MODULE CONTENT

Module Title: # ASSESSMENT IN SCHOOL SCIENCE

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Module Description:

What are some of the dilemmas associated with assessment in science? How can we decide whether we are using good quality assessment procedures? This module examines some of the challenges associated with assessment in science and provides participants with an opportunity to reconsider existing practices as well as adding some new approaches to their science assessment repertoire.

Summary of Activities:

	Title	*Min*
1.0	Views of Assessment	10
2.0	Values and Assessment	25
3.0	Cocopops Probe	15
4.0	Assessing Creative Writing	40
5.0	Blood System Analogy	30
6.0	Question Production	10
7.0	Fishbowl Discussion /Cocopops Revisited	30
8.0	Final Debrief	15
	Total	175

Module Outcomes:

- To encourage participants to reflect on their views about the different purposes for assessment.
- To assist participants in identifying their values in relation to assessment in science as well as identifying discrepancies between stated beliefs and actions.
- To consider the range of purposes for assessment and the types of assessment which match these purposes.
- To explore the use of a diagnostic assessment tool (Probe of Prior Views) which can be used to identify students' understanding of science concepts prior to formal teaching.
- To discuss the use and management of student portfolios as an assessment tool in science.
- To provide an example of an alternative approach to assessment (Translation task) which can be used to identify gaps in students' understanding of written communications.
- To consider the role of creative writing in science and to assist participants in the assessment of different forms of science writing.

Resources and Materials:

- Small packet of Cocopops
- Paper for participants to write on
- OHTs 2.1, 7.5
- Attachments 1.1, 3.2, 4.1 (1 per participant)
- Attachments 4.5, 5.2 (1 per small group)
- White Board Markers
- OHT markers

Activity 1: Views of Assessment

Purpose: For participants to identify their views concerning the purposes for assessment.

Teaching Procedures: Semantic Map

Time allocation: 10 Minutes

What to do

FACILITATOR	PARTICIPANT
1.1 Explain the purpose of semantic maps, hand out maps to participants and set a time limit. (Approx. 5 mins) See Attachment 1.1 (Enlarge map to A3) 1.2 Explain that during the session participants will be given opportunities to add to or modify their semantic maps following different activities. Some time will be given in the debrief for participants to revisit and reflect on their maps.	1.1 Complete maps

Discuss/Consider:

- How can you see semantic maps being used in your science teaching? What is their function as assessment tools? (One idea is that they can be used as ongoing assessment, tracking change in students' ideas).

- Participants have recorded their beliefs about what the purposes of assessment are. Compare this through discussion with what the purposes of assessment should be for each of the groups.

Tips and Tricks:

- Encourage participants to use a different coloured pen when later making modifications to the map.

- Encourage participants to revisit their maps as the module proceeds. Most participants should be able to identify at least one change in their thinking about assessment by the end of the module.

- Revisiting map at the end of the module may allow opportunity to devise a set of criteria for the assessment of semantic maps. Using the criteria devised, participants can assess each other's maps.

Activity 2: Values and Assessment

Purpose: For participants to identify their own values in relation to assessment in science and to consider the values held by others.

Teaching Procedures: Attitude Scale

Time allocation: 25 Minutes

What to do

FACILITATOR	PARTICIPANT
2.1 Mark out a continuum on the floor/wall*. One end of the continuum indicates strong agreement, while the other end indicates strong disagreement. Explain that a series of statements will be read out. See OHT 2.1 for Values Statements. 2.2 Ask questions of the participants when they have placed themselves on the continuum following each statement. **Questions** • Why have you chosen to stand where you have on the continuum? • Do you assess for this in your classroom? How? • If you value it and do not assess for it, why not?	2.1 After each statement participants will move to a place on the continuum which best represents their level of agreement with that statement.
It is important for the facilitator to generate discussion between participants concerning their different views. This can be done by encouraging individuals to explain to the group reasons for the position they have taken. The facilitator may need to place her/himself on the continuum, in order to encourage discussion about a particular statement.	

Discuss/Consider:

- What is assessed? Is this limiting? Do we assess that which is traditionally easy to assess?
- Could you assess something that you are currently teaching in your science course using this procedure? (The notion of a probe of prior values may be worth discussing at this point.)

Tips and Tricks:

- * If the continuum is marked on a wall, then each participant needs to write his/her name on a piece of paper which can then be pinned to the continuum in a position which best reflects the beliefs of the participant for that question.
- The facilitator may need to play devil's advocate and take on an extreme view to generate some good discussion.
- Allow participants to move if they are persuaded by the arguments of others.
- The value of this activity lies in participants confronting the (often uncomfortable) recognition that aspects of science learning in the classroom that they value highly are often not regularly assessed, whereas aspects of learning that they do not value highly (eg. rote learning) are regularly assessed. If teachers value aspects of good learning in science (eg. discussion) these must be included in assessment and assessed in a way that reflects their value.
- This maybe a confronting experience for some people. After the activity, the facilitator should acknowledge the importance of participants' honesty and willingness to contribute. Recognising conflict between beliefs and practices can lead people to feel vulnerable or defensive. The facilitator can present herself as a person who also experiences values confusion. The purpose of the activity is that through recognising discrepancies between beliefs and actions, participants may be encouraged to bridge the gap through changing practices or beliefs.
- Following this activity, participants should return to their semantic maps to add to or modify any of their ideas.
- Primary teachers may wish to modify the wording of the attitude scale statements to better reflect science-teaching practices in primary schools.

Activity 3: Diagnostic Assessment

Purpose: To use an example of diagnostic assessment (Probe of Prior Views) and to discuss the function and usefulness of this form of assessment in science. Also, to identify participants' understanding of the function of the digestive system and the relationship between the digestive system and other systems of the body.

Teaching Procedures: Probe of Prior Views

Time allocation: 15 minutes

What to do

FACILITATOR	PARTICIPANT
3.1 Eating the Cocopops. Introduce the activity by passing around a packet of Cocopops.	3.1 Participants to think about the components of the Cocopops and what is happening to them as they chew and digest them
3.2 Ask the participants to record their ideas about the fate of the Cocopops at various times over a 24 hr. period, on a body outline. See Attachment 3.2 for Body Outline and task instructions. (Enlarge body outline to A3 size.)	3.2 Participants to draw where Cocopops might be and indicate what's happening to them at various times (as specified on the sheet).
3.3 Ask for volunteers to explain the fate of the (molecules of) Cocopops at time frames of 5, 10 and 24 hours. (Consider asking volunteers to draw their responses onto an overhead of the body outline.)	

Discuss/Consider:

- Facilitator asks participants to consider the purpose and value of the probe. (The probe can be used as a means of identifying students' beliefs/ideas at the start of a unit/lesson.) Revisiting the task after some teaching/discussion (as participants will do) gives teachers the opportunity to observe changes in students' understanding that can then be used as a means of assessment for one of the learning outcomes. Revisiting can also be used to identify misconceptions or areas for further development.

- The assessment in this case need not be formal. Ask participants how they might use this as an assessment task. This also provides an opportunity to talk about the language of assessment, using the example of diagnostic assessment.

- If one of the purposes of diagnostic assessment is as an indicator of students' preliminary thinking about a particular concept, then it is important for students (and teachers) to keep a record of different pieces of work that students do during a unit (and to reflect on these as progress indicators). This can be done through student portfolios. Ask participants to consider portfolios as a useful tool for both the student and the teacher as a record of learning growth.

- Ask participants to reflect on the value of drawing a response rather than writing it.

- If particular misconceptions are identified at the start of a unit, what are the implications for teachers in terms of curriculum planning? Consider here the need for a flexible curriculum so that the learning needs of students can be addressed. It is pointless to identify misconceptions then ignore them because the curriculum does not allow them to be addressed!

Tips and Tricks:

- Facilitator observes the extent to which participants make links between systems and view the body as a functioning whole. Students commonly view body systems as discrete, independent parts, rather than a functioning interdependent whole.

- Facilitator to take note of the extent to which participants are seeing different ways in which the nutrients from the Cocopops are being used in the body.

- This procedure also provides an example of linking assessment to CSF outcomes eg. Level 5 Life and Living (structure and function) Level 3 Life and Living (structure and function).

Activity 4: Creative Writing and Assessment

Purpose: To assist participants in the development of criteria appropriate to the assessment of creative writing in science. Also, to reflect on the purpose and value of creative writing in science and to consider ways in which these purposes and values link with assessment practices.

Teaching Procedures: Translation Task (Creative Writing /Text Types)

Time allocation: 40 minutes

What to do

FACILITATOR	PARTICIPANT
4.1 Distribute sample of creative writing to each participant. (Read also imaginary or narrative text types wherever creative writing is referred to below). See Attachment 4.1	4.1 Read sample.
4.2 Many science teachers use creative writing (imaginary or narrative text types) as a science activity but are unsure about how to assess it as a piece of science work. Explain that this activity will offer a chance to develop some criteria that may be used in the assessment of creative writing.	
4.3 Ask how many people have used creative writing in science? Why? When?	4.2 Participants to identify what they value in science creative writing.
• If creative writing is seen as a legitimate science activity, then what is important to consider in its assessment? (Suggestions might include: accurate relevant science information, demonstrated understanding of the information used, linking of science ideas, linking science to everyday life, clarity of communication, imaginative response.)	

4.4 After discussion, participants are organised into small groups. 4.5 Hand out additional samples of student creative writing about circulatory system. See Attachments 4.5 (3 creative writing pieces) for extra samples. Participants are asked to assess sample pieces according to the criteria they have developed. 4.6 Ask participants to rank pieces from best to worst according to the criteria they used. Was there consensus amongst the whole group for the ranking of the pieces? If not, why not? 4.7 Use this activity as an opportunity to lead into a discussion about the criteria used by each group. (Do slight differences in criteria used affect the overall ranking? ie is consistency affected?) 4.8 Participants may recognise that variations in criteria selected do not necessarily lead to significant discrepancies in the overall assessment of a piece of work. 4.9 Ask participants about the usefulness of the criteria they developed. How easy were they to apply in the assessment of these pieces? Discussion should lead to consideration of the value of particular criteria in the assessment of creative writing.	4.3 In small groups develop a set of criteria that can be used to assess science creative writing 4.4 Participants work in small groups using samples of creative writing.

Discuss/Consider:

- In what ways can/should students be involved in the process of developing criteria and assessing their own or others' work? (Brings out ideas about what the students' value in their work. Is it the same as what teachers' value? Why/not?)

- What are the implications for teachers/students in involving students in the assessment of their own or others work? (Consider that students will only put in effort when they see personal value in a task and/or they believe the teacher also values the task.)

- Discuss the usefulness of drafting in a piece of science creative writing. In what ways might this be incorporated into assessment?

- Discuss ways in which creative writing can be incorporated as a portfolio piece.

- What place do diagrams and drawings have in creative responses? How should they be included in the assessment?

- What other kinds of creative responses can students submit? For example, can a song or a poem be included? Should the assessment criteria be the same for different kinds of creative response?

- Discuss creative writing as a portfolio piece.

- Is creative writing useful as summative, formative or diagnostic assessment? (Discussion of these terms may be relevant depending on the experience of the group.)

Tips and Tricks:

- Primary teachers will be more familiar with the term "Text Types" to describe what has been presented as Creative Writing in Activity 4. Imaginary and other narrative forms of writing would best correspond to the purposes for writing described in this activity.

- Through discussion of the role of drafting and how this may be used in the process of assessment, the notion of formative assessment can be introduced. Between the draft and the final piece, students have an opportunity to show learning growth which is an important aspect of CSF assessment. This links well with creative writing (including draft) being used as a portfolio piece.

- It is important to realise that there will always be differences between teachers and schools in the assessment of work. However, such variations are usually minor. A good piece of work should be recognised as such by a variety of teachers, and a poor piece likewise.

- Following this activity, ask participants to revisit their semantic maps to add/modify ideas.

Between Session Tasks:

Participants should set a piece of science creative writing for their students. Some time should be spent asking students about what they think are suitable criteria for marking. One suggestion is that the teacher separately prepares his/her own set of criteria and reveals this after students have had a chance to devise their own. Discrepancies can be discussed, it is important to be mindful that students may see the teacher' s responses as "right answers". Participants should consider using samples collected from this task for use in their own sessions.

Activity 5: Diversifying Assessment

Purpose: To provide an example of a translation task (developing an analogy) which can be used to monitor and develop students' understanding of scientific concepts.

Teaching Procedures: Translation Task

Time allocation: 30 Minutes

What to do

FACILITATOR	PARTICIPANT
5.1 Introduce the idea of using analogies to explore and develop students' understanding of complex concepts. When direct experience of a scientific event is not possible, analogies can be a useful way of making (and probing) links between the event and students' own experiences. In this activity, participants will develop an analogy related to the functions of the blood circulatory system.	5.1 Divide into groups of 4
5.2 Hand out task instructions for analogy. See Attachment 5.2. It may be helpful for the whole group to begin with a practice example. Ask participants, "What is the function of the heart in the circulatory system. What part of a city and its roadways compares with the role of the heart in the body?" (One response is that the heart in a human circulatory system is like the CBD of the Melbourne metropolitan area. Both are centres of activity for each system.)	5.2 Divide into small groups. Select and draw symbols on to poster paper.
5.3 Allow 10 mins for groups to complete task. Call for volunteers to share ideas about the symbols they chose and processes they used to decide them.	5.3 Groups to offer ideas about symbols they chose and how they made decisions about which symbol to choose.

5.4 Point out ways in which the task has encouraged participants to explore their understanding of the function of various components of the circulatory system.	

Discuss/consider:

- What knowledge/skills are required for a task such as this? (Suggestions include reasonable knowledge of the concept being converted to analogy, the analogy that is being made must be something that is familiar to students, ability to translate knowledge from one form to another.)

- How could analogy creation be assessed? What would you be assessing for? (It may be helpful to look at the criteria developed from the previous creative writing activity. Would any of these criteria be appropriate to this task?) Could analogy creation be used for diagnostic, formative or summative assessment? (Might it cover more than one of these assessment types?)

- What are the advantages/disadvantages of using a procedure such as analogy creation as an assessment tool? (Advantages include a means of diagnosing students' misunderstanding of concepts, opportunities for students to explore and extend their understanding of a concept, more than one answer is possible depending on the explanation given. Disadvantages include the need to choose analogous situations with which students are familiar.)

- Discuss some of the limitations of models and analogies. To what extent should students acknowledge possible limitations?

- What are some variations on the analogy task? (Give students a complete analogy and ask them to consider its merits, compare one analogy against another, students choose their own analogy and justify it, students could make a model of the analogy rather than drawing it.)

- Revisit semantic map. Add/modify as appropriate.

Tips and Tricks:

- Facilitator should aim to draw out comments about the links between the extent of students' understanding of a concept and the ability to create workable analogies.

- There may be time to discuss ways in which an analogy activity may be included as a portfolio piece.

Activity 6: Asking Questions

Purpose: To examine the role of student question asking in the assessment of students' understanding of science concepts. This activity has direct links with Science Teaching and Learning, Activity 5, Sources of Student Engagement.

Teaching Procedures: Question Production

Time allocation: 20 Minutes

What to do

FACILITATOR	PARTICIPANT
6.1 Students are often assessed on their ability to answer questions in science, but they are rarely assessed on their ability to formulate questions. Facilitator explains that in this activity participants will have a chance to form some different kinds of questions and discuss ways in which this can be built into assessment.	
6.2 Ask participants to form groups of three.	6.1 Take out Cocopops probe. Within group, list in point form all that the group knows about the fate of the Cocopops over the 24 hour period. 6.2 After compiling the list, each group should devise three questions that would challenge a person's understanding of the digestion of Cocopops. Write each question on a separate piece of paper.
6.3 Refer to module Science Teaching and Learning 2, OHT 2.2 for question types. 6.4 Collect the questions and keep them for the next activity.	

Discuss/Consider:

- How demanding was the task of producing questions? Do you find it easier to generate questions when you know the content well? (It may be worth discussing how easily participants would have completed this task when they first completed the probe.)
- Have you used students' questions in assessment? How/Why not?
- What are some different ways of assessing student questions?
- How reliable is question asking for revealing student understanding of a particular concept?

Tips and Tricks:

- Few students spontaneously ask high quality thinking questions in class. Many students do not acquire the skill easily. If participants value the sorts of learning required by question production then sufficient class time must be devoted to practising this skill and to allow students to see the nature and purpose of their role as question producers.
- Allow time following this activity to return to semantic maps for modification/additions.
- This will be a good task to draw out differences between ways in which primary and secondary teachers conduct their assessment. Primary teachers' assessment is much more likely to be based on field observations of students, which includes question asking.

Activity 7: Fishbowl Discussion

Purpose: Discussion is a popular and flexible teaching method, however it is not often used as a formal assessment tool. In this activity participants will be involved in a planned discussion, (Fishbowl) then reflect on the value of this experience as a means of assessing students' understanding of science concepts.

Teaching Procedures: Fishbowl Discussion
Interpretive Discussion

Time allocation: 30 Minutes

What to do

FACILITATOR	PARTICIPANT
7.1 Explain that in this activity participants will be involved in a planned discussion. Two questions from the previous activity will be selected for discussion.	
7.2 Facilitator selects 2 questions from those collected. Write questions on to white board. Label questions A and B.	
7.3 Ask participants to form pairs. Each pair should brainstorm possible answers to both questions. (Allow ~7 minutes)	7.1 Participants form pairs and brainstorm possible answers to both questions.
7.4 Ask members of each pair to choose to be A or B. All A's will be discussing possible answers to Question A, while all B's will be discussing Question B. Explain that the discussions will take place one at a time.	7.2 All A's to form a (seated) circle. B's should make a circle around the outside of A's circle, so that B's can observe the discussion taking place.
7.5 Explain the procedure for a Fish Bowl discussion. Those in the outer circle will observe those in the inner circle as they discuss their responses to the question. See OHT 7.1 for discussion guidelines.	7.3 Outer circle members to observe and comment on progress of discussion.
7.6 Swap roles.	

Discuss/Consider:

- What was the effect of having time to prepare for the discussion?
- What are the purposes of the Fish Bowl technique?
- How could you measure a person's contribution to the discussion?
- How could the purposes of this discussion forum be linked with its assessment?
- Ask primary teachers to comment on the way in which they use observation in the assessment of student progress.
- Discuss the advantages/disadvantages of computer assisted discussion. (One obvious advantage is that students may feel more willing to respond when they can have time to read the responses of others and are allowed time to think about their own response. An advantage for the teacher is that a record can be kept of student contributions.) How could you operate a discussion using a single computer, or using several computers that are not connected to a network?
- How much of what is regularly assessed in science is product? How can the assessment of process, values, decision making, links with the real world be incorporated in a way that shows that these are valued? In what ways can a balance be achieved between the different domains?

Tips and Tricks:

- A discussion is more than the teacher presenting some information and then asking questions of students. If the discussion is to be a useful learning experience the students must need and want to actively participate and to do that there must be a clear purpose for what is being discussed and why.
- Be careful to select questions for discussion in this activity that will be most likely to generate a variety of different responses.
- If it is not raised during discussion, discuss the idea of using discussion in conjunction with other factors to identify student learning and development.

Module Review

Reflection:

1. Revisit Semantic map.
   Ask participants to comment on:
   - types of responses they made
   - changes that they made (or didn't make)
   - how participants see the function of the semantic map in relation to their thinking about assessment in science.

   Ask participants to consider "What does a good semantic map look like?"
   As suggested in Activity 1, participants may have time to formulate a set of criteria for assessment of semantic maps, then apply these to individual maps.

2. Ask participants for their views about what has been presented in the session. Which of the procedures from the module would participants be prepared to try out in their own classrooms? Are there any procedures which participants consider too risky? What might help to increase comfort level to try the procedure?

3. Revisit thinking about Portfolios. How could they be used within participants' own science teaching?

4. Revisit thinking about values related to assessment. While this module may have presented a set of teaching approaches that participants may be prepared to try, they are more importantly a set of assessment tools to help to build a more authentic picture of students' learning in science. Ask participants to comment on the difference between what they value and what they currently assess in the classroom. How do values restrict assessment practices?

Between Session Tasks:

Participants should set a piece of science creative writing for their students. Some time should be spent asking students about what they think are suitable criteria for marking. One suggestion is that the teacher separately prepares his/her own set of criteria and reveals this after students have had a chance to devise their own. Discrepancies can be discussed and the teacher should be mindful that students may see the teacher' s responses as "right answers". Teachers may wish to use samples from writing produced by their own students in Activity 4.

Support Materials:

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Killen, R. (1996). *Effective Teaching Strategies. Lessons from Research and Practice*, Social Science Press: Sydney

Kempa,R. (1986). *Assessment in Science*, Cambridge: Cambridge University Press.

Grant,P, Johnson,L., & Sanders, Y.(1990). *Better Links*: *Teaching Strategies in the Science Classroom.* Melbourne: STAV Publishing

Baird,J., and Northfield, J.R. (1992). *Learning from the PEEL Experience* Melbourne: Monash University Printing Services.

Paulson,F.L., Paulson,P.R., & Meyer, C.A., What Makes a Portfolio a Portfolio?, *Educational Leadership* Vol.48, No.5, Feb.1991, pp.60-63

Chapman, R. (1993) *If the Shoe fits…How to develop Multiple Intelligences in the Classroom*, Hawker Brownlow.

Electronic references:

Assessment and Reporting Support Materials (SOFWEB)
http://www.sofweb.vic.edu.au/assess/index.htm

Glossary of Portfolio Assessment
http://webby.sdcoe.k12.ca.us/notes/5/glossary.html

North Carolina Middle School Association - Portfolio Assessment in the Middle School.
http://www.uncg.edu/edu/middle/Portfolio.html