## WHAT IS FORMATIVE ASSESSMENT?

It's easy to think about assessment as something that's separate from everyday teaching. You finish teaching a unit, and students take a test to show what they learned. The state department of education interrupts your class for three days to see how well students in your school and district are progressing toward proficiency on the state standards. Juniors take the SAT for their college applications, and seniors take AP tests to get college credit.

These examples all have one thing in common: they are considered to be summative assessment or assessment that's intended to take place when instruction is finished to establish what students have learned. These assessments often have high stakes attached to them because they determine, for example, the kind of college to which a student can apply, the grade a student will get in a course, or the rating given to a school. Summative assessments serve an important purpose in finding out what students know—for example, finding out if students in a given class or school are meeting state standards. However, the high stakes attached to these tests have given the word *assessment* a bad name.

The problem with using only summative assessment in your classroom is that if you wait to assess your students when teaching is over, it's already too late. Returning to the road trip analogy, a summative assessment of your progress would simply state that you had arrived in Sacramento instead of San Francisco. It would have been much more helpful to know when you had made a wrong turn along the way so that you could have turned around and gotten back on the right road.

Fortunately, there's more than one kind of assessment. Assessment that takes place while learning is still in progress gives you information about what students know so that you can reteach a concept students have not understood, talk to individual students who may be off course, and better adapt your teaching so that all of your students can learn. *Formative* assessment is a kind of assessment that helps you modify teaching and learning while learning is in progress and can be thought of as assessment *for* learning and not *of* learning. It is called formative because it informs teaching and learning. It may sound a lot like a description of effective everyday teaching, and there's a reason for that; good teachers pay very close attention to what their students understand and constantly adjust instruction to help students learn.

Formative assessment follows the same procedure that you would use in driving from your home in Los Angeles to San Francisco. It consists of three steps that can be phrased as questions:

Where are you going?

Where are you now?

How are you going to get there?

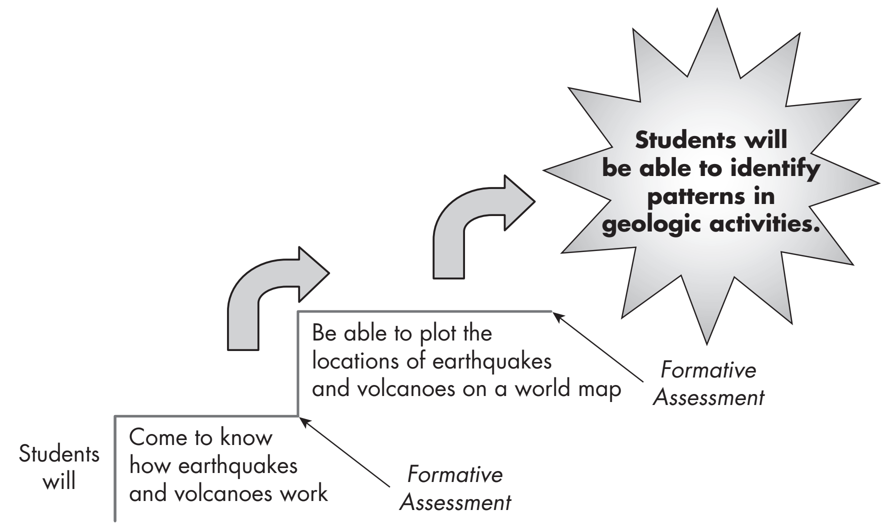
This standard is stated in a manner lending itself all too easily toward a *know* overarching goal: "The students will come to know that lithospheric plates . . . ." However, we want to push our students to engage and interact with the content they are learning, so merely memorizing information isn't enough. To go beyond this know goal, the standards suggest that an activity for students learning about lithospheric plates could involve them plotting the locations of geologic activities such as earthquakes and volcanoes.

**Table 2.4** Overarching Learning Goal and Essential Question for Earth Science Unit

| *Overarching Learning Goal* | *Big Idea Question* |
|---|---|
| Students will be able to identify patterns in geologic activities such as earthquakes and volcanoes. | Where do earthquakes and volcanoes happen? |

To be able to reach this overarching goal, students need to have some basic knowledge of what earthquakes and volcanoes are, and they need to be able to plot the locations of these geologic events on a world map. These two supporting goals form the steps leading to the overarching goal, and you can develop a formative assessment at each step to make sure students have the necessary foundational understandings in order to meet that overarching goal.

**Figure 2.3** Supporting Learning Goals for Earth Science Unit



## Asking Open-Ended Questions

I'll state the obvious: If you want to know what students really think, "yes" or "no" questions or questions that can be easily answered with one or two words are not enough. In order to really get at what students are thinking, you need to ask more authentic, open-ended questions that are genuine requests for information about student thinking. Cazden (2001) calls questions that teachers ask when expecting a right or wrong answer *instructional* questions and questions that teachers couldn't answer themselves *real* questions. Whereas an instructional question might entail stating a scientific term and asking students to define it, a real question could be asking for a prediction or an explanation of why something happened.

Instructional questions will keep you in the traditional mode of teaching that is pervasive in classrooms. To find out what your students know, you need to ask open-ended questions that get students to share their thinking, respond to each other, and clarify their ideas. A collection of this type of question is shown in Table 3.2.

Don't worry about memorizing all these questions; just pick a few that would work well with the goals of your lesson plan and ask them over and over to multiple students. Jot these down in your lesson plan book or on a piece of paper you can keep with you when you're teaching. Before you start a class discussion or go around to individual students or small groups, just glance at these questions to remind you of what you'd like to ask.

Keep in mind that these are going to be tough questions for students to answer, and responses to them won't just pop out of students' mouths. Give students plenty of time to think before you ask anyone to share his or her answer. The basic rule of thumb for wait time is eight seconds, and sometimes counting this out in your head can help you realize how rarely we as teachers wait long enough for students to respond. If you're talking to the whole class, ask students to raise their hands before shouting out answers so that all students have a chance to be heard. You might see a few hands shoot up right away when you ask the question, but keep waiting until you get a larger sampling of students with something to say before calling on anyone. Wait time gives more students a chance to think what they might answer themselves rather than cutting short their thinking time by calling on the fastest or boldest student first.

## Teaching Strategies

So far, we've talked about conditions for creating a classroom environment supportive of formative assessment as well as types of questions that you can ask students to get at what they are thinking. How do we embed these questions into instructional strategies? Later in the book, I'll present five specific formats for formative assessments, but regardless of what format you use, it's helpful to mix things up by using a lot of different strategies to get students working with each other and reflecting on their ideas. Sometimes, you'll want to get students to share their ideas quickly just so you know what they are thinking; sometimes you'll want them to

## Formative Assessment in Action: Big Idea Questions

Ms. Holmes was nearing the end of the school year and wanted to reflect with her students on one of the overarching learning goals that had framed her science class for that school year: What kind of scientist am I? She worked to help students view themselves as scientists and to think about the different kinds of skills they had developed through the year. Students had been asked to apply what they had learned to develop their own scientific investigations during their current unit, so Ms. Holmes decided to frame a question to her students that homed in on a framing question for that unit: the characteristics of a scientific question. She prepared a simple handout for her students for the question, "How do you write a good scientific question?"

During class on the day she gave the formative assessment, Ms. Holmes began by reminding her students about the work they had done all year.

"We've done a bit of work on this topic during the year," she began. "If you remember, we had a discussion about what makes a good scientific question. For example, when we were investigating enzymes earlier in the year, we asked, 'What makes pineapple jelly set?'"

After waiting a moment to check students' expressions for signs of remembering this investigation, Ms. Holmes also reminded them about investigations from earlier in the year that they had done with creating and using identification keys, as well as investigating the structure and properties of snow.

Ms. Holmes then said, "I'm going to hand out a sheet to you now; it's very short, and the question is very clear. I'd like you to answer this question to the best of your abilities, and I am very interested in what *you* are thinking about it."

Ms. Holmes walked around the room, giving the formative assessments to students individually. After a pause of a minute during which students filled in their name and the date, there was a flurry of activity as a few students were unsure as to how to get started. Several pulled out their science notebooks, flipping through furiously in search of an answer to the question. Ms. Holmes simply smiled, saying, "Your notebook won't help you; it's what's up here," as she tapped the top of her head. "But you can use it to refresh your memory if you like."

As the students got down to work, several called her over, asking for clarification. Ms. Holmes provided several hints:

- "Think about what would make a question *good."*
- "What do you think?"
- "What experiences have you had?"
- "It's not a memory test; it's based on what *you* think."

While half of the class was finished after about 15 minutes of writing, Ms. Holmes gave the class another five minutes so that all students had a chance to write something down. When the five minutes were over, she walked around the room and collected all of the students' papers.

While Ms. Holmes primarily wanted to read through students' responses, she had about five minutes left in class and decided to use it to get a preview of what some of her students had written. She asked the class, "Now, I would like a little feedback from you. Who would like to share with us what they had for that answer? Remember, there's no right or wrong answer; this is about your opinion. Yes, Ahmed?"

"To do a good scientific question, you have to have a question that is specific and has information about what you want to do," said Ahmed, glancing at his paper. "And it needs to be easy to understand."

"Ah, so if it's general, it's not as good?"

# CONCEPT MAP EXAMPLE 6.1: POLLUTANTS IN THE ATMOSPHERE

| | |
|---|---|
| *Step 1: Setting Learning Goals* | |
| **Science content** | The National Science Education Standards for Science in Personal and Social Perspectives in Grades 9–12 Earth and Space Science Content Standard state that students should develop understanding of environmental quality. Students should come to understand that humans are changing the natural process of maintaining the atmosphere and that the changes may be detrimental to humans. In addition, the Physical Science Standards state that students should understand the reactions contributing to the presence of ozone and greenhouse gases in the atmosphere and the burning and processing of fossil fuels. |
| **Supporting learning goal** | Students will be able to relate different pollutants to their sources and consequences in the atmosphere. |
| *Step 2: Finding Out What Students Know* | |
| **Assessment purpose** | Students should understand that methane, sulfur dioxide, and carbon monoxide are all released into the atmosphere as pollutants created by the production or burning of fossil fuels. They should also know that methane and carbon dioxide are greenhouse gases and thus contribute to global warming, whereas sulfur dioxide can dissolve in water to produce acid rain. |
| **Placement in unit** | Students are partway through a unit on air and air pollution. The concept maps will serve as a check to see how well students are able to connect the terms together. |
| **Assessment activity** | The teacher will use the "Concept Map Instructions" page to explain the procedure for making concept maps with students. The students will then complete the concept map individually, using sticky notes to arrange concept terms between a draft and final map. Then they will work in small groups to construct a group map, having conversations about where concept terms should go and how they should be linked. |
| **Data to be collected about student learning** | The teacher will circulate to groups, listening in and asking questions. |
| *Step 3: Anticipating Feedback* | |
| **Probable student alternative conceptions** | Students may think that all chemicals released into the atmosphere have the potential to produce acid rain. Students may not know that all three gases in the concept map are related in some way to fossil fuels. Students may link acid rain to greenhouse gases or global warming. |
| **Feedback ideas** | Focus on talking about the mechanism behind global warming and how greenhouse gases contribute to it. Explore with students the composition of fossil fuels and how different pollutants are formed during their production or consumption. Talk about the differences between the mechanisms leading to acid rain and global warming. |

Science Content Standard is from National Research Council. (1996). *National Science Education Standards.* Washington, DC: National Academies Press.