Appendix E

Best Practices in Science Assessment

Assessment in science is everywhere. It is present in the form of a simple clarifying question, a paper and pencil test, an investigation, or a large-scale assessment. The National Science Teachers Association Position Statement on Assessment states:

“Science assessments are necessary tools for managing and evaluating efforts to ensure all students receive the science education necessary to prepare them for participation in our nation’s decision-making processes and lifelong learning of science in a technology-rich workplace.”

As a content area, science is something that students actively do, rather than something that is done to them or for them. Science is not merely a collection of concepts; it involves the development of skills in investigation, measurement, observation, analysis, discourse, and synthesis. Science also involves problem solving and the application of new knowledge gained through the process of connecting evidence to form conclusions.

Measurement of student learning of these skills and concepts requires a variety of assessment strategies and tools. Assessment in science is organic to instruction and learning. Assessment, by its very nature, can be likened to a scientific process. It involves careful planning, entails the design of measurement tools and instruments, necessitates the collection of data along with analysis and discussion, and, ultimately, requires decision-making based upon conclusions drawn from the data.

What Does Assessment Look Like In A Science Classroom?

The word science is derived from the Latin verb *scire* which means to know. Students have an innate desire to discover, explore, and investigate. Our goal as science educators is to capitalize on that natural curiosity and build understanding. To determine student understanding, science educators ask questions and listen to student responses, observe how students engage in activities, and study their work. Student discourse, inquiry, and the free flow of ideas should be encouraged. The ideal orchestration and measurement of science instruction is a blend of purposeful and spontaneous teacher-to-student, student-to-teacher, and student-to-student verbal and written interactions that involves a variety of assessment techniques. These assessment techniques are used to aid students in thinking deeply about their ideas in science, uncover pre-existing ideas students bring to their learning, and help teachers and students determine how well individuals and the class are progressing toward developing scientific understanding.

In a comprehensive assessment system, science educators must accommodate the variety of purposes that the assessments will serve. Of the three assessment types outlined in the *Criteria and Guidance*, research strongly supports the use of formative assessment to strengthen students’ understanding of science. Science educators need to spend time understanding how their students think and what they know prior to and during instruction and use that information to design opportunities to learn that help students develop conceptual understanding. These opportunities to
learn are historically defined as “what schools and teachers must do if curriculum and achievement standards are to be met.” They exist as a result of educator awareness of the experiences and understandings that students bring into the classroom. It is incumbent upon the educator to connect these experiences with learning goals. This “bridging” process comes about with the careful and cohesive use of formative assessment to inform instruction.

With respect to a comprehensive local assessment system, collaboratively-designed and administered interim assessments in science are useful for assessing progress of students at the grade or course level. For example, collaboratively-designed assessments may be constructed at the school level using item banks that have been aligned to standards. If the assessments are administered as part of a guaranteed and viable curriculum, the data garnered over prescribed intervals (approximately 6-8 weeks) will provide important guidance to students, teachers, schools, families, and LEAs.

A summative assessment in science may take many forms. For instance, an end-of-unit assessment determines student learning over the course of several lessons. Science projects as well as topic papers and lab reports may be used in a summative way as well. Summative assessments could be either objective or subjective in nature, or some combination of the two. An example objective assessment item would be those that generate clear correct or incorrect responses (i.e., multiple choice, true and false, fill in the blank) whereas subjective items would be open-ended in design such as constructed response or performance based tasks. Objective tasks can be scored easily and fairly quickly. Subjective tasks, on the other hand, require calibration, as well as more time and analysis. The scorer must possess requisite knowledge of the concepts in order to make proper judgments of learning. Table E.1 describes various assessment formats that may be used in a science classroom.

Regular administration of a variety of assessments produces rich data that science educators can use to adjust instruction and carefully monitor students’ progress. Science educators are the critical agents in aligning assessment, instruction, and learning with a guaranteed and viable curriculum that will boost student achievement in science classrooms.

### Table E.1: Assessing Student Learning In the Science Classroom

<table>
<thead>
<tr>
<th>Objective-Response Formats</th>
<th>Subjective-Response Formats</th>
<th>Process-Focused Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product</td>
<td>Performance</td>
</tr>
<tr>
<td>Multiple-choice</td>
<td>Constructed response</td>
<td>Oral presentation</td>
</tr>
<tr>
<td>True-false</td>
<td>Concept maps</td>
<td>Science lab/demonstration</td>
</tr>
<tr>
<td>Matching</td>
<td>Research paper</td>
<td>Hands-on inquiry task</td>
</tr>
<tr>
<td>Enhanced multiple choice</td>
<td>&quot;Show your work&quot;</td>
<td>Data analysis task</td>
</tr>
<tr>
<td>Simple calculations</td>
<td>Portfolio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video/audiotape</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charts/Graphs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab report</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student notebooks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fill in the blank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phrase(s)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Label a diagram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual representation</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from McTighe and Ferrara (1998)
Sources


29 Ibid.


37 Ibid.


39 Ibid.