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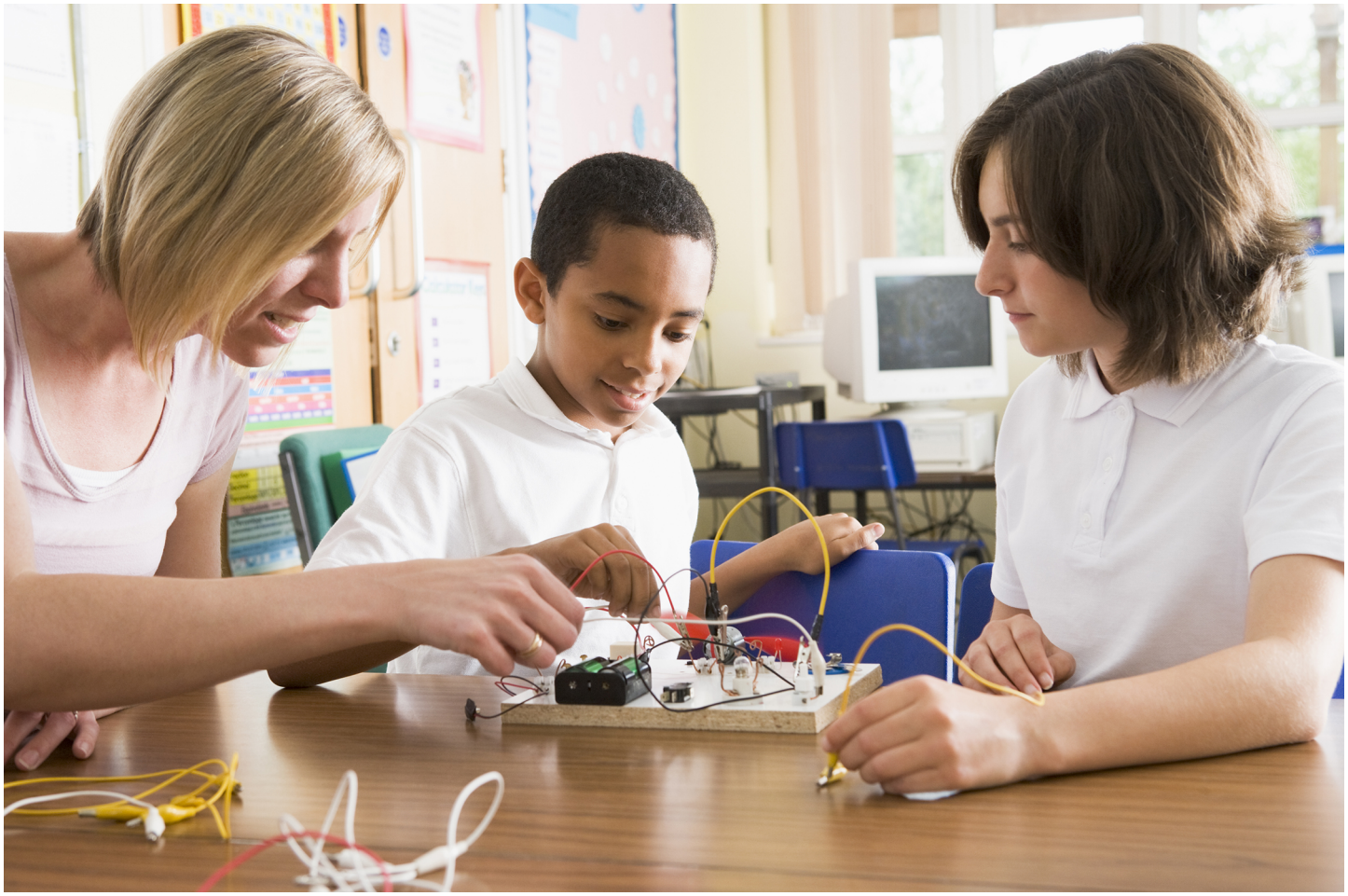
Assessment in secondary science



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Contents

Introduction

This free course, *Assessment in secondary science*, will identify and explore some of the key issues around assessment in secondary school science. Engaging with these issues and debates will help you to reflect upon and develop your practice as a science teacher. You will also develop a greater awareness of the role of assessment in science education.

In Section 1 you will consider what is assessed in science. Section 2 examines how assessment can support learning. This is developed in Sections 3 and 4, which focus on assessing students' conceptual understanding and involving students in assessment.

This course you help you to examine some of the many issues that surround assessment. You will explore the connection between assessment, teaching and students' learning, as well as how to involve students in assessment. You will be asked to draw on your own experiences of, and ideas about, assessment; how the concept of assessment has changed in recent times; and the principles underpinning assessment that support learning and what teachers assess in science.

Now listen to an introduction to this course by its author, Sandra Amos:

Audio content is not available in this format.

As you work through the activities you will be encouraged to record your thoughts on an idea, an issue or a reading, and how it relates to your practice. Hopefully you will have opportunities to discuss your ideas with colleagues. We therefore suggest that you use a notebook – either physical or electronic – to record your thoughts in a way in which they can easily be retrieved and revisited. If you prefer, however, you can record your ideas in response boxes within the course – in order to do this, and to retrieve your responses, you will need to enrol on the course.

This OpenLearn course is part of a collection of Open University short courses for teachers and student teachers.

Learning Outcomes

After studying this course, you should be able to:

- articulate what it means to make progress in science
- outline the features of formative assessment
- use a variety of techniques to assess students' conceptual understanding
- evaluate the implementation of some formative assessment strategies
- explain the value of involving students in assessment.

1 Assessing progress in science – what's involved?

There are two key considerations when thinking about assessment in science:

- What elements of science should be assessed?
- How can progress in these elements be identified?

1.1 What should be assessed in science?

The science curriculum is not simply a fixed collection of facts, but is a complex discipline that includes various skills as well as understanding concepts and scientific processes. Consequently, assessment in science should not be concerned only with what 'facts' students can memorise and recall without understanding.

Activity 1 What is assessed in science?

Allow about 30 minutes

Read the curriculum document relevant to your location and identify the science skills, processes and understanding that students are expected to acquire at Key Stage 3.

Select ten statements that represent the range of skills, processes and understanding of science as an activity (not scientific content knowledge). For each statement, consider how it could be assessed.

Teachers need to use a range of assessment techniques to match different aspects of science learning. If the concern is to assess skills and processes, what kinds of assessments are required? Clearly timed, written, externally set tests may not be appropriate for assessing such processes. Some aspects have to be observed, for example, to confirm the accuracy of student observation. Measurement and oral questioning are also useful for corroborating evidence, as students do not always write down everything they know.

1.2 Progress in science

As a teacher, it is your responsibility to help students make progress in learning. That is, as a result of engaging in the learning activities you provide in a sequence of lessons, your students will know what you intend them to know at the end, and that is more than they knew at the start. However, progress is a broad concept and is understood to be about more than acquiring science content knowledge. There are many different elements to consider including conceptual understanding, technical skills, investigative skills and understanding of the nature of science. When thinking about each of these some notion of what it means to make progress must be agreed and shared. You also need to have a

clear understanding of the learning that they need to do, where they are now and how best to help them bridge the gap.

Reflection point

What is distinctive about progression in scientific understanding in relation to content, skills and understanding of science methodology?

Progression takes place over a number of different timescales: for example, across a sequence of lessons, or a year, or a key stage. Secondary school departments and teachers have to decide how to structure their teaching over these timescales in order to support students' progression in learning.

Progression can be considered in two ways:

1. Progression in relation to the learning experiences planned by the teacher; that is, planning for:
   - increasing breadth of study
   - greater complexity of phenomena studied
   - introducing more precise subject terminology and vocabulary
   - increasing use of generalised knowledge and abstract ideas
   - requiring greater precision in undertaking intellectual and practical tasks
   - a more mature awareness and understanding of issues and of the context of differing attitudes and values within which they arise.
2. Progression in students' performance; that is, the kind of performance expected in students' work as they make progress in the subject. Progress in this sense is seen as students demonstrating increasing levels of achievement. Level descriptions are this kind of statement; examination grade criteria and a range of marking schemes and criteria for specific units of work have a similar purpose.

Whatever system is in place, if progress in learning science is to be assessed, teachers need to have a clear framework for progress.

Activity 2 Examining progress in science

Allow about 30 minutes

Table 1 gives some dimensions of progression in a person's knowledge and understanding. Fill in other science examples (as far as possible) for the other dimensions suggested.

Table 1 Progression in a person's knowledge and understanding of dimensions of progression

Example of dimension of progression	From	To
Narrow to broad: experiences and understanding in a small number of examples to many examples in a broad range of context	Knowing that a paper towel draws up water	Knowing that liquids rise up a capillary tube or that water moves up a plant stem

Simple to complex: understanding simple events to knowing and understanding complicated situations	*Provide your answer...*	*Provide your answer...*
Using everyday ideas to using scientific ideas	*Provide your answer...*	*Provide your answer...*
Qualitative to quantitative explanations using formulae and equations	*Provide your answer...*	*Provide your answer...*
Explanations based on observable entities to ones using unobservable, idealised entities.	*Provide your answer...*	*Provide your answer...*

Just as with knowledge and conceptual understanding of the content, assessing skills should be an integral part of everyday teaching, so that both students and teachers can build on existing skills and develop new ones. Teachers need to use a range of assessment techniques to match different aspects of science learning and provide students with opportunities to practise skills. By using different assessment techniques, teachers can differentiate between knowledge that is simply memorised and the nature of students' conceptual understanding.

2 How can assessment support learning in science?

What does ‘assessment’ mean to you? For some people it brings to mind timed, written tests, or tests that determined which class they were placed in. Often associated with these memories are feelings of anxiety or elation. For those who find learning more difficult, assessment may impact on their self-confidence and self-worth, as well as their attitude towards the subject and towards school. This is unsurprising given that examinations mean that whatever someone feels they have learned on a course, their knowledge was going to be summed up by a timed test. If a person had an off-day, if the questions did not quite correspond to the ones they knew the answers to, or if mistakes were made in the stress of the moment … then hard luck!

More often than not, assessment in the past was done to students. Its main purpose was not to help improve learning; it was to find out what someone did (or did not) know. Even with smaller-scale assessments – say, a piece of homework – learners were often simply given a mark or a brief comment (‘excellent’, ‘could do better’, ‘neat work’, and so on). Again, the key point is that assessment was done to the learner. A significant recent development has been the recognition that assessment can be used to promote and support learning. Today, summative assessment is balanced by assessment for learning (AfL), also known as formative assessment.

2.1. Assessment for learning

Assessment for learning (AfL), as opposed to assessment of learning (AoL) is carried out on a continual basis in order to inform subsequent planning and teaching. Formative assessment is done for students and with them, instead of to them. It is used to promote learning through informing teachers and students about what needs to be done to make progress. It requires teachers and the learners themselves to make continual assessments of understanding and progress in order to identify individual, evolving needs and shape teaching and learning accordingly. Therefore, ideally, assessment should not just be an isolated part of a lesson; it needs to be a systematic and integrated part of all lessons. Most importantly, without the process of adapting teaching, the assessment is not formative – it is merely frequent.

A summary of the differences between AoL and AfL is provided in Table 2.

Table 2 A summary of AoL and AfL

	Assessment of learning	Assessment for learning
Purpose	To find out what students know, understand and can do (skills)	To find out what students know, understand and can do (skills)
Uses	Reporting to others	To inform planning
	Judging school effectiveness	To support students in making and monitoring progress
	Certification	To support teacher evaluation of the effectiveness of practice

Audiences	Parents	Students
	School	Teacher.
	External agencies (e.g. inspections).	

The importance of formative assessment and the crucial role that it plays in enhancing teaching and learning is supported by a great deal of research. Perhaps most significant though, as David Hargreaves (2001) reminds us, is that assessment should be the servant of teaching and learning and not their master.

There are four important issues to bear in mind when thinking about making assessment integral to learning. Teachers should do the following:

1. **Identify exactly what they want students to learn; use a task that is designed to enable students to learn, and blend in an appropriate activity that will allow assessment of the students' learning.** Teachers need to assess not just how well students can perform individual techniques and skills, but also how well they understand wider concepts and can apply their understanding in less familiar contexts.
2. **Assess students as individuals.** Students learn at different rates. They learn different things from each other and from their experiences, and some develop misconceptions. So students need to be assessed as individuals in order to ensure that teaching is matched to their particular needs. This means that assessment must have a clear purpose, and be designed to yield the necessary information.
3. **Integrate assessment into every lesson.** To match teaching to individual needs, assessment must be integrated into day-to-day teaching and built into lesson planning. The information gained from assessment should be used to plan subsequent activities. In fact, it is only when the evidence from assessment 'is actually used to adapt the teaching work to meet learning needs' (Black et al., 2004, p. 10) that such assessment becomes assessment for learning.
4. **Assess the effectiveness of their teaching.** As well as assessing students' learning, teachers must also assess their own actions. Assessment provides evidence about the effectiveness of the decisions that teachers take, so that they can modify their actions accordingly.

Assessing students' prior understanding is an important aspect of formative assessment. Teachers need to establish whether students have the prior knowledge and understanding to build on. If they do not, then some revision or consolidation will be needed.

Clearly, it is better to carry out such an assessment before you have planned the sequence. Finding out in the first lesson that the pupils don't have the required understanding may lead to a nasty surprise for you. On the other hand, if the pupils already have a good understanding of the topic, they will be bored and a learning opportunity will have been missed.

2.2 Developing assessment practice

Formative assessment is used in a variety of situations and for different purposes; for example, to:

- gauge how well the students have grasped ideas (with whole classes)
- find out what learners already understand and can do before teaching

- monitor understanding, progress and plan next steps with individuals
- understand problems that individuals are having with learning
- encourage learners to take ownership of their learning.

Reflection point

What techniques have you observed or used in your own teaching for the different purposes of assessment listed above? How effective do you think these are?

It is important to use a variety of assessment methods. Assessment also needs to be manageable. One way to achieve this is to design assessment tasks or activities that students can do independently. This will leave you free to focus on the students that you are unsure about.

No matter what the purpose or situation, if formative assessment is to promote learning, you need to:

- be aware of the intended learning objectives
- look for evidence or devise activities to determine individuals' achievement of the objectives
- investigate the nature of the difficulties or where problems exist, and establish remediation measures
- involve students in the assessment process.

Activity 3 Classroom assessment methods

Allow about 30 minutes

Resource 1, 'Assessment techniques', describes some classroom formative assessment techniques.

For each of the techniques described, consider:

- the nature of the assessment information that could be obtained by the technique
- the possible criticisms (for example, how reliable is it?)
- the possible challenges of implementing each one in a class of 30 students.

Isolated assessments may help assess students, but will only tell you about a student's performance or response to a particular question on a particular day. General judgements about individuals made on the basis of such assessments could be flawed, even when they are well designed, as many students suffer from anxiety when being tested or assessed.

It is often preferable to assess the knowledge, skills and understanding that students bring to a lesson by setting up a challenging, interactive task that encourages students to reveal how they see a topic.

Activity 4 Planning to use formative assessment techniques

Allow about 90 minutes

Watch these two video clips:

- ‘Assessment for learning in KS3/4 Science – Andy and physics’ (YouTube link here. Alternatively, you can read a transcript.)
- ‘Assessment for learning in KS3/4 Science – Anita and biology’ (YouTube link here. Alternatively, you can read a transcript.)

As you watch the clips, identify:

- any assessment of students that the teacher might be doing during the lesson
- which techniques the teacher is using
- opportunities for assessment that the teacher has during the lesson.

For each example you have identified, suggest:

- what assessment information could be gained
- whether the assessment gives the teacher information about the class as a whole or about the understanding of an individual
- the benefits and possible drawbacks.

Assessment is not something that is simply confined to specific assessment points or activities during a lesson. It goes on in the teacher’s head throughout the lesson and is central to effective teaching. Throughout a lesson there are many opportunities to assess students. You might have identified strategies such as:

- questioning
- talking and listening to students while they are working
- judging students’ body language and facial expressions.

These strategies enable teachers to get a sense of whether students understand what is being taught. Different techniques suit different purposes, but all have strengths and weaknesses. For example, some widely used assessment techniques, such as mini-whiteboards and traffic lights, provide a crude snapshot of students’ understanding, and students may copy their friends or simply show the green card to avoid admitting their confusion publicly. Teachers therefore need to evaluate assessment practices critically.

3 How can teachers assess students' conceptual understanding?

Effective assessment will elicit students' underlying conceptual understanding rather than just what information they can recall. Students may do reasonably well in tests that rely on recall and have only a superficial conceptual understanding. Although understanding can be assessed through skilfully written questions, there are other techniques that you can use to elicit students' conceptual understanding and their understanding of the links between different concepts. Such techniques include drawings, predict–observe–explain, sorting activities, relational diagrams and concept mapping.

Activity 5 Assessing understanding

Allow about 2 hours

Part 1: Drawings

Drawings allow students to express ideas that are hard to express in words. For example, students can be asked to draw what's inside the body, how we see objects or how plants get their food (Figure 1).

Figure 1 Students presenting their ideas through a drawing

Figure 2 shows three beakers containing water in a different state: as a vapour, a liquid and a solid. The drawing illustrates a student's view of the way the particles are distributed in these three different states.

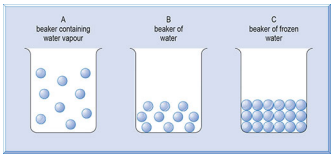

Figure 2 One student's representation of the distribution of particles in different states of water

Note down your responses to the following questions:

- To what extent does Figure 2 match the scientific understanding of the behaviour of particles in solids, liquids and gases?
- What possible misconceptions are revealed?

Now redraw the particles in the containers so that they are more scientifically accurate representations of the water particles. Explain the differences between the two diagrams and the significance of the differences.

Part 2: Predict–observe–explain

Predict–observe–explain (POE) focuses students on an observable event and elicits their theories.

Consider these two situations:

- Situation A: A block of wood rests on a table. Predict what would happen if you pushed the block along the table.
- Situation B: Two objects (e.g. a ball) are the same shape and volume, but of different weights. Both objects are dropped from 30 metres above the ground. Predict which object will reach the ground first. Produce a clear explanation of your reasoning.

Having observed what happens, a student gives the following responses:

- Situation A: 'The block will move and then slow down, because the force is only there at the start.'
- Situation B: 'The heaviest ball will reach the ground first because it falls faster.'

These are typical responses based on common misconceptions about forces. What ideas are these responses based on?

For each situation, answer the following questions:

- What was being assessed?
- What did the students' responses reveal about their understanding?
- What would happen in reality?
- What is the accepted scientific explanation?

Part 3: Concept mapping

Concept maps are not the same as brainstorms, spider diagrams or flow charts. They are more sophisticated because they reveal the conceptual understanding of the person devising the map. Pairs of concepts are connected by words and phrases along an arrow that shows the direction in which each pair should be read. So for example, how would you connect the concepts of 'water' and 'ice'?

Consider the three concept maps in Figures 3–5 (White and Gunstone, 1992, p. 25), which show a variety of understandings of electricity.

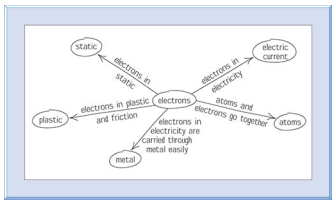

Figure 3 Concept map 1

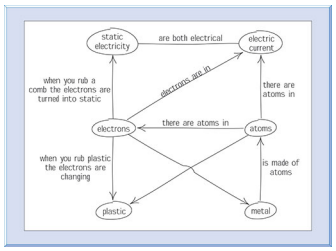

Figure 4 Concept map 2

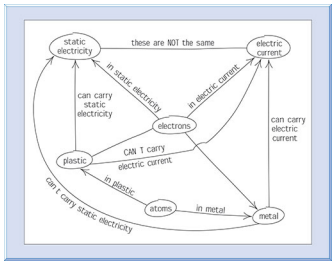

Figure 5 Concept map 3

Next, answer the following questions:

- Which map do you think shows the best understanding and why?
- Which map shows the lowest level of understanding and why?
- What misconceptions are revealed by each map?
- What would you do to confirm your interpretations of the maps?

Follow the instructions given in Resource 2, 'Concept mapping', to construct a concept map of your choice. Then think about the process you have just been through.

- How does the process elicit understanding?
- Which terms caused you the most problems?
- How does the map reflect this?

The connecting words reveal how someone sees the relationships between concepts. Terms that are not used or are not well-connected (spurs) suggest a poor understanding.

Concept maps can be used to support teaching as well as to assess understanding. For example, completing a concept map as a group to consolidate new work enables students to discuss their ideas. By listening to the conversations, the teacher can assess students' understanding.

Plan to try one or more of these techniques in your own teaching. You can find out more about concept mapping and teaching students how to construct concept maps in Resource 2.

4 Involving students in assessment – why and how?

A review of research conducted by Black and Wiliam (1998) revealed that improving learning through assessment requires students to be involved in their own learning, assessing themselves and understanding what they need to do to improve. The ultimate goal is to involve students in the assessment of their learning, but how can teachers do this and what are the benefits?

4.1 Involving students in assessment

There are many ways in which teachers can involve students in assessment, for example by:

- sharing learning goals and assessment criteria with them
- helping them know and recognise the standards they are aiming for
- involving them in self-assessment
- providing feedback that helps them to recognise their next steps and how to take them
- both teacher and students reviewing and reflecting on assessment data.

Involving students in the assessment of their learning means encouraging them to review their work critically and constructively, and involving them in identifying the learning goals that they will work towards. Involving students like this has the potential to empower them and lead to a greater commitment to learning and progress. Students are more likely to understand the learning goals and assessment criteria if they are discussed and devised with them rather than if they are imposed.

4.2 Feedback

An important aspect of formative assessment is feedback, which is most effective when it is a dialogue between the student and teacher. Written feedback is important to students; most, if not all, will look keenly at the grades, comments and corrections that their teachers make, and they often share the outcome and comments on their work with each other. Work that goes unmarked is a source of disappointment and can result in students feeling let down and being critical of the teacher. But how can feedback be affective formative assessment?

Activity 6 Features of formative assessments

Allow about 20 minutes

Watch the programme 'Secondary assessment – formative assessment' (YouTube link here), in which Paul Black and Chris Harrison, authors of the influential pamphlet *Working Inside the Black Box*, outline what they see as the key features of formative assessment. (Alternatively, you can read a transcript.)

- In what ways do they advocate the involvement of students in assessment?
- What negative impact can grades have on low-attaining students?
- How can teachers use written feedback to develop a dialogue with students?

Marking students' work is one means to get to know your students and their individual needs. It also provides the opportunity for teachers to have a dialogue with students about their work. Communication is too often one-way from the teacher to the students, who are unlikely to respond to instructive comments such as 'Complete this …' or 'Redraw the diagram'. Students need time to respond to comments when the work is fresh in the mind. Giving students time to read and respond to written feedback is a valuable means of encouraging a dialogue. Feedback might include questions to encourage the students to reflect on their learning. Questions might focus on the work itself, the student's attitude or feelings towards it, which aspects they have found difficult, or what they want or need to improve. In this way, marking and feedback become an excellent opportunity for you to 'listen' to students.

Sharing your marking policy and criteria with students before setting work enables them to think about their work in relation to the criteria. This is one way that you can involve students in the assessment of their learning.

To support learning, the monitoring and assessment that take place in the classroom should always be related to the declared learning outcomes. Feedback given to students should always take the form of constructive comments on what they have done well and how they can further improve their work.

4.3 Peer and self-assessment

Peer assessment is an important tool in enabling students to develop as independent learners. Independent learners are able to self-assess effectively and to use metacognitive skills to regulate their own learning.

Being able to monitor your own progress against learning outcomes (i.e. to self-assess) is important in becoming an independent learner. Discovering for yourself how to move forward (i.e. to use self-assessment formatively) develops self-regulation and self-efficacy.

To be successful, you need to consider the conditions that impact on self-assessment or peer assessment. Sebba et al. (2008, p. 17) gives three important conditions:

- Developing a positive classroom culture in which students feel able to discuss learning and develop effective student feedback.
- Moving from a dependent to an interdependent relationship between teacher and students that enables teachers to adjust their teaching in response to student feedback.
- Involve students in 'co-designing' the criteria for evaluation to help them to develop a better grasp of their own strengths and weaknesses. Students need to be aware of the targets they are trying to achieve, and these should focus on outcome not process goals.

Reflection point

Consider the points above. Which is the most surprising? What factors may need to be emphasised in your teaching to establish a classroom culture that is conducive to peer and self-assessment?

Activity 7 Students' role in assessment

Allow about 90 minutes

Read Bet McCallum's document report 'Formative assessment – implications for classroom practice' (McCallum, 2000); then watch the video clip 'Self-assessment and peer-to-peer marking' (Alternative link here). (Alternatively, you can read a transcript.)

Summarise the key research findings about peer and self-assessment in relation to student performance.

Make a list of any strategies that are given for using peer and self-assessment in lessons.

Use the reading and the video to summarise in a list what you will need to do and be aware of if you are to implement peer and self-assessment successfully in your own practice.

Embedding peer and self-assessment can take time, but can reap rewards for both teachers and students. Peer and self-assessment help students develop self-regulation. As they learn to become more self-regulatory and therefore independent in facilitating their own learning, they are able to monitor, direct and regulate their own actions towards their learning goals. Peer assessment provides opportunities for students to reflect on their own work and that of peers, a process that builds higher-order thinking skills. They will also become more engaged in their learning, and will build their confidence in discussing work with peers in a reflective, collaborative process.

Conclusion

In this free course, *Assessment in secondary science*, you have looked at a range of assessment techniques and the importance of probing students' conceptual understand of science concepts. A central theme of this course has been the impact of assessment and feedback on students, an important message being that assessment should be done with students, rather than to them. Engaging students' in assessment empowers them and enables them to take responsibility for their learning.

References

Black, P., Harrison, C., Lee, C., Marshall, B. and Wiliam, D. (2004) 'Working inside the black box', *Phi Delta Kappa*, vol. 86, no. 1, pp. 8–21.

Black, P. and Wiliam, D. (1998) 'Inside the black box: raising standards through classroom assessment', *Phi Delta Kappa*, vol. 80, no. 2, pp. 139–48 [Online]. Available at https://weaeducation.typepad.co.uk/files/blackbox-1.pdf (Accessed 7 March 2016).

Hargreaves, D.H. (2001) 'Opening minds, increasing opportunities: a future for the school curriculum', lecture to the RSA/SHA conference, November.

McCallum, B. (2000) 'Formative assessment – implications for classroom practice', London, QCA [Online]. Available at http://dera.ioe.ac.uk/4565/1/formative(1).pdf (Accessed 7 March 2016).

ProTeachersVideo (2005) 'Secondary assessment – formative assessment', March [Online]. Available at http://www.proteachervideo.com/Programme/565/secondary-assessment-formative-assessmen (Accessed 7 March 2016).

ProTeachersVideo (2008a) 'Assessment for learning in KS3/4 science – Andy and physics', March [Online]. Available at http://www.proteachervideo.com/Programme/24765/assessment-for-learning-in-ks3-ks4-science-andy-and-physics (Accessed 7 March 2016).

ProTeachersVideo (2008a) 'Assessment for learning in KS3/4 science – Anita and biology', March [Online]. Available at http://www.proteachervideo.com/Programme/24759/assessment-for-learning-in-ks3-ks4-science-anita-and-biology (Accessed 7 March 2016).

ProTeachersVideo (2011) 'Self assessment and peer-to-peer marking', February [Online]. Available at http://www.proteachervideo.com/Programme/86921/self-assessment-and-peer-to-marking (Accessed 7 March 2016).

Sebba, J., Deakin Crick, R., Yu, G., Lawson, H., Harlen, W. and Durant, K. (2008) *Systematic Review of Research Evidence of the Impact on Students in Secondary Schools of Self and Peer Assessment*, EPPI-Centre, Social Science Research Unit, Institute of Education, University of London, 1614T [Online]. Available at http://www.eppi.ioe.ac.uk/cms/LinkClick.aspx?fileticket=laxzMTLTTWM%3D&tabid=2415&mid=4477 (Accessed 7 March 2016).

White, R. and Gunstone, R. (1992) *Probing Understanding*, London, Falmer Press.

Further reading

Assessment Reform Group (ARG) (2004) 'Testing, motivation and learning', Cambridge, ARG [Online]. Available at https://assessmentreformgroup.files.wordpress.com/2012/01/tml.pdf (Accessed 4 March 2016).

McMillan, J. and Hearn, J. (2008) 'Student self-assessment: the key to stronger student motivation and higher achievement', *Educational Horizons*, vol. 87, no. 1, pp. 40–9, which you can find via the Open University Library.

ProTeachersVideo (2006) 'Secondary assessment – assessment for learning: questions and answers', April. Available at http://www.proteachervideo.com/Programme/3308/secondary-assessment-assessment-for-learning-questions-and-answers (Accessed 4 March 2016).

Wiliam, D. (n.d.) 'Self and peer assessment', *Journey to Excellence* [Online]. Available at http://www.journeytoexcellence.org.uk/videos/expertspeakers/selfandpeerassessmentdy-lanwiliam.asp (Accessed 4 March 2016).

Wiliam, D. (2011) *Embedded Formative Assessment*, Bloomington, Indiana, Solution Tree Press.

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