This chapter outlines the process of developing worthwhile diagnostic and summative assessment tasks, as well as developing analytic and holistic scoring rubrics. The chapter provides examples of assessment tasks, scoring rubrics, and student responses as well as data that show the appropriateness of open-ended response items over selected response type tests.

Diagnostic assessments are often ignored as an integral part of instruction and summative assessments usually take on a more traditional format using selected response items such as multiple-choice, matching, or true and false. Early in my career I used pre-tests that were primarily multiple-choice and never found them to be particularly insightful. Since then I had always dismissed the importance of diagnostic assessments because I felt that after, 20 years of experience, I knew the needs of my students. I felt that any diagnostic assessment would only confirm what I already knew about my students’ level of understanding. After using an alternative form of a diagnostic assessment, I found that very valuable insights are missed when diagnostic assessments are not done or done well. The most important and useful information that I have found using diagnostic assessments is that students have so many misunderstandings.

My summative assessments had always been dominated by selected response items (e.g., multiple-choice, matching, and true and false questions). I remember being convinced by my college courses that anything could be accurately tested by a selected response question. With the advent of the SCANTRON grading machine the selected response test seemed to be the only choice. When I started to experiment with alternative forms of assessment, I discovered that I was missing a multitude of insights about my students that go unnoticed on a multiple-choice test. I also found that students could more properly express themselves on an alternative assessment format. Multiple-choice tests prevented students from learning how to express themselves, a great disservice, and it reduced students’ ability to think through the assessment.

As I began to use alternative assessments, I began to think about what it means to be scientifically literate. I used to think that a student who did well on a selected
response or constructed response (e.g., fill in the blank, short answer questions) test was scientifically literate, because the test score demonstrated that the student had gained knowledge and competencies in science. A scientific literate individual, however, is one who:

- Understands science concepts and principles
- Has a capacity for scientific thinking
- Uses science knowledge to think about and make sense of events and situations that they encounter in everyday life
- Comprehends scientific explanations (American Association for the Advancement of Science [AAAS], 1990; 1993)

Scientific literacy goes beyond knowing science facts and involves understanding and applying science concepts and principles to explain events and situations. Assessment from this perspective would require students to demonstrate conceptual understanding, use science concepts and principles to explain situations and events, and engage in thinking and reasoning about problems and situations.

I also began to think differently about what constituted student learning and achievement. I used to think that learning was reflected in an increase in achievement as measured by selected response and constructed response formats or tests. From my point of view, students who scored higher on tests showed higher achievement and learning. I now view learning as the process involved in changing or constructing understandings, knowledge, ability, and skills through experience (Wittrock, 1977). Learning is the active construction or reconstruction of cognitive structures based on social interactions and experiences. On the other hand, achievement is the numerical score one receives on an individual assessment; it reflects a snapshot of student ability, but not necessarily any change or development in understanding, knowledge, ability, or skill. For me, learning reflects change and achievement reflects application. In other words, "The performance potential acquired through learning is not the same as its reproduction or application in any particular performance situation" (Good & Brophy, 1986, p.134).

This distinction between learning and achievement has profound ramifications for both teaching and assessment (Cizek, 1997). Assessment of science learning emphasizes measuring change in students’ understanding, knowledge, science process and inquiry skills, and even in science attitudes. The measurement of student performance on an individual assessment task more accurately reflects achievement. On this view, diagnostic assessments become a necessary component of classroom assessment practice. Diagnostic and summative assessments work together to determine student learning, change and development in conceptual understanding, knowledge, and science process and inquiry skills.

In contrast, traditional methods of assessment, such as multiple-choice tests, do not always identify specific needs or misunderstandings. Selected response formats provide students with the opportunity to guess at a correct response but often do not include the response that the student would actually select. Alternative assessment techniques more accurately assess students thinking and understanding, better