

Science Unit, Curriculum Support Directorate, NSW Department of Education and Training

A MODEL FOR PROGRAMMING THE NEW STAGE 4-5 SCIENCE SYLLABUS

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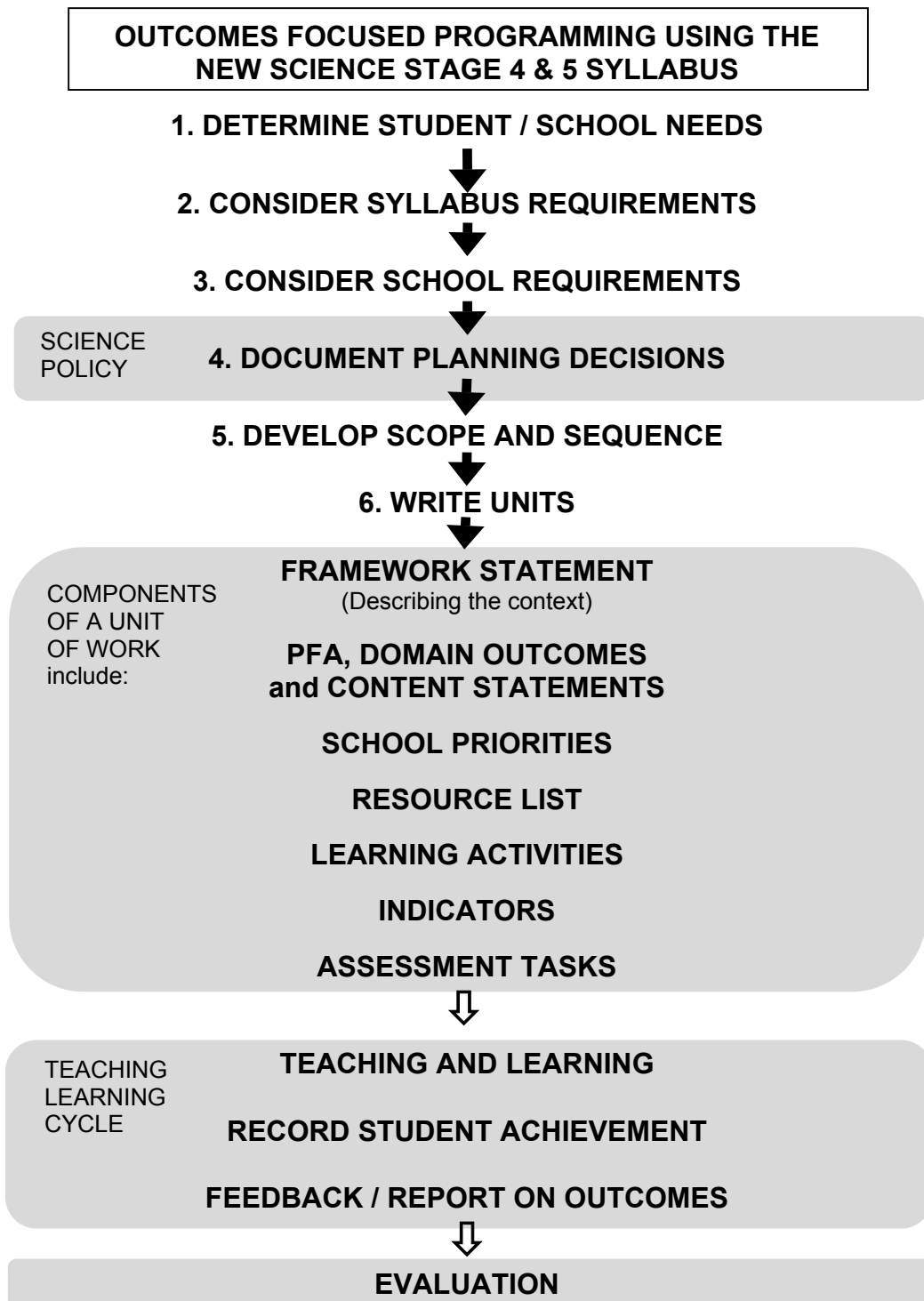
NEW SOUTH WALES
DEPARTMENT
OF EDUCATION
AND TRAINING



Developing a Stage 4-5 science program for your school

The **model** outlined here is an approach to programming designed to place the emphasis on learning as described by outcomes. The description of the model is supported by a **simulation** constructed for two Year 7 units (*Life in a space colony* and *A trip to Antarctica*).

The model is summarised by the following chart.

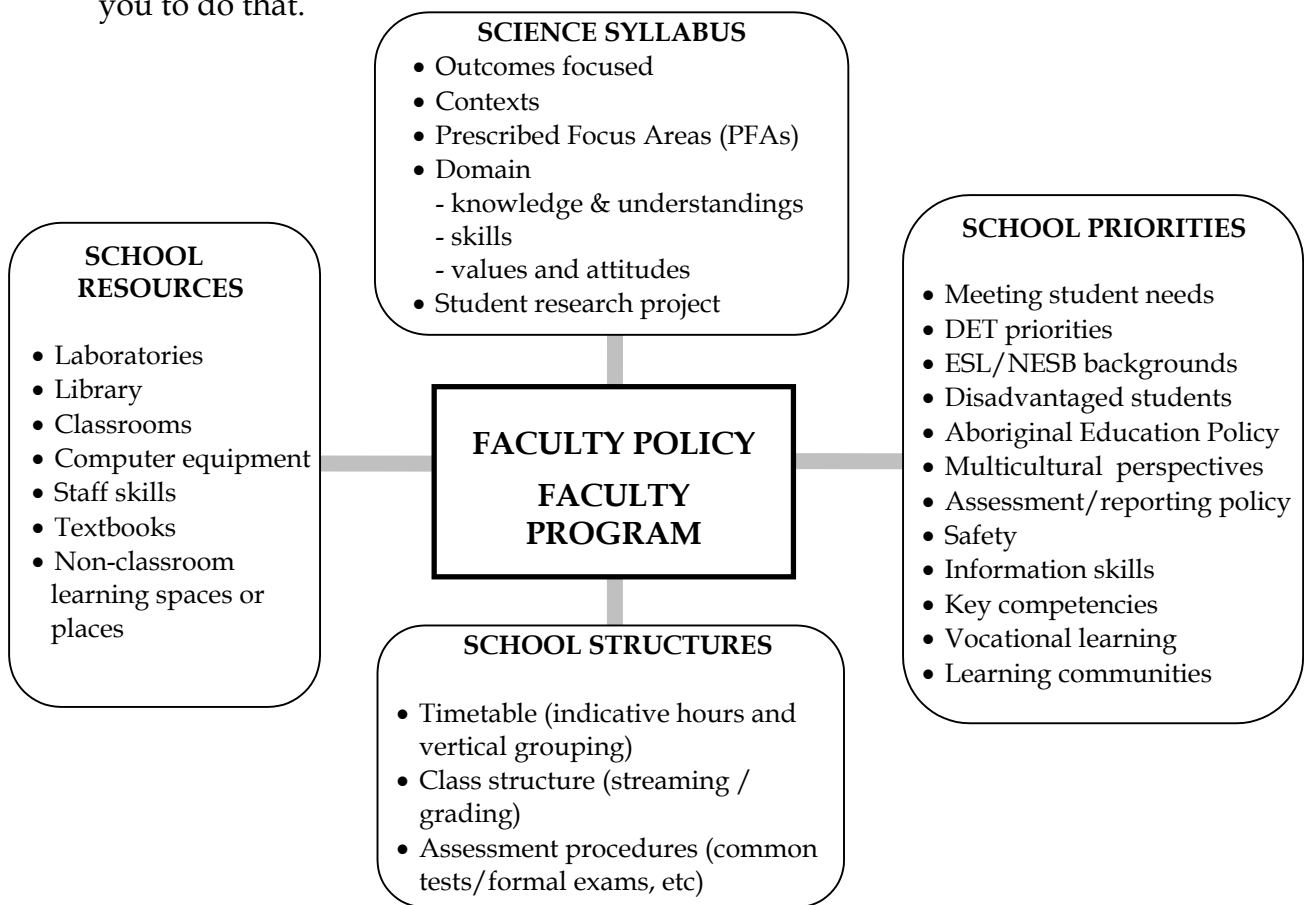


The science faculty program

There are a number of steps in the development of a science program. The science program here refers to a faculty-level program composed of the documentation of faculty decisions as well as a number of units of work for each year. Each teacher would need to take the units of work and develop from them a sequence of activities to suit the students in their classes.

STEP ONE: Situation analysis

As a faculty team, carry out a situation analysis for your school and present your analysis in the form of a mind-map. The information below may help you to do that.



Do some big picture planning for the four years from the school perspective. Assess your situation and make decisions about

- a timeline for managing the process of science curriculum change in Years 7-10. You will need to leave time for developing programs to implement the new Stage 6 syllabuses
- how many units of work will be treated in each year and how long will they be? You will need to take into account the actual teaching time

available (a forty-week year may have only thirty weeks of actual teaching time available)

- how you might format the units of work
- how much of the teaching time will be in laboratories and classrooms
- what resources, including those of the library, could be used (Internet connection, CD-ROM access, video collection, science references)
- how you will make the best use of staff skills and interests (e.g. in astronomy, technology, organic chemistry or earth science)
- what timetabling decisions could be used to maximise the use of resources (e.g. topic or teacher rotation).

STEP TWO: Syllabus requirements

This model reflects the following interpretations in relation to the new syllabus.

- Outcomes are a major focus of the syllabus, guiding both teaching and assessment.
- Outcomes for a stage describe significant achievements in learning that a typical student would be able to demonstrate after eighty weeks of schooling over two years.
- There is mandatory content which students must experience in both Stages 4 and 5.
- The course content needs to be presented to students in ways that maximise their opportunities to achieve the outcomes related to that content.
- Units of work based on the syllabus must be developed from a synthesis of the three syllabus content areas (*prescribed focus areas (PFAs), contexts and domain*) and their related outcomes (refer to the syllabus, page 7). Each topic or unit of work must be related to a context. Each topic or unit of work must incorporate at least one PFA.
- Indicators of achievement can be used to help plan and assess the achievement of outcomes. In time, annotated work samples could be collected and used to exemplify the standard of a particular stage.
- Assessment activities will provide students with a diversity of opportunities to demonstrate the achievement of syllabus outcomes.
- Students must carry out a student research project in each stage.
- More than 50% of the allocated science time must be practical work.

Therefore, some issues which may need to be resolved at faculty level:

- How many outcomes can you reasonably address in a unit and how do you assess achievement of them?
- Do you attempt a mix of outcomes from each part of the domain (knowledge and understanding/ skills) in each topic, in each year? Why?
- Should you provide experiences that include all Stage 4 skill outcomes in Year 7 and again in Year 8?
- What about students who have not achieved Stage 3 or are already beyond Stage 5 and moving toward Stage 6?
- How do you deal with the mandatory student research project? (. . as a discrete topic or unit of work or completed over several topics?)
- How are you going to achieve the >50% practical work requirement?
- Decide how you will deal with the values and attitude outcomes. Will they be deliberately taught or simply caught as you work through units? How will they be assessed (**not** for the SC) and reported upon in the school context?

STEP THREE: School/faculty requirements

Your school or faculty may have some particular priorities. DET has system priorities which are listed in DET Agenda documents (e.g. Agenda 1998 and Agenda 1999) and should be reflected in your school priorities.

Identify relevant faculty and school priorities. These could be organised as *learning experiences* or matched to syllabus outcomes as *faculty* or *school indicators*. Produce your priorities as a list and have it ready to use in programming. Some examples follow [CODE: "SI" - *school indicator* (with the number e.g. 4.16, being the syllabus outcome to which it is linked.)]

Literacy

SI 4.16 use a dictionary to support understanding of science concepts

SI 4.17 read subject specific words with confidence

SI 4.18 read aloud to an audience

Aboriginal Education

SI 4.4 describe the impact of western culture on the culture of Aboriginal people in Australia.

SI 4.18 demonstrate knowledge and skills through non-verbal activities

ESL

SI 4.17 demonstrate awareness of basic register requirements of spoken English in familiar, formal and informal situations

SI 4.18 read for a range of purposes and identify main ideas and specific information in simple science texts

SI 4.4 relate own culture, knowledge and experience to information in a science text.

STEP FOUR: Faculty policy and procedures document

Having made some hard decisions, now is the time to begin documenting them for the sake of consistency and to avoid, unnecessarily, re-making decisions.

A faculty policy and procedures document is more than a record of decisions. It has a number of purposes apart from accountability. The faculty policy document explains to teachers why your program is the way it is, especially for new teachers who may come in after the process has commenced.

It also provides guidance to teachers about how and what to teach in ways that reflect your school, as well as syllabus, needs and priorities.

The faculty policy and procedures document *might* include statements about:

- student needs, aims, faculty goals, mission statement, principles for action
- faculty philosophy
- school priorities or outcomes
- student outcomes (specific to science learning)
 - for each stage
 - at the end of Year 10
 - at the end of schooling, Year 12
- planning documents, such as *scope and sequence charts*
- guidelines for best practice
- teaching/learning styles
- resources
- assessment policy, such as *assessment programs, guidelines, assessment criteria*
- classroom management
- student welfare
- laboratory procedures and safety
- roles and responsibilities
- timetables
- class structure (streams/vertical grouping).

STEP FIVE: Scope & sequence

A scope and sequence is a mapping of the syllabus outcomes and content statements across Years 7 to 10. **All core content statements are mandatory.** It could also involve a map of specified skills across a stage or across Years 7 to 10, developed to explicate syllabus skill outcomes. School priorities could also be mapped across Years 7 to 10.

You could do this mapping by looking at the outcomes and related content statements that you feel are appropriate for each year and the outcomes and content statements that you think may naturally be grouped together. How this develops depends on whether you are starting with a clean sheet or whether you are starting with your existing programs.

The purpose of the exercise is to provide a way of ensuring that you have included all the outcomes and core content statements in your program and whether there is more than one opportunity for students to demonstrate achievement of each outcome in a stage. It also makes explicit the assumptions you have made about an appropriate learning sequence for concepts and skills across the four school years.

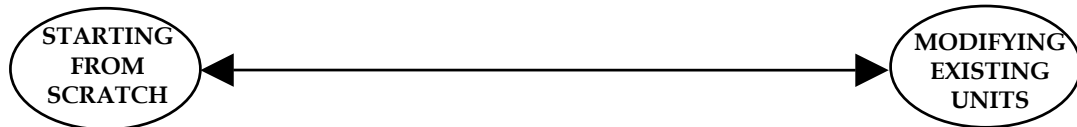
The following map was produced as a starting point for the simulation.

| Year map of outcomes/content statements against units | | | | | |
|---|------------------------|-----------------------|---|---|-------|
| Year | UNIT | PFA | DOMAIN | | |
| | | | K&U | SKILLS | V&A |
| 7 | Life in a Space Colony | 4.1 a, b, c | 4.9 4.9.1a, b c, d 4.9.2a, b, | 4.16a, d 4.18a, b, e 4.22.2d, e | 4.26c |
| | A trip to Antarctica | 4.5 a, c, d | 4.7 4.7.1a 4.7.2a, b, c 4.7.3a 4.9 4.9.5a, b | 4.14a, b, c 4.15a, b 4.16a, b, c, d 4.18a, b, c, d, e, f 4.22.1 | 4.27a |
| | Living Treasures | 4.3 | 4.8 4.8.2a, b, c 4.10a, b, c, d | 4.16 4.18a, b, e 4.22.1a, b, c | 4.25 |
| | Science Show | 4.2 | 4.6 4.6.3, 4.6.4, 4.6.5, 4.6.6, 4.6.7, 4.6.8, 4.6.9, 4.6.10 | 4.13.3a, b, c 4.14d, e, f 4.15a, b 4.18a, e, f 4.19a, b, c | 4.23 |
| | Looking for Oil | 4.4 | 4.11 4.11.1a, b, c | 4.16a 4.12a, c, f 4.17a, b, c, d, e | 4.27 |

Note: Be prepared to modify the choices you make here when the unit is constructed. The development of the scope and sequence is bound to be an iterative process. The initial scope and sequence you design will almost certainly be changed by experience.

STEP SIX: Writing a unit of work

This step describes two **methods** you can use to produce units of work. The two methods are at the ends of the programming spectrum.



It is likely you will use a range of approaches over time, however you should initially use the method you feel most comfortable with.

These two programming methods are supported by a **simulation** which is provided from page 19.

The elements of the simulation are:

| | <i>location</i> |
|---|-----------------|
| • Unit 7.1: <i>Life in a space colony</i> | Pages 20 - 24 |
| • Assessment record sheet | Pages 25 - 26 |
| • Unit report | Page 27 |
| • Unit 7.2: <i>A trip to Antarctica</i> | Pages 28 - 33 |
| • Assessment record sheet | Pages 34 - 35 |
| • Stage tracking sheets (Years 7 & 8) | Pages 36 - 37 |
| • Semester report (for two units) | Page 39 |

For the purposes of the simulation, the following decisions have been made.

- The program will be based on units of work or topics, each 5 weeks long, with 12 units to be taught in Stage 4 and 12 units to be taught in Stage 5.
- Between four and six syllabus outcomes will be targeted each topic.
- The units of work will be written as teaching/learning units so that they can be:
 - used by teachers to develop their class programs
 - given to students as a guide to their learning and to encourage them to take responsibility for their own learning
 - used to develop the faculty assessment program and reports.

Method A: Starting from scratch

The unit of work, *Life in a space colony*, has been developed to show how the model can be used to develop a new unit of work for which there is no existing or previous unit of work.

A1 Write a **framework statement** for the topic or unit.

The following is the framework statement for Unit 7.1 in the simulation.

Students will extract information about space travel from a variety of media and work in teams to investigate, plan and develop a tour manual for space tourists seeking a place on the now regular space trips to Pluto and back. The manual will convey what the tourists will experience and be able to do on the trip. It will include a focus on how these things are different to what they would experience on Earth. The unit will provide opportunities for students to understand the beliefs of others and to value their cultural understandings. Some historical information relating to space travel will also be included as will information about the place of the solar system and how it functions in the universe.

The framework statement is written for students and teachers. It should:

- describe the link to a context (e.g. for the purposes of *motivation, development of conceptual meaning*, etc. In Unit 7.1, the student is cast as a writer in a group of writers. The teacher has decided to do it this way in order to encourage them to use their personal experiences of travel as a starting point for writing about situations in space that will lead to the development of more scientific concepts related to space travel.
- identify the prescribed focus area/s to be addressed (e.g. the history of science)
- outline the scope of the domain outcomes and content to be addressed in the unit (K&U, skills, and values and attitudes)
- make explicit particular emphases, such as literacy and numeracy strategies
- identify the teaching/learning strategy e.g. *investigative learning, independent learning, modelling, cooperative teams*, etc
- provide a scenario so that the development of skills is seen as relevant for a situation by the students.

A2 Select the **outcomes** and **content statements** from the PFA and Domain.

The intention is to limit the number of outcomes addressed in each unit of work to about seven or eight, mainly because this appears to be as many as can be practically managed for the purposes of assessing student

achievement and to use when evaluating the effectiveness of the unit of work later on.

In reality, much of what you do in each unit relates to many outcomes, particularly in the skill, and values and attitudes domain.

In this case the PFA is *History of Science* (4.1). The Domain outcomes are 4.9, 4.16, 4.18, 4.22 and 4.26. This unit will not address all of the syllabus content statements for these outcomes. The rest will be addressed in the other Year 7 and Year 8 units.

A3 Select **school/faculty priorities** (e.g. Literacy: *speaking, writing*; multicultural perspectives; learning styles).

Decide how they will be incorporated into the program. It may be convenient for you to express school or faculty priorities as separate school outcomes (different to syllabus outcomes) or as particular activities and related indicators. To reduce confusion we are advocating the latter about outcomes.

A4 Design appropriate **teaching/learning activities** to allow students to achieve the identified outcomes for the topic.

A5 Establish what **resources** are available and how they will be accessed.

A diversity of resources should be used, including:

- science and other faculty equipment
- text books (personal issue or class sets?)
- computer resources such as data sensing/ data logging, networked rooms, free standing units; authoring tools, software programs and Internet?
- other media resources including library (newspapers, reference, video, CD ROM?)
- learning spaces other than those traditionally associated with science such as courtyards, multipurpose hall, corridor spaces, etc
- local natural, governmental, industrial or commercial resources
- local community individuals and groups.

A6 Write **indicators** which are specific descriptions of student behaviours that are indicative of achievement of a syllabus outcome.

Indicators can be developed from the syllabus content statements as a specific statement of how students may show achievement of an outcome.

A7 Consider the situations you will provide for students to demonstrate the behaviours made explicit in the indicators. These can be developed into assessment tasks.

Assessment is the selection by a teacher of a few behaviours or responses from a range of student behaviours for recording as evidence of achievement related to an outcome. It may involve the use of specific tasks which are designed to elicit the required responses or behaviours or it may involve informal observation by the teacher during teaching and learning activities. At some stage, a judgement will need to be made using this evidence to conclude that a particular outcome has (or has not) been achieved.

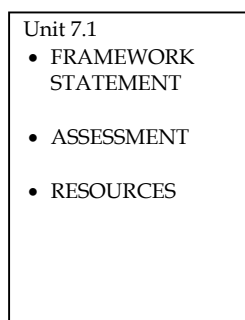
In an outcomes focused program it is important to plan your assessment and to at least draft formal assessment tasks as you construct your units of work. Where possible, assessment tasks should be designed to allow students to demonstrate achievement at other stages. In the simulation, Stage 5 outcomes have been included to assist teachers to judge if students are achieving beyond Stage 4. Further advice relating to assessment and reporting is given in the next section.

A8 Decide how the **elements of a unit** will be arranged on paper or computer.

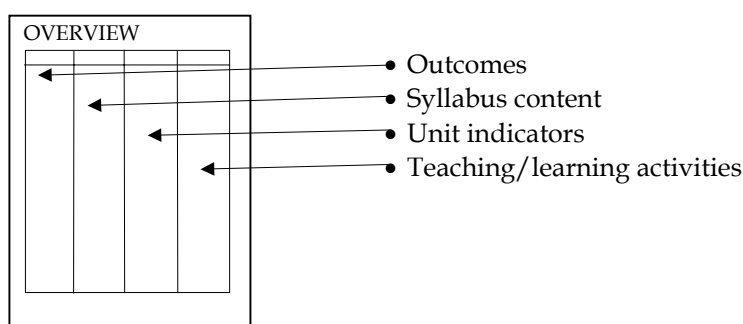
Organise your units so that the links between the elements (*objectives, outcomes, content statements, indicators, teaching/learning experiences, etc*) are clear and useful. Consider how teachers can work with them to develop their own class program.

In the simulation, units are organised in the following form:

Unit cover sheet



Unit overview



Other elements of a unit might be:

- vocabulary
- suggested homework
- remediation ideas
- extension ideas for able or highly motivated students
- registration.

A9 Write the units.

Negotiate who will do it and how other staff will contribute.

Method B. Using your existing program as a starting point.

The unit of work, *A trip to Antarctica*, has been developed to show how the model could change if you wish to modify a useful unit developed under the old syllabus.

B1 Choose a **current unit of work** that you feel has been successful and evaluate it.

Discuss why it was successful (students enjoyed it, thought it was relevant, engaging practical work, etc.) and note this information for use in developing a unit framework statement later on.

Evaluate the existing unit against the new syllabus, especially:

- PFAs e.g. *current issues, research and development*
- Context e.g. for the purposes of *motivation, scientific literacy, etc*
- Domain - *knowledge and understandings, skills and values and attitudes.*

Identify syllabus **outcomes** and **content statements** for the unit from the PFAs and Domain.

In this case the PFA is *current scientific research* (4.5). The Domain outcomes are 4.7, 4.9, 4.14, 4.15, 4.16, 4.18, 4.22 and 4.27. This unit will not address all of the syllabus content statements for these outcomes. The rest will be addressed in the other Year 7 and Year 8 units.

B2 Write a **framework statement** for the unit (see **Method A**, Step A1).

The synopsis for a previously successful unit, *Matter*, in an existing program, was:

In this topic students will learn about the three states of matter. They will identify its properties and state how it is possible to change from one state to another. It will include the particle theory and they will conduct experiments to heat water. They will learn about the water cycle.

Comment. As it stands it is difficult to identify a context that makes this a compelling topic with a clearly identifiable purpose. It does not indicate why the student needs to learn these things and it makes no reference to a prescribed focus area. It needs to be rewritten to include these things.

In the simulation the unit title has been changed from *Matter* to *A trip to Antarctica* and a framework statement written:

Scientists work in many fields and situations. In this topic, each student will take on the role of a science writer for a large newspaper. The editor of the newspaper sends the writer to accompany a hydrology team on a scientific expedition to Antarctica for the summer (3 months: December, January, February). The task is for the writer to:

- *investigate what will be experienced by way of weather extremes. The impact on the forms of water (solid, liquid and gas) in the water cycle should be an explicit focus of attention.*
- *describe difficulties in using water in extremely cold conditions and provide practical advice to readers about how to survive such conditions.*

Students will gain confidence in reading aloud and working independently. They will apply knowledge to new situations and write explanation text types for a specified purpose and audience.

B3 Identify **school/faculty priorities** (e.g. Aboriginal Education policy; Literacy: *reading, writing*; using computer-based technology).

Decide how they will be incorporated into the program.

B4 Modify **teaching/learning activities**.

Use those activities found valuable from previous experience with the topic and add others to express the context and to provide opportunities for students to demonstrate achievement related to outcomes for the prescribed focus area and domain.

B5 Evaluate **resources** and consider new opportunities - refer to A4.

B6 - B9. Refer to Steps A6 - A9 (Method A) for information on how to complete writing your unit of work.

Assessment plan and procedures, and reporting

Your assessment of a student's achievement of outcomes involves you making a professional judgment about whether the indicators you have observed in a student's work satisfy you that the student has achieved the outcome.

It is unlikely that the evidence from one unit of work would convince you that they have achieved a particular syllabus outcome, because the outcomes have been written at a level of generality that tries to capture some aspect of learning that would typically occur over a two year period (i.e. in the time it takes a student to work through 12 different units of work).

In an outcomes focused program, the method of recording of assessments is influenced by the syllabus outcomes and the form of reporting to be adopted.

You may decide to record your assessment in words, as numbers, or as codes or grades. Whatever you decide, the interpretation should be clear to others who may have to use your assessments in another context or in your absence.

Achievement can be indicated in all sorts of situations as well as formal testing situations. A task that is useful for teaching, can also be useful for assessing (e.g. assessing how well students handle equipment in an experiment).

Students should be issued with your assessment plan and procedures.

To assist you to choose the most appropriate assessment strategies, refer to:

- *Principles for assessment and reporting in NSW government schools*. DET 1996
- *Assessment and reporting issues 7-12, Bulletins 1, 2 & 3*. DET 1998. More Bulletins will be available through 1999
- *Securing their future: Subject based assessment materials for the school certificate – Science folder*. There are ten assessment tasks, suggested assessment strategies and annotated work samples that you may want to use as models for your assessment
- *Assessing and reporting using stage outcomes, Part 1*. Board of Studies NSW, 1996.

A suggested approach to assessment using outcomes as the focus follows.

1. Choose the most appropriate assessment strategies.

Possibilities include *observation sheets, performance assessment* (including projects or assignments with a process diary for verification, speeches,

experiments, debates), *class tests, peer and self assessment* (using checklists), and *student journals*.

2. Decide on the number and types of assessment tasks and develop an assessment plan.

In the unit *Life in a space colony*, the teacher has chosen the following assessment tasks:

Formal assessment

Diagnostic test: *What happened last night*, Tapping students' science beliefs, ACER kit. Use to establish and inform students and the teacher of prior learning.

- TASK 1. Written class test - 4.1a, c, 4.9.1b, c, d, 4.9.2a, b;
 TASK 2. Writing task - 4.1b, 4.9.1a, 4.16a, d, 4.18a.
 TASK 3. Group plan of the trip to space, presented in writing - 4.22.2e; presented orally - 4.18a, 4.22.2d, e;
 TASK 4. Manual for tourists - 4.9.2b, 4.16a, d, 4.18a, b, e.

Informal assessment

Observations of students engaged in:

- researching in library - 4.16a
- making scale models - 4.9.2
- reading a variety of given texts - 4.16d
- solving problems as a team member - 4.22.2d
- a simulated crisis as a team member - 4.22.2d.

3. Write the tasks.

For each task, consider carefully:

- precisely what is being assessed. Use the indicators related to the unit's syllabus outcomes and content statements.
- that the task is created as openly as possible to allow students to demonstrate higher levels of achievement than the targeted outcome
- the number of opportunities (more than one item or question) within each task for students to demonstrate achievement
- how the task instructions, both written and oral, are given to ensure students clearly understand the task and the outcomes being assessed
- how each item within the task will be marked (e.g. as a ✓ or ✗, 0 or 1; given a mark or grade; or written comments related to indicators)
- referencing to the appropriate content statements and therefore to the appropriate syllabus outcome

- that the tasks satisfy the principles for effective assessment.

These points are important to ensure that your assessment supports outcomes focused learning.

4. Record the assessment in an appropriate form.

The recording of outcomes focused assessment procedures may involve some change from a teacher's traditional mark book. However there are a variety of useful systems available for scrutiny.

The simulation uses one such system which allows easy movement to a linked reporting procedure. Read the following description while referring to the *Assessment record* sheets for each unit in the simulation.

Assessment information is recorded in code (ticks and crosses) on an assessment sheet. The sheet lists the outcomes and indicator statements from the unit. It provides a column for the teacher to record their assessments. The system requires a separate assessment sheet for each student for each unit. The teacher records each time a student responds to a item in an assessment task. The item relates to an indicator which is referenced to a content statement so that a clear link to the appropriate outcome is recognisable.

*Enter informal assessment information (**Inf**) at any time.*

Each record sheet could be added as part of a portfolio for each student. A big advantage of this system is that useful information on student achievement can be passed on to future teachers of the student.

5. Design a report format which meets your needs and is compatible with school requirements.

In the simulation, reports can be generated from column 1 of the unit assessment record sheets for one or more units.

Teachers can determine the achievement level for each student by referring to one or more unit assessment sheets and using the following code to report achievement of outcomes for a stage.

Reporting code:

1 - **progressing towards**

2 - **achieved**

3 - **working beyond**

It may be useful to have all the outcomes for a stage together on one sheet to refer to while completing reports (See the sample *Stage tracking sheets* in simulation, page 36-37. These are designed to be used with each student and can also be used as planning sheets when mapping outcomes over a stage). However reports could be written directly from individual students' unit assessment sheets.

Examples of reports are given in the simulation:

- The report on page 27 is a faculty report generated from the program directly using the outcomes column and could be issued for each unit of work.
- The report on page 39 is a report for two units. Such a report could be issued twice a year and developed from a small number of units of work.