-hand experiences to the importance in scientific investigations of making accurate and objective observations.

Description of sample lesson sequence: (3–5 weeks)
This lesson sequence focuses on developing students' research skills using appropriate content for the Stage 4 outcomes of gathering, processing and presenting information from first-hand investigations and secondary sources. The emphasis in the teaching and learning experiences is on developing students' understanding of the role and importance of making accurate observations. To make it easier to study the vast number of living things, biologists classify them into groups with similar features. Students will develop their understanding of how keys assist in identifying living things and, by performing first-hand investigations, students further develop their skills of making and recording observations of the features of a variety of organisms. The system of classifying living things involves an observer making judgements about the type and importance of the characteristics used and is subject to change due to the understanding the observer brings to the situation and as new information becomes available.

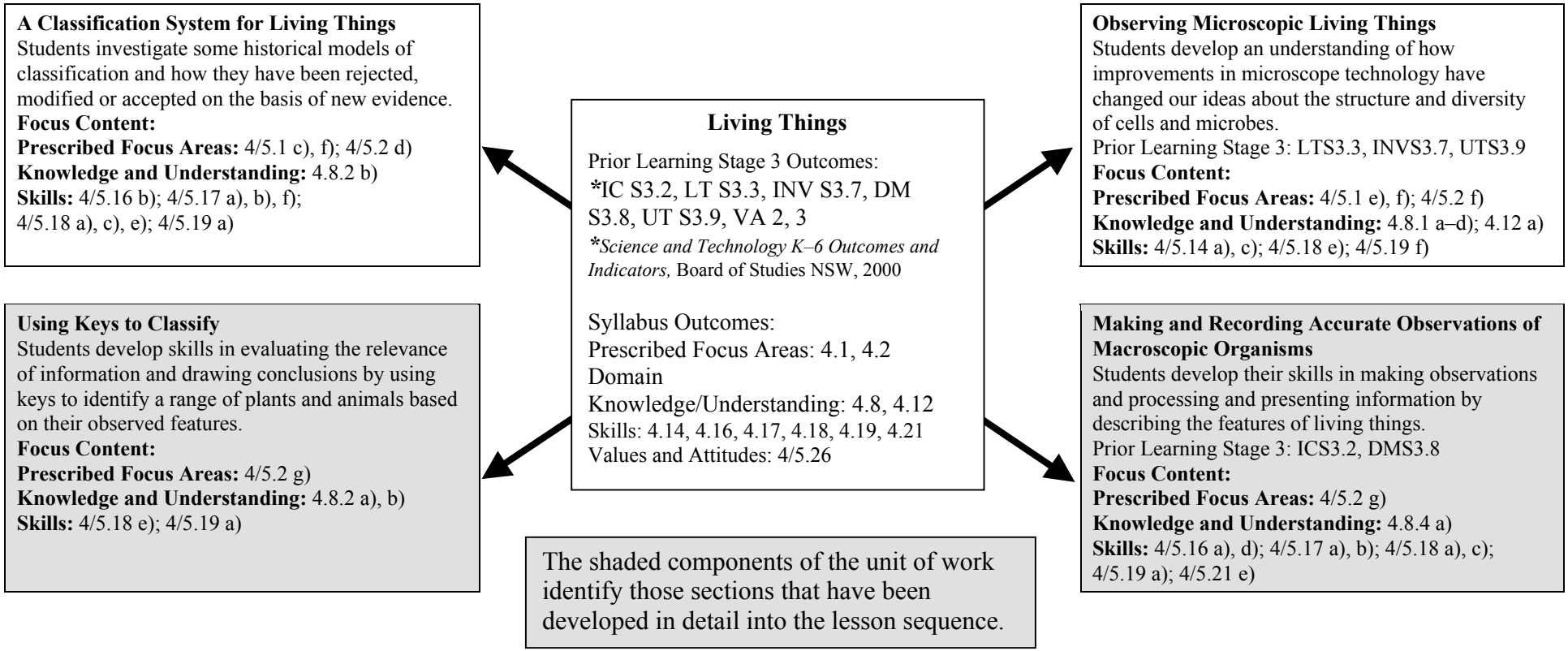
Targeted Outcomes in the lesson sequences:
A student:

- 4.2 uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena
- 4.8 describes features of living things
- 4.16 accesses information from identified secondary sources
- 4.17 evaluates the relevance of data and information
- 4.18 with guidance, presents information to an audience to achieve a particular purpose
- 4.19 draws conclusions based on information available
- 4.21 uses creativity and imagination to suggest plausible solutions to familiar problems

Resources:
The resources listed below are suggested only.

Watson, C, 1991, *Process Science in Action,* Heinemann Educational Australia, Port Melbourne, Vic.
Thickett, G, Stamell J & Thickett L, 1999, *Science Tracks 7*, Macmillan, South Yarra, Vic.
Watson, C, 2002*, Interactive Science 1*, Heinemann Educational Australia, Port Melbourne, Vic.
Haire, M et al, 1999, *Core Science 1*, Jacaranda, Milton, Qld.
Garton, A, 1996, *Science Moves 1*, Heinemann Educational Australia, Port Melbourne, Vic.
Jennings, T, 1996, *101 Optical Illusions*, Macdonald Young Books, East Sussex, Great Britain.

Unit Overview



The detail in the lesson sequences is provided to illustrate the process of *assessment for learning*. This level of detail reflects the planning that may be undertaken by a teacher in developing their individual lesson plans. It would also assist a beginning teacher in planning, programming and developing classroom experiences that integrate learning, instruction and assessment.

Students learn about:	Students learn to:	Integrated learning experiences, instruction and assessment:	Evidence of learning:	Feedback:
		Making and Recording Accurate Observations of Macroscopic Organisms		
4/5.2 the nature and practice of science	g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation	Group Activity: How well do we observe? • Teacher introduces discussion to identify students' prior learning and ideas about the role of making objective observations in science investigations. • In groups students observe a range of optical illusions that incorporate two images (eg two faces or a vase) – providing different background information to each student; the group then asks them to identify what they see.	• Students recall that science investigations require accurate observations using one or more of the senses.	• Oral feedback provided by teacher to guide student discussion on the role of observation in science investigations.
		Group Activity: Observation for meaning. • Students are shown a set number of objects/photographs for a short time and asked to record, describe and estimate the size of the objects seen. • In pairs, one student makes observations of an object/photograph for 15 seconds then must describe the object/photograph to their partner. Students reverse roles and repeat the activity. • Teacher poses question: Why would different students see different things from the same image? • In a think/pair/share activity students identify possible reasons why different people see the same object in different ways. • In small groups students brainstorm and list ideas/suggestions for increasing the accuracy of their observations. Each group reports back to class.	• Students identify and accurately record the features of a range of objects. • Students identify that observations may vary because of the differing understanding the observer brings to the situation. • Students suggest ways to increase the accuracy and range of their observations.	• Peer feedback and discussion of observations. • Self and peer feedback to identify ways of improving accuracy of observations. • Oral feedback and discussion between teacher and students relating to making objective observations.
4/5.19 thinking critically	a) justify inferences in light of gathered information	Group Activity: Observation and inference. • Teacher introduces the terms 'observation' and 'inference'. • Students undertake a range of activities to extend their understanding of the differences between observation and inference. For example: using a graphical representation of a scene or series of events that have occurred over time. • Teacher/student discussion of the need for recording and summarising information clearly.	• Students identify that: – an inference is based on observations made – many inferences may be made from the same observations. • Students use examples to accurately distinguish between observation and inference.	• Oral feedback provided by teacher and peers during reflection on activity.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
4/5.17 processing information 4/5.18 presenting information	b) distinguish between relevant and irrelevant information a) select, and use appropriately, types of text for different purposes and contexts including a discussion, explanation, procedure, exposition, recount, report, response or experimental report for oral or written presentation	Class/Group Activity: Using a scaffold to construct a descriptive report. • Teacher models the use of a descriptive report scaffold as a means of organising information gathered from a secondary source. • Students are provided with a descriptive report that includes the observable features of an organism. With guidance they identify and record the observable features on a descriptive report scaffold. • Students compare their recorded information to further clarify that people may emphasise different features from their observations. Individual/Pair Activity: Organising information using a scaffold. • Teacher provides a descriptive report and in a guided discussion students describe the structure and purpose of the text. • In a think/pair/share activity students identify the element of the report and record the relevant element next to the text provided. • Students compare the parts of the descriptive report scaffold with those elements identified in the provided text. Individual Activity: Using a scaffold to construct a descriptive report. • Students write a descriptive report using the provided scaffold to summarise and collate the characteristics of a multicellular organism.	• Students extract relevant information from a descriptive report. • Students recall that descriptive text is used in some reports. • Students use a descriptive report scaffold to record relevant information. • Text is appropriately related to each component of the descriptive report. • Students construct a descriptive report using the provided scaffold.	• Oral feedback from teacher and peers during activity to recall the structure and purpose of a descriptive report. • Written teacher feedback based on relevancy of information extracted from the passage. • Teacher provides oral feedback as students work through activity of writing a descriptive report. • Teacher provides written feedback to students on their descriptive report.

Students learn about:	Students learn to:	Integrated learning experiences, instruction and assessment:	Evidence of learning:	Feedback:
		Sample Assessment for Learning Activity 1 **Students are provided with a description of the activity. They are to research information on observable features for a selected vertebrate and present a descriptive report of the animal in the form of a poster.**	• Students state a range of elements that are evident in a descriptive style poster.	• Peer and teacher oral feedback during activity of identifying the elements of a poster used to present descriptive text.
4/5.21 the use of creativity and imagination	e) apply critical thinking in the consideration of proposals	Think/Pair/Share activity: Identifying some elements to be used in presenting information in a poster format. • Teacher provides a range of commercially produced descriptive-style posters (eg National Parks and Wildlife Service posters, Health Department). • Students observe the posters to identify the elements that are used to effectively present descriptive information in this type of format, and justify their decisions based on objective criteria rather than personal preference.	• Students justify their choice of some elements of a descriptive-style poster.	• Peer and teacher feedback relating to viewer preference and the understanding the observer brings to the situation.
		• Class brainstorms and identifies an agreed set of elements for a descriptive-style poster and proposes a range of possible poster layouts.	• Students organise the agreed elements into an evaluation sheet.	
4.8.4 multicellular organisms	a) identify that there is a wide range of multicellular organisms	• Students organise the identified elements into a table to be used to guide the self and peer evaluation of the posters. • Students identify a range of vertebrates to research for their poster. • Class suggests a range of sources that could be used to obtain information about their identified animal.	• Students identify a range of sources of secondary information.	• Teacher-guided discussion of proposed sources of information.
4/5.16 gathering information from secondary sources	a) use a range of sources including databases, CD-ROMs and the internet, to access information	Class Library Activity: Developing skills in information searching. With guidance from the librarian, students: • recall the processes for conducting library and internet search, including the appropriate use of resources • conduct a number of searches and identify initial sources of information both within the library and on the internet • discuss with teacher/librarian methods to acknowledge sources of information and provides an appropriate model for recording sources.	• Students recall that skills in identifying and gathering information are important in research. • Students access a range of sources from the library and internet.	• Oral feedback provided to guide and refine search techniques and on the suitability of sources of information.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
4/5.18 presenting information	c) select and use an appropriate method to acknowledge sources of information	Library Session: Identifying and gathering information from secondary sources. • Students use the provided descriptive report scaffold to collect and summarise relevant information about their selected vertebrate from a range of sources, ensuring all sources are appropriately acknowledged.	• Students summarise relevant information using the scaffold. • Students use an appropriate strategy to correctly acknowledge their sources of information.	• Oral teacher feedback to guide students in correctly using methods to acknowledge information sources.
4/5.16 gathering information from secondary sources	d) summarise information from identified oral and written secondary sources			• Teacher provides oral and written feedback and guides students to refine the draft summaries and to correctly acknowledge the sources of information.
4/5.17 processing information	a) collate information from a number of sources	Individual Activity: Presenting information. • Students collate and summarise information collected from their searches. Using the elements agreed on by the class, each student presents their descriptive text information with appropriate diagrams and/or graphics in the form of a poster. This work will be completed outside of class time and submitted in its final form together with the descriptive report scaffold on an agreed date.	• Student presents a poster using the agreed elements developed by the class.	• Self, peer and teacher feedback and assessment provided, using an Evaluation Sheet.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
		Using Keys to Classify		
4/5.2 the nature and practice of science	g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation	Group Activity: Introducing classification. • Students observe and record the features of a range of vertebrates from the information on the posters. • Students play 'Guess What Vertebrate'. A student mimes a vertebrate and answers questions with yes or no. The class act as observers and recorders, and each tries to identify the vertebrate by asking a single question in turn. Students record their questions and ideas. At intervals students make guesses as to the identity of the vertebrate. At the end of the activity students explain how the information gathered from the questions changed their ideas about the features and identity of the vertebrate.	• Students identify that structural features can be used to identify living things.	• Self, peer and teacher feedback in reviewing how ideas changed as information increased about the identity of the vertebrate.
		Class Group Activity: Why do people classify? • Teacher reviews students' ideas about the term 'classification' and the class develops a working definition for the term (eg to sort/group objects or living things). • Teacher asks students to consider why people group objects, and stimulates discussion by suggesting that students think about the question in relation to the arrangement of goods in a supermarket. • Teacher uses questions to explore student ideas about why the goods in all supermarkets are not organised in the same way. • Students brainstorm other situations where people sort things into groups, why the objects need to be grouped and how they are grouped.	• Students recall that classifying is the process of arranging/ grouping things into categories based on similar features.	• Peer and teacher feedback on why people classify objects/living things differently.
4.8.2 classification	a) classify living things according to structural features and identify that they have patterns of similarities and differences	Class/Group Activity: Modelling a process for classifying objects. • Joint construction – students identify a range of features that could be used to distinguish tools/kitchen equipment. Using these characteristics the teacher models a process of classifying or sorting the devices into groups. • Groups of students are provided with the same set of laboratory equipment and develop a way of grouping the objects using the observable features. Each group provides an oral report back to class. • In a class discussion students compare the different groupings proposed and suggest why it is possible for there to be several different ways of sorting the same objects.	• Students identify that classification requires making accurate observations of the features of objects/ organisms.	• Self, peer and teacher oral feedback provided throughout activity to assist in grouping the objects based on the observable features.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
4.8.2 classification	b) identify a range of plants and animals using simple keys	Pair/Individual/Activity: Introducing dichotomous keys. • Teacher introduces the concept of a branching/dichotomous key as a tool used by biologists for classifying objects/living things. • Teacher models the use of a simple dichotomous key to identify organisms within a group of living things (eg different types of beetles) and to demonstrate the rules for using dichotomous keys. • Students use dichotomous keys to classify objects and extend their understanding by sharing their experiences.	• Students describe a dichotomous key as a branching diagram with two branches and alternatives of the same feature at each step.	• Teacher provides oral and written feedback on the dichotomous key activities.
4/5.19 thinking critically	a) justify inferences in light of gathered information	Class/Group Activity: Using dichotomous keys to identify animals and plants. • Students recall why the structural features of organisms are used to identify living things and why different keys can exist to classify the same groups of organisms. • Students use dichotomous keys to identify living things and describe the similarities/differences in the features used to classify living things.	• Students use simple dichotomous keys to identify a range of plants and animals. • Students use the information in keys to describe similarities and differences in the features of some groups of organisms.	
4/5.18 presenting information	e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly	Individual Activity: • Using first-hand investigations and/or information from secondary sources, students extend their understanding of, and skills in using, simple keys to identify a range of living things.		• Teacher provides oral and written feedback on the students' use of keys to identify organisms.
		This activity is not essential content and should only be undertaken if there is time remaining for this section of the unit. Individual Activity: Constructing simple keys. • Students develop a list of observable features for the class that will be used in constructing dichotomous keys to identify a number of students; and/or • Students construct a dichotomous key to identify the animals from the 'Guess What Vertebrate' activity using the information from the vertebrate posters.		

5.1.1 Sample assessment for learning activity: Vertebrate Poster

Context
In the Year 7 unit Living Things students are introduced to Biology as a branch of science. The unit builds on students' knowledge, understanding and skills from Stage 3 in investigating, designing, making and using technology. It uses examples to enable students to gain an understanding of how historical developments in science and technology have changed ideas about cell structure, microscopic and macroscopic organisms and classification. Students are also introduced through their first-hand experiences to the importance in scientific investigations of making accurate and objective observations.

As a component of a unit of work on the classification of living things students learn and practise research skills through gathering and processing information from a range of secondary sources on a selected vertebrate. Using a provided scaffold they summarise gathered text to construct a descriptive report that includes the observable features of their animal. Students will present their collated and summarised descriptive text in a poster. The poster elements have been identified and agreed to by the students based on their observations and discussion around the features of a range of those available commercially.

Outcomes
A student:
4.8 describes features of living things
4.16 accesses information from identified secondary sources
4.17 evaluates the relevance of data and information
4.18 with guidance, presents information to an audience to achieve a particular purpose.

Description of activity
Students are to prepare a descriptive report of the observable features of a named vertebrate using a poster format. They will examine a range of commercially produced posters and identify agreed elements for descriptive posters that they will apply to the presentation of their final product. They will utilise a provided descriptive report scaffold to gather, summarise and correctly acknowledge text for inclusion in their poster.

In summarising the information that will form the final text in their poster presentation students will access information from text and graphics from a range of secondary sources including library resources and the internet.

Criteria for assessing learning
(These criteria would normally be communicated to students with the activity.)

Students will be assessed on their ability to:
- describe accurately the observable features of a selected vertebrate
- locate relevant information and graphics from a range of secondary sources
- extract and summarise relevant information from secondary sources using the provided scaffold
- appropriately acknowledge sources of information
- apply the student-agreed elements for a poster format to their presentation.

Guidelines for marking

The following guidelines for marking show one approach to assigning a value to a student's work. Other approaches may be used that better suit the reporting process of the school. Categories, marks, grades, visual representations or individual comments/notations may all be useful.

Range	A student in this range:
High	• describes accurately the observable characteristics of a named vertebrate summarised from a variety of sources • uses and correctly acknowledges information from a variety of media, for example the internet, CD-ROM, books, encyclopaedias, journals, newspapers • presents summarised information using the student-agreed elements in a poster format
Satisfactory	• describes some observable features of a named vertebrate using information extracted from sources • uses and acknowledges information from some sources, for example the internet, CD-ROM, print • presents descriptive information using some of the student-agreed elements for the poster format
Progressing	• states some features of a named vertebrate • uses and acknowledges a source of information • with guidance presents information using some of the student-agreed elements for the poster format.

Feedback

Students will undertake self-assessment of their poster presentation and also receive peer and teacher feedback through the use of a poster evaluation sheet. During the teaching-learning experiences leading to the presentation of their poster, students will receive oral and/or teacher feedback in relation to:

- identification and use of appropriate sources of secondary information relating to the named vertebrate
- techniques for summarising gathered information into a concise description of vertebrate characteristics for the named animal
- their use of the provided report scaffold in gathering relevant information from a range of secondary sources
- methods used to acknowledge sources of information gathered
- use of student-agreed elements for the poster format.

Future directions

Students will use the posters produced by the class as a resource for developing their knowledge and understanding of the variety of vertebrates that currently inhabit the Earth, and the use of observable characteristics in developing a system of classification of these animals. Through future activities students will, in increasingly unguided situations, practise and apply their skills in extracting and summarising information from secondary sources. Students would apply their skills in identifying data sources, gathering, processing and presenting first-hand information when undertaking the mandatory Student Research Project in Stage 4.

5.2 Stage 5 Sample Lesson Sequence: Our Changing Earth

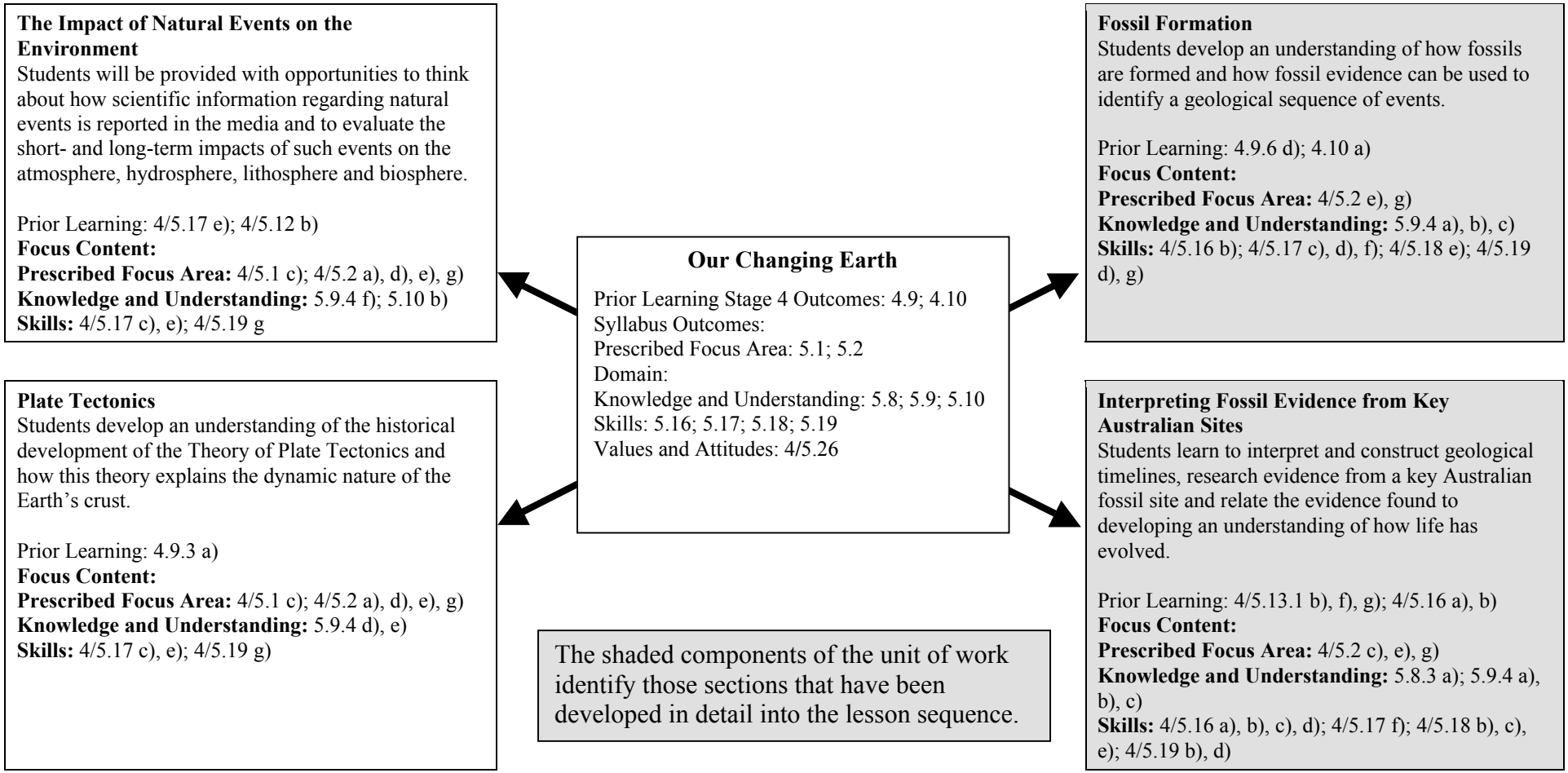
Title: Our Changing Earth	**Stage 5 (Year 9)**	**Suggested Unit Length: 6–10 weeks**

Unit Context:
In the Year 9 unit Our Changing Earth students develop an understanding of the planet as a place of constant change. Sometimes this change is too slow to be seen in a lifetime, and at other times violent and destructive changes can be witnessed in a short space of time. In the unit students extend their knowledge and understanding of the nature and practice of science by examining scientific evidence that explains changes in the life forms and the Earth and how ideas are rejected or modified as new scientific evidence emerges. Within this context students investigate evidence of crustal movement, volcanic activity and earthquakes to explain how these changes impact on the Earth.

Description of sample lesson sequence: (3–5 weeks)
The role of observation in the practice of science is the emphasis applied in this lesson sequence to develop students' knowledge and understanding of fossil formation and interpreting fossil evidence through research skills. The teaching-learning experiences provide examples of students extending their skills in processing gathered information including explaining trends and patterns. Students are encouraged to apply their skills in critical thinking and evaluation to present information to an audience. These presentations may take a variety of forms including brochures, timelines and models.

Targeted Outcomes in the lesson sequence:	**Resources:**
A student: 5.2 describes the processes that are applied to test and validate models, theories and laws 5.8 relates the structure and function of living things to models, theories and laws 5.9 relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions	*The resources listed below are suggested only*. Video: *Walking with Beasts*, BBC, 2002. Video: *Walking with Dinosaurs*, BBC, 1999. CD-ROM: *Tales from the Kangaroo's Crypt*, Department of Communications, Information Technology and the Arts (DCITA), 1997. Websites: http://science.uniserve.edu.au/school /quests/project.html http://www.ucmp.berkeley.edu/geology/animal.html Texts: A variety of current texts are available that could be used in the learning experiences in this lesson sequence.

Unit Overview



The detail in the lesson sequences is provided to illustrate the process of *assessment for learning*. This level of detail reflects the planning that may be undertaken by a teacher in developing their individual lesson plans. It would also assist a beginning teacher in planning, programming and developing classroom experiences that integrate learning, instruction and assessment.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
		Fossil formation		
4/5.2 the nature and practice of science 4/5.17 processing information	e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation c) check the reliability of gathered data and information by comparing them with observations or information from other sources	Group/Class Activity: Determining students' prior understanding of fossils and evidence of past life. • Teacher presents a short section of video and/or diagrams and text showing prehistoric organisms (eg 'Walking with Dinosaurs' or 'Walking with Beasts'). Students brainstorm ideas about how we know what organisms were like in the past and suggest possible reasons why changes have happened over long periods of time. • With guidance students identify the scientific information presented and recall some examples of structural adaptations of living things explaining how features can be related to survival in their environment (Syllabus ref 4.10 a). • Students recall how the reliability of information can be assessed and using selected resources they evaluate the reliability of the information in the video segment and/or text. Individual Activity: Students answer questions relating to making inferences about the environment and features of past organisms using the provided information.	• Students identify: – changes in the environment have caused changes in groups of organisms – changes have occurred slowly over long periods of time – information needs to be checked for reliability.	• Teacher and/or peer oral feedback on the difference between observation and inference.
5.9.4 natural events	b) describe conditions under which fossils form	Pair/Group Activity: Following a planned procedure to model how a fossil forms. • Students follow a procedure to make a fossil model from a latex mould or use plastic cooking moulds to make chocolate fossils. • Students relate how they made their fossil models to the conditions needed for fossil formation and check their ideas with those of other groups.	• Students describe how fossil formation can occur.	• Self/peer oral feedback on the procedure and results during the activity.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
4/5.18 presenting information	e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly	Class/Group Activity: Determining students' understanding of constructing and interpreting flow charts. • Teacher provides a blank template to demonstrate a simple flowchart. Additional information will be added to the flow chart throughout the unit. • Students observe some typical examples of rocks of each major group and recall key words relating to sedimentary, igneous and metamorphic rocks. • With teacher guidance students use the key words to complete a flow chart to summarise their ideas about the rock cycle and the origins of sedimentary, igneous and metamorphic rocks (Syllabus ref. 4.9.6 d) • Students discuss their flow charts and make appropriate additions and changes.	• Students use a scaffold to construct a flow chart. • Students interpret a flow chart to revise their ideas about the origin of sedimentary, igneous and metamorphic rocks.	• Self/peer oral evaluation of flow charts. • Teacher oral feedback during flow chart construction and on the appropriate use of scientific terms.
4/5.17 processing information 4/5.19 thinking critically	d) organise data using a variety of methods including diagrams, tables, spreadsheets and databases g) use cause and effect relationships to explain ideas	Group/Class Activity: Sequencing diagrams and descriptive text to show fossil formation. • Students set up a sediment column to model how horizontal layers of sediment form and, working in groups, students develop a sequence of diagrams to demonstrate the process. Groups exchange their diagrams and provide suggestions/ comment on how the clarity of the diagrams could be improved. • Students draw a sequence of diagrams to explain the layered structure of sedimentary rocks. • Teacher provides a dictogloss explaining the process of fossilisation in sedimentary rocks. In groups students reconstruct the text. • Students sequence a series of provided diagrams demonstrating the process of fossilisation in sedimentary rocks. • Students use reconstructed text to write captions to describe each picture of the sequence. • Students identify the conditions needed for fossils to form in sedimentary rocks to explain why the fossil record is incomplete. Think/Pair/Share Activity: Discussing and amending the flow chart. • Students discuss where the steps in fossil formation could be placed and amend their flow charts appropriately.	• Students use text and diagrams to describe how fossils are formed in sedimentary rocks. • Students list some conditions needed for fossil formation in sedimentary rocks. • Students amend the flow chart to include fossil formation.	• Teacher/peer oral and written feedback on the captions and the appropriateness of their relationship to the sequence of pictures.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
5.9.4 natural events 4/5.17 processing information	a) identify that geological history can be interpreted from the formation, by sediments, of horizontal layers in which the oldest are at the base and the youngest at the top f) identify trends, patterns, relationships and contradictions in data and information	Group/Class Activity: Interpreting geological cross-sections. • With guidance students interpret geological cross-sections containing fossils to identify the sequence of events involved in the formation of a geological region. • Students use fossils (with particular reference to index fossils) to correlate several geological cross-sections. • Students discuss the importance of index fossils.	• Students identify that: – fossils provide evidence of past life – typically the oldest fossils are in the lowest layer and youngest in the top layer.	• Teacher provides oral feedback to assist students interpret the sequence of events in the geological cross-sections.

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
		Interpreting fossil evidence (including Australian examples) of changes on life forms over the history of the Earth		
4/5.2 the nature and practice of science	e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation	Group/Class Activity: Interpreting and constructing timelines • Students list at least eight (8) significant events in their lives and the year each occurred. • Teacher provides a scaffold and the students follow instructions to construct a personal timeline. • Teacher introduces a time scale and discusses techniques used to measure the age of objects/the Earth. • Students undertake a guided interpretation to complete a geological time scale using provided secondary information that identifies aspects of organisms within each era/period. • Students gather information regarding the eras and periods, symbols used, extinctions and types of organisms, understanding that the timeline is based on current scientific knowledge. • Students use a scaffold to construct a timeline for the changes in organisms in the Cainozoic era. Teacher demonstrates to students how to calculate the scale to be used in the scaffold.	• Students use a scale to correctly identify aspects of a simple timeline. • Students construct a timeline using an appropriate scale from data provided.	• Teacher provides written feedback on student responses to questions related to use of the timeline. • Teacher provides oral feedback on: – student calculation of scale – construction of the timeline.
5.9.4 natural events	c) relate the fossil record to the age of Earth and the time over which life has been evolving	• Students calculate scale and construct a geological time scale wall chart to display around the room, that shows the eras and periods. • Students discuss supporting evidence scientists must have to construct a timeline and suggest information that might change our ideas about the timeline and the age of the Earth.	• Students identify evidence to support the idea that over time there have been changes in the diversity of living things on Earth.	• Teacher, peer oral feedback on how new information on fossils and/or improved technology have changed our understanding.
4/5.18 presenting information	e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly			

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
5.8.3 the theory of evolution and natural selection	a) discuss evidence that present-day organisms have evolved from organisms in the distant past	Group/Class Activity: Summarising and presenting relevant information on changes in life forms over the history of the Earth. • Teacher revises techniques for locating information from text (such as using subheadings, diagrams, bolded words, skimming and scanning).	• Students define biological evolution as changes in life over time.	
4/5.16 gathering information from secondary sources	b) use a variety of techniques, such as keywords, skimming and scanning to identify appropriate information	• Students research a major group of organisms using a variety of provided secondary sources to prepare an outline of the currently held view of the evolution of the group of organisms including when scientists believe they first appeared, how long they existed and changes in the group over time. • A student representative(s) from each group gives a brief oral presentation to the class and the prepared outline is aligned with the appropriate era on the geological timescale wall chart.	• Student identifies that some groups of organisms have existed on Earth over vast periods of time while others have become extinct.	
4/5.17 processing information	f) identify trends, patterns, relationships and contradictions in data and information	• Students use the wall chart timeline to identify trends and make generalisations about the age of the Earth and evolution of life on Earth.		• Teacher provides oral feedback to assist students to describe trends and make generalisations.
4/5.19 thinking critically	d) make generalisations in relation to a relevant set of observations or experimental results			

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
4/5.2 the nature and practice of science	c) apply scientific processes to test the validity of ideas and theories e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation	Think/Pair/Share Activity: Developing students skills in interpreting and extracting information from simple evolutionary tree diagrams. • Teacher provides an incomplete simple evolutionary tree showing the geological eras and the changes in diversity of some major animal or plant groups to the present. • Students use the provided information to complete the tree and are asked to justify the locations they choose for their selected plant or animal group. • Teacher selects one or two examples of groups of organisms to model how to interpret evolutionary tree diagrams and make generalisations about the observed changes in fossil evidence. • Students independently answer the provided questions to identify how life has changed over the history of the Earth and propose reasons for changes in abundance and diversity of various groups of organisms. They compare their responses with their partner(s). • Students use selected secondary sources to identify and check evidence to support their proposed reasons for the changes in diversity and abundance of various groups of organisms over time. • Students share ideas/reasoning in a class discussion and collate and record the classes responses in an appropriate form.	• Students use secondary sources to complete a simple evolutionary tree diagram and to identify possible causes for change in the abundance and diversity of organisms.	• Teacher oral feedback during the activity guides students in identifying trends and patterns.
5.8.3 the theory of evolution and natural selection	a) discuss evidence that present-day organisms have evolved from organisms in the distant past		• Students describe evidence to support the idea that present-day organisms have evolved from organisms in the past.	• Teacher oral feedback relating the changes of abundance and diversity of organisms to changes in the environment.
4/5.16 gathering information from secondary sources	c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources			
4/5.19 thinking critically	b) identify data which supports or discounts an hypothesis, a question being investigated or a proposed solution to a problem d) make generalisations in relation to a relevant set of observations or experimental results			

Students learn about:	**Students learn to:**	**Integrated learning experiences, instruction and assessment:**	**Evidence of learning:**	**Feedback:**
		Sample Assessment for Learning Activity 1: **Students are placed in the role of scientific officer for the National Parks. They must present, in a brochure format, information to promote the preservation and protection of one fossil site in Australia as important in providing significant evidence supporting the idea that life on Earth has changed over time.** **Students must choose an Australian fossil site from the following list: Riversleigh, Ediacaran Hills, Naracoorte, Lightning Ridge, Dinosaur Cove, Lake Acraman, Koonwarra, Somersby and Winton.**		
4/5.16 gathering information from secondary sources	a) use a range of sources, including databases, CD-ROMs and the internet, to access information b) use a variety of techniques, such as keywords, skimming and scanning to identify appropriate information d) summarise information from identified oral and written secondary sources	Individual Activity: Identifying, gathering and processing information from secondary sources. • Students recall and review techniques for accessing information from databases, CD-ROMs and the internet. Using both electronic and print-based resources students locate and gather information relating to one of the following fossil sites in Australia: Riversleigh, Ediacaran Hills, Naracoorte, Lightning Ridge, Dinosaur Cove, Lake Acraman, Koonwarra, Somersby and Winton. • Students keep a file that includes summaries and collated information relevant to the scientific significance of the chosen Australian fossil site. All sources of information accessed are to be correctly acknowledged.	• Students independently locate, gather, summarise and collate information from a range of sources. • Students present correctly acknowledged sources for all accessed information.	• Teacher oral and written feedback guides students during the activity.
4/5.18 presenting information	b) select and use an appropriate medium to present data and information c) select and use an appropriate method to acknowledge sources of information	Individual Classroom Activity: Preparing and presenting information to an audience. Students are provided with access time to computer resources. • Students revise/recall basic procedures for using desktop publishing software. • Students generate a brochure to promote the scientific significance and preservation/protection of a specific Australian fossil site using the information they have collected and synthesised. • Students submit copies of their information with the brochure.	• Students present a completed brochure which addresses the criteria established for the task.	• Teacher-written feedback based on the criteria for assessing learning established for the task.

5.2.1 Sample assessment for learning activity: Australian fossil site brochure

Context
In the Year 9 unit Our Changing Earth students develop an understanding of the planet as a place of constant change. Sometimes this change is too slow to be seen in a lifetime and, at other times, violent and destructive changes can be witnessed in a short space of time. In the unit students extend their knowledge and understanding of the nature and practice of science by examining scientific evidence that explains changes in the life forms and the Earth and how ideas are rejected or modified as new scientific evidence emerges. Within this context students investigate evidence of crustal movement, volcanic activity and earthquakes to explain how these changes impact on the Earth.

During the course of this unit students expand and apply their research skills. Through a range of activities students will develop and demonstrate their skills of extracting and summarising information from secondary sources. They build on their experiences from Stage 4 to present the information that has been collated and synthesised into a brochure to promote the preservation and protection of an Australian fossil site.

Outcomes
A student:
5.9 relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time
5.16 accesses information from a wide variety of secondary sources
5.17 explains trends, patterns and relationships in data and/or information from a variety of sources
5.18 selects and uses appropriate forms of communication to present information to an audience

Description of activity
Students are placed in the role of scientific officer for the National Parks. They must present, in brochure format, information to promote the preservation and protection of one fossil site in Australia as important in providing significant evidence supporting the idea that life on Earth has changed over time.

Students must choose an Australian fossil site from the following list: Riversleigh, Ediacaran Hills, Naracoorte, Lightning Ridge, Dinosaur Cove, Lake Acraman, Koonwarra, Somersby and Winton.

During the learning process students will keep a record of their sources of information, copies of text gathered from each source and a record of the summaries of this information in the production of their brochure. The record of information will be used to provide ongoing feedback to students on the application of their research skills during the activity.

Criteria for assessing learning
(These criteria would normally be communicated to students within the activity.)

Students will be assessed on their ability to:
- evaluate the importance of an Australian fossil site in providing evidence that present day organisms have evolved from organisms in the distant past
- gather, process and present information in the form of a brochure to support an argument for the preservation and protection of an Australian fossil site
- correctly acknowledge sources of information.

Guidelines for marking

The following guidelines for marking show one approach to assigning a value to a student's work. Other approaches may be used that better suit the reporting process of the school. Categories, marks, grades, visual representations or individual comments/notations may all be useful.

Range	A student in this range:
8–10 High	• evaluates the importance of the fossil site in providing evidence that present-day organisms have evolved from organisms in the distant past • provides a concise summary of information from a range of correctly acknowledged sources which clearly supports their argument for preservation and protection of the site • includes diagrams and/or graphics that support their evaluation of the importance of the site
4–7 Satisfactory	• discusses the importance of the fossil site in relation to providing evidence for living things changing over time or provides an argument for its preservation and/or protection • presents relevant information from two or more identified sources which provides support for their argument for preservation and/or protection of the site • includes diagrams and/or graphics clearly related to the information provided
1–3 Progressing	• identifies the fossil site as important or recommends the preservation and/or protection of the fossil site • presents relevant information from at least one identified resource to support the preservation or protection of the site • includes relevant diagrams and/or graphics.

Feedback

During the teaching-learning experiences leading up to the presentation of their brochures students will receive oral and written teacher feedback in relation to:

- identification and use of appropriate sources of secondary information relating to the scientific significance of the chosen Australian fossil site
- the purpose of and the need for the maintenance of accurate records, and the suitability of the summarised information gathered at particular points in time
- techniques for summarising and synthesising gathered information in support of the preservation and protection of the chosen Australian fossil site
- acknowledging the sources of information gathered.

At the completion of the activity and the submission of their brochure, including their file of information used in the brochure, students will be given written feedback based on the criteria for assessing learning.

Future directions

Students will continue to practise and apply their research skills through a range of activities in following units of work and the Stage 5 Student Research Project. Students will also apply their research skills in extracting, summarising, synthesising and presenting information from different media and sources of information including video.

6 Appendix

Values and Attitudes
The following content may be used to develop the values and attitudes outcomes of the syllabus or teachers may develop their own content in assisting students' work towards achievement of these outcomes.

This content was previously provided as core content of the *Science Stage 4/5 Syllabus* (1998).

4/5.23 A student demonstrates confidence and a willingness to make decisions and to take responsible actions
Students learn to: • develop a positive view of themselves and their capabilities • exhibit self-direction in their own learning • initiate and persevere with activities to completion to achieve a reasonable end point • demonstrate a willingness to make decisions and to take responsibility for their actions.
4/5.24 A student respects differing viewpoints on science issues and is honest, fair and ethical
Students learn to: • be honest and open in their dealings with others • respect the rights and property of others • work cooperatively in groups • show flexibility and responsiveness to ideas and evidence • demonstrate a commitment to safe personal and community practices in the home and workplace • appreciate the need to assess opinions and values within the community.
4/5.25 A student recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life
Students learn to: • acknowledge the continued impact of science in many aspects of everyday life • realise that the knowledge base of society grows continually • retain a healthy curiosity about the world around them.
4/5.26 A student recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them
Students learn to: • value a scientific problem-solving approach • experience satisfaction in applying the processes of science • show awareness that scientists must be accountable for their actions • appreciate that scientific information should be disseminated objectively • appreciate that scientific theories can only be judged on the basis of scientific evidence • appreciate the need for careful assessment of science reports in the media.
4/5.27 A student acknowledges their responsibility to conserve, protect and maintain the environment for the future
Students learn to: • appreciate and be curious about the nature and behaviour of people and the environment • demonstrate a commitment to conserving and improving the quality of society and the environment.