Assessment in Scientific Teaching Workshop
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Goals:
The goal of this workshop is to help participants understand that assessment provides feedback to both instructors and students about learning, assessment drives student learning, it can be used to create an inclusive classroom, and it is more than grades.

By the end of the workshop participants will:

1. Understand that regular classroom assessment is one of the most effective ways to engage students in learning.
2. Understand that assessment tools and active learning exercises can be combined; together they simultaneously engage students in learning and gauge their learning.
3. Understand that the results from assessments can be used to evaluate student learning, evaluate teaching, and guide changes in student behavior and instruction.
4. Be able to solve teaching problems with assessment techniques.
5. Have developed a list of assessment techniques and resources that can be used in the classroom.
6. Have developed an action plan for assessment.

Case of the Frustrated Student
I am a junior majoring in biology. I was thinking I might go to graduate school to do research and become a professor, or maybe apply to medical school. I usually get A's in my courses; only a few B's so far in college. I totally breezed through high school; it was so easy.

This semester, I enrolled in an introductory microbiology course. I approach this class like most others; I attend lecture (have only missed two this semester!), read the textbook (usually before class, if I have time), and turn in the homework if it's going to be graded. Professor Lopez is great; he's really well organized and follows the book closely. The homework has been helpful for learning the terms and information.

The first midterm exam in this course was NOT what I expected. None of the questions were multiple choice. We had to write out short (and sometimes LONG) answers. I barely finished it in the 2-hour exam period. Plus, three of the questions tested us on things we never learned and skipped stuff we covered in class. For example, we learned about the lac operon last week, and it wasn't even on the test. But there was this question about asking us to "describe a strategy that bacteria use to regulate gene expression and explain why such a strategy might provide a selective advantage." How am I supposed to know about that? I got a 72% on that test. What a crock!

Forget microbiology; it's not for me.

Table 3.1 Examples and Objectives of EnGaugements

Biology Example and Instructions	Objectives
Brainstorming Answer the following question in large group. One person records answers. Optional: Arrange the list into two or more categories (*e.g.*, abiotic vs. biotic factors) *Question*: What does a plant need to survive?	Brainstorming elicits responses from large audience and aggregates them into a single list. It provides the instructor and students with an overview of the group's collective knowledge. By separating the brainstorm list into two or more categories, students evaluate how well they understand the role of each response in a specific context.
Case study and decision making Read the following case. Write a paragraph to explain what the patient should do next. Justify your recommendation with biological reasons. *Case*: A patient expressed eye irritation, which the doctor diagnosed as conjunctivitis. Antibiotic treatment alleviated the symptoms within a few days, but the symptoms returned two weeks later. The doctor recommended taking antibiotics again.	Cases engage students in solving a problem in a real-life context. To solve them, students need to evaluate what they know about infectious disease, causal agents, and antibiotic resistance; apply that knowledge to the case; and determine what additional information is needed to make a recommendation.
"Clicker" questions Answer the following question on your electronic response keypad. *Question:* Which organisms are most distantly related? (a) bacteria and archaea; (b) plants and animals; (c) plants and fungi; (d) humans and fungi.	Clicker questions require students to gauge whether they understand a concept or topic, thereby engaging students in the ensuing activities (*e.g.*, lecture) about that topic.
Group exams Work with a group to discuss the following statement. Write your answer individually. *Statement:* Explain the role of aflatoxin in liver cancer.	Group exams engage students in working collaboratively to identify creative solutions to a problem. Writing individual answers requires students to evaluate how well they understand the topic and its underlying concepts.

Table 3.1 Examples and Objectives of EnGaugements (continued)

Biology Example and Instructions	Objectives
Mini-map Arrange the following terms in a logical order. Explain (using arrows or words) how the terms relate to each other. *Terms:* tRNA, DNA, protein, mRNA, amino acid, translation, transcription, replication, promoter	Mini-maps engage students in developing a non-verbal representation of a concept. The process of developing a visual arrangement requires students to evaluate different ways that terms can relate to each other and to appreciate that a biological process may not be unidirectional or linear.
One-minute paper Write for one minute to answer the following question. *Question:* What about the structure of DNA suggests a mechanism for replication?	One-minute papers engage students in articulating their knowledge about a topic or applying their knowledge to another situation. By writing their answer in one minute, students need to evaluate the most important and relevant components of their argument.
Pre/post questions Write for one minute at the beginning and end of class in response to the following statement. Explain any differences between your responses. *Statement:* Describe two mechanisms that a bacterium can use to harm a plant.	Pre/post questions can take many forms, including one-minute papers or clicker questions. They engage students in thinking critically about a specific question or problem. By comparing pre/post responses, students evaluate whether and why their answers changed during the class period.
Strip sequence Use your textbook as a guide and work with a partner. You write the important steps in meiosis; your partner writes the important steps in mitosis. Cut the steps apart and scramble the order. Each of you should try to put the other person's steps into the correct order. Discuss.	Strip sequences engage students in recognizing cause and effect and in determining the logical sequence of events. When students derive their own strip sequences, they need to evaluate the critical steps in the process.
Statement correction Discuss with a partner what is wrong with the following statement. Propose an alternative statement that is correct. *Statement:* "I don't want to eat any viruses or bacteria, so I refuse to buy foods that have been genetically modified."	Statement corrections engage students in evaluating what concepts are misrepresented and in determining what information they need to correct it.

from Handlesman, J., S. Miller, and C. Pfund. 2007. Scientific Teaching. New York: W.H. Freeman and Co.

Compare and Contrast Two Assessments

Work with a partner to compare and contrast what students experience during two different types of assessment activities.

	Case 1 Each week, students are assigned a reading. All students take a 10-minute quiz that tests factual knowledge. Quizzes are handed in for points.	**Case 2** Each week, students are assigned a reading. All students generate a diagram or flow-chart to illustrate the concept from the reading (individually). They explain their figure to each other in small groups for 10 minutes at the start of class. After discussion, they write a one-minute paper to explain what they learned. Diagrams and papers are handed in for points.
How does the assessment motivate students to learn the material or figure out the concepts they don't understand?		
How does the assessment capitalize on the diversity of learners?		
Does the assessment help students gauge what they know or how well they understand the concepts?		
Does the assessment build the students' skills in collaboration and critical feedback?		

“EnGauge” Students in Learning

“EnGaugements” are activities that capture the spirit of scientific teaching; students simultaneously ***engage*** in learning and ***gauge*** what they are learning. Engaged students are more motivated to achieve the learning goals and take responsibility for learning, which is precisely the type of academic curiosity that effective science courses aim to awaken. A well-designed enGaugement motivates all students to learn and provides instructors and students with feedback about learning, and it integrates the three core themes of scientific teaching--active learning, assessment, and diversity. EnGaugements are particularly effective at addressing difficult concepts or skills, targeting common misconceptions, or emphasizing important points. Many enGaugements also lend themselves well to grading.

Instructions

1. **Misconception:** List a common misconception that students have about a topic in your discipline (i.e. evolution).
2. **Learning goal:** Write the correct version of the concept that students should understand.
3. **Intended learning outcomes:** Describe the specific performances or behaviors that will demonstrate whether students understand. (Use Bloom’s Taxonomy or another resource to help articulate the outcomes.) In other words, what will it look like if students achieve the learning goal in the context of your classroom?
4. **EnGaugements**: Describe an activity that will “EnGauge” students and help them to achieve the learning goal.

Misconception	**Learning goal**	**Intended learning outcomes**	**EnGaugement**

Case of Faculty Grading

I attended a workshop about assessment, and the main thing I learned is that I am supposed to assess students before class so I can target what the students need to know, but most students don't do them because they are not graded. However, I don't have the time to grade 320 of these each week--much less the 16 other assessments that the workshop suggested. I'll just to back to trusting my gut to know how well the students are doing.

Tables 3.3a and b. Examples of two rubrics.

The first provides little insight into expected performance, whereas the second gives clear expectations about the work and describes the consequences therein.

Table 3.3a. ***Instead of:***

Criteria	Excellent	Good	Poor	Unacceptable
Accuracy of information	No errors were made.	1–3 errors were made.	4–6 errors were made.	More than 6 errors were made.

Table 3.3b. ***Try:***

Criteria	Level of performance			
	Sophisticated	Good	Needs improvement	Unacceptable
Accuracy of information	No factual errors were made. Your work will be very useful in aiding the reader make a decision about whether this genetic engineering technology would be a significant contribution as an alternative method to pesticide use in agriculture.	No significant errors were made. The reader recognizes any errors as the result of hasty conclusions or oversights. Your work is usable for making decisions about employing this technology, but would be considered more reliable if you were more careful in proofreading your work.	Enough errors were made to distract the reader, but the reader is able to use the information to make judgments. The technology will appear more useful if the reader is able to decide what evidence is reliable.	Your proposed technology is highly improbable because there are so many factual errors. The reader cannot depend on this report as a source of accurate information, or you have included so little information that the reader is not sure what the technology is about. It will not be approved by the FDA.

The second rubric is adapted from Huba and Freed (2000).

from Handlesman, J., S. Miller, and C. Pfund. 2007. Scientific Teaching. New York: W.H. Freeman and Co.

Key Concepts in Assessment

Assessment drives student learning, it can be used to create an inclusive classroom, it is more than grades, and it provides feedback to both instructors and students about learning.

1. Regular classroom assessment is one of the most effective ways to engage students in learning.
2. Assessment tools and active learning exercises can be the same thing; together, they simultaneously engage student in learning and gauge their learning.
3. Results from assessments can be used to evaluate student learning, evaluate teaching, and guide changes in student behavior and isntruction.

Suggested Reading

Angelo, T.A., and K.P. Cross. 1993. Classroom assessment techniques: a handbook for college teachers. San Francisco: Jossey-Bass.

Handlesman, J., S. Miller, and C. Pfund. 2007. Scientific Teaching. New York: W.H. Freeman and Co.

Huba, M.E., and J.E. Freed. 2000. Learner-centered assessment on college campuses: shifting the focus from teaching to learning. Needham Heights, MA: Allyn and Bacon.

National Institute for Science Education, C.L.O.C.-T. 1999. Field-tested learning assessment guide (FLAG). Madison, WI: Wisconsin Center for Educational Research. http://www.flaguide.org

National Institute for Science Education, C.L.O.C.-T. 1999. Student assessment of learning gains (SALG). Madison, WI: Wisconsin Center for Educational Research. http://www.wcer.wisc.edu/salgains/instructor/

Wiggins, G. and J. McTighe. 1998. Understanding by design. Alexandria, VA: Association for Supervision and Curriculum Development.

Action Plan for Assessment

1. Which tools, strategies, or resources from today's workshop will be most helpful to you in teaching in the near future?

2. Think of your last few lectures. What topics have you struggled to teach?

3. List two colleagues who could help you brainstorm ways to address this struggle using assessment tools.

4. Next time you teach, try one of these strategies that you and your colleague identify. How will you know if the strategy is successful? What will you observe or measure?