# *Preface*

*The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.*

—Ausubel, Novak, and Hanesian (1978)

## FORMATIVE ASSESSMENT IN SCIENCE

Science educators agree that good assessment practices are integral to informing teaching and learning, as well as measuring and documenting student achievement. In the current climate of high-stakes testing and accountability, the balance of time, resources, and emphasis on students' scores related to assessment have been tilted considerably toward the summative side. Unfortunately, this imbalance has led to a cycle of even more standardized testing of students and "mile wide, inch deep" instruction, often with only marginal gains in achievement. When science test scores fail to improve significantly, often the knee-jerk reaction is to increase the cycle of testing and test preparation, covering large amounts of content in a superficial way. This tension between assessment for accountability and assessment to inform teaching reduces the amount of time teachers spend on understanding what their students think prior to instruction and using that information to design learning opportunities that help students develop deeper conceptual understanding.

This book addresses the need to balance opportunity to learn, which includes assessment *for* learning (Black, Harrison, Lee, Marshall, & Wiliam, 2003), with assessment *of* learning. Optimal opportunities to learn exist when science teachers are aware of the variety of different ideas students are likely to bring to their learning, see the connections between students' thinking and the specific ideas targeted by state and national standards, and provide learning experiences that build a bridge between their students' thinking and the accepted scientific ideas. What is effective for one purpose—external accountability—may not effectively serve the

purpose of informing instructional planning and decision making, which is what ultimately affects student learning. A rich repertoire of formative assessment techniques provides the ongoing feedback and stimulus for deep thinking that a high-stakes test once or twice a year cannot provide in time to inform instruction and affect learning.

Teachers are the most important link in the chain that connects assessment, instruction, and learning. The need for a varied repertoire of purposeful techniques that weave assessment throughout instruction and learning is what led to this book. I hope you can turn the insights and ideas gleaned from this book into practical actions that will transform teaching and learning in your classroom.

## PURPOSE AND NEED

A substantive body of research indicates that formative assessment can significantly improve student learning. Yet this same research shows that the features of formative assessment that affect student achievement are, sadly, missing from many classrooms (Black et al., 2003). The purpose of this book is to provide teachers with guidance, suggestions, and techniques for using formative assessment to improve teaching and learning in the science classroom. A wide variety of assessment books and resources available to science educators provide the theoretical rationale for formative assessment and its implications for teaching and learning. This book expands on the current literature by identifying and describing practical techniques teachers can use to build a rich repertoire of formative assessment strategies for the science classroom.

The acronym, FACT, is used to label the 75 techniques included in this book. FACT stands for **f**ormative **a**ssessment **c**lassroom **t**echnique. Through the varied use of FACTs, explicitly tied to a purpose for gathering information about or promoting students' thinking and learning, teachers can focus on what works best for learning and design or modify lessons to fit the needs of the students.

## AUDIENCE

The primary audience for this book is K–12 science teachers. However, many of the techniques described can be used in other disciplines such as mathematics, social studies, language arts, fine arts, health, and foreign language and are thus noted in each of the FACT descriptions. University faculty may also find the FACTs useful with college students. In addition, professional developers can use several of the FACTs to design and monitor learning experiences for adult learners, including teachers.

## ORGANIZATION

Chapter 1 provides an introduction to formative assessment in the science classroom. It describes the inextricable link between assessment, instruction, and learning. It describes what a FACT is and the cognitive research that supports the use of FACTs. It describes the learning environments that support assessment, instruction, and learning. It examines the relationship between teaching and learning and describes new roles and implications for a formative assessment-centered classroom.

Chapter 2 focuses on the use of FACTs to integrate assessment, instruction, and learning. It examines the connection between assessment and instruction and describes a learning cycle model in science (SAIL cycle) that integrates assessment with instruction and learning and provides a framework for using FACTs. It describes how formative assessment promotes learning in the science classroom, including the role of metacognition, self-assessment, and reflection. It provides suggestions for strengthening the link between assessment, instruction, and learning.

Chapter 3 addresses considerations for selecting, implementing, and using the data from science formative assessment. It includes a matrix for matching FACTs with their primary purposes in teaching and learning.

Chapter 4 is the heart of the book. It includes a collection of 75 different FACTs. The FACTs are arranged in alphabetical order so that teachers can locate them by name. They are also numbered on the matrix in Figure 3.4 (starting on page 42) in Chapter 3. Each FACT uses a common format that provides a description, how it promotes student learning, how it informs instruction, considerations for design and administration, modifications that can be made to a FACT for different types of students or purposes, caveats for using a particular technique, general attributes, and uses in other disciplines besides science. Where appropriate, each FACT includes an example that shows or describes how the FACT is used in science. Space is provided after each FACT to record your notes on how it worked in your classroom and any modifications or suggestions for further use.

The Appendix contains annotated resources referenced in Chapter 4. These resources also contain additional material that a teacher would find useful for expanding his or her knowledge of formative assessment and building a repertoire of strategies.