

## Making the Grade: What Is Assessment Without a Test?

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In this open case, Carol shares Dan Mayfield's story about how he is changing his chemistry teaching. Based on his belief that students learn science by doing science, Dan involves his students in open-ended, self-paced investigations. Dan observes their work and products to assess their learning. But the assignment of grades is a high-stakes event for Dan's students, and he worries that his evaluation procedures are not valid and fair to all. Dan's dilemma is captured in the question, Can I ever know what my students are learning without giving tests? Commentary on the case is provided by Mark Templin, a science educator with expertise in classroom-level assessment practices.

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**F**or most of his 16 years as a chemistry teacher at Rice High School, Dan Mayfield has used the textbook, the publisher's lab manual, and tests as his guides to formulating the curriculum in his classes. In past years, he has occasionally engaged his students in project work; however, these opportunities for students to explore chemistry on their own were few. This year, though, Dan decided that things were going to be different.

Last summer Dan attended a school district workshop that focused on the new state standards for science education. Mrs. Jenson, a district science teacher who presented the workshop, emphasized that the new state standards suggest that students should be engaged in doing science rather than learning science in more passive ways, like reading or lecture. She suggested that many activities typically done as recipe laboratory assignments could be modified to provide opportunities for students to plan most of the experimental procedures for themselves. During the workshop, teachers were provided with time to examine their own curriculum and plan several laboratory activities that would provide learning opportunities that were consistent with the standards. The types of learning experiences that Mrs. Jenson was

recommending were particularly interesting to Dan because they were designed to encourage students to apply their knowledge in real-life situations, rather than simply repeating science facts and principles or using algorithms to solve textbook problems.

Dan had always wanted his students to find ways to use chemistry in their daily lives. Yet, constrained by a traditional approach to teaching chemistry, Dan recognized that his students had little opportunity to construct such relationships. Mrs. Jenson's presentation and the discussion and activities that followed encouraged Dan to provide more opportunities for students to experience authentic ways of learning chemistry. With implementation of the new curriculum guidelines, students would be encouraged to place more emphasis on developing problem-solving skills than on memorizing facts and algorithms. "Perhaps," he thought, "this would be the key to helping my students understand the importance of chemistry." Besides, he liked the idea of being able to facilitate, rather than direct, students' learning experiences.

When the new school year began in August, it was much like any other year; getting to know the students, developing rules for classroom behavior, passing out textbooks, organizing for group work, introducing students to the laboratory, assigning readings, and developing class discussions. But there was also the challenge of implementing curriculum consistent with the vision Mrs. Jenson had presented.

Near the end of September, as Dan is leaving the department meeting, he is joined by Eric Dupree, who teaches physics in the room across the hall from Dan.

ERIC: Dan, how's it going?

DAN: I'm not sure. I've really been thinking a lot about what Mrs. Jenson said, and the activities we did this summer at the workshop. I've been trying some of those open-ended labs with my students, and so far they seem to be going well.

ERIC: What do you mean by open-ended lab? I was at the beach the week of the workshop, remember.

DAN: Well, I've set up some experiments that the students can pretty much explore on their own or together in small groups. I spend my time in class circulating around the room and looking at what they're doing and asking them what they're thinking. I try to avoid telling them if they are right or wrong. Rather, I try to help them clarify their thoughts and maybe suggest some avenues they might explore. It seems that in their groups, the ones who understand help the others. And if nobody understands, they can at least talk about it and try to figure it out.

ERIC: Tell me more. Exactly what kind of experiments are you talking about?

DAN: For instance, this week, I told them to imagine that there'd been a hurricane and, although they can buy water for drinking, the only water they have available for cleaning is from a nearby pond. I made up some dirty water with mud, salt, oil and threw in some garlic juice

to make it smell bad. I told them this water had suffered from saltwater inundation and run off from various sources that had added several contaminants they would need to remove. I gave each team some water, and I made available some materials, like alum, filters, charcoal, sand, and a heat source (if they needed it) to use to clean the water up. Most of the groups did a pretty good job of getting their sample of water clear. I didn't have to help them much either. The students really got into it! Next week, I plan to have them study the chemical change that takes place when baking soda and vinegar are mixed. This will involve some library research and some experiments for them to find out how this particular reaction occurs. The students will report their findings during a mock scientific conference in a couple of weeks. Different teams will be responsible for setting up the various aspects of the conference so they can see what it's like to be involved in that aspect of professional life in science.

ERIC: You have really been busy. Sounds great, but it also sounds like more work than I'd want to do. How do you keep track of who's doing what? It's almost time for 6-week grades, how are you managing to keep track of what the students are learning? Are you giving tests?

DAN: You've brought up something that has been bothering me. I really like having the students work in groups, and they seem to be enjoying chemistry, but I'm very uncomfortable with how to grade their work. I can watch them as they work, and it seems as if they are really learning. The experimental designs they come up with and the way they make sense of the data just amaze me. I have them turn in reports of their work sometimes individually and sometimes for the group. Overall, they are very good. But assigning a grade, that's another story. Without a quantitative criterion, I'm kind of lost. I know, there's that business about, "you're a professional, you should be able to tell whether it's an A or a B by looking at it," but how do I know if I'm being fair?

ERIC: What are you doing now when you look at the reports you get that you think might not be fair?

DAN: Well, for example, last week, before I looked at the papers, I tried to think through an answer that seemed reasonable to me. Then, I read their papers to get an idea of what they produced. In scoring, I tried to come to some balance between what they did and what I expected. If the response had some reasonable chemistry in it in relation to the question, right or wrong, I gave at least 1 point, on a scale of 0 to 4. You could tell from what they wrote that some of them really didn't understand the lab. But I didn't feel I should give them a 0 because they had, in a sense, done what I asked them to do—to solve the problem to the best of their ability. I gave zeros to some students who just put something down that had nothing to do with what the

problem was about. And I gave fours to students whose explanations came very close to mine but maybe had a minor error or two.

ERIC: That doesn't sound like a bad plan, although I sometimes wonder about giving students full credit when the answer is not completely correct. Besides, you've always done project work and graded it. What's bothering you about it?

DAN: Yes, I know I've done projects before, but they were only a small part of my overall grading plan. Now the projects are high-stakes work. And when I think about it, the real problem with grading is the consistency. You know if you do a multiple-choice test and you grade it, you've got consistency from one person to the next in terms of how you arrive at the number of right or wrong. If you have to look at each person's answer and make a judgment about it, then ensuring consistency across the group is real hard. I guess that's my concern, that it might not be totally fair in some cases. At the beginning, I may have graded one of them a certain way, and then by 50 papers later, I may have gotten harder or easier. At least if you have a number of right or wrong, you've got some measurable thing, as opposed to just your personal opinion. I just don't know what to do. I can really see a change in my students' attitudes toward chemistry with these kinds of learning activities. If I start testing again, I'm afraid the students will focus on learning the wrong kinds of things. But if I don't test them, I'll never be sure that the grades I'm giving are what students really deserve. To top it off, the other day, Kenny Jacobs, who has always been an honors student, got really upset when I handed back one paper with a grade lower than he is used to getting. He threw it in the trash can as he left class and mumbled "Why can't we just have tests like everybody else?"

ERIC: Wow. I can see you have thought a lot about this. You want your students to learn chemistry by actively participating in the learning process, and you think that learning and assessment should be intertwined, so you don't give tests. But you haven't found a way to assess students' learning while they are engaged in their various projects that allows you to easily assign grades.

DAN: That's it! That's my problem.

ERIC: I'm afraid that right now, I don't have an answer that will help you. I know that testing is a big part of what we do, and we have become so comfortable with this form of assessment, it's hard to think that any other format might be just as good. And it really makes it hard when students, and maybe their parents, fight against change. Give me some time to think about it, maybe I can come up with some ideas to help.

DAN: I hope so, Eric. I'd really like to be able to say with assurance that my students have learned this or that. Right now, I think they are learning, but I'm not sure. I sometimes think that it's too complicated for us to even know. What do you do?