Preface

Since we wrote the first edition of this book, the assessment of students has continued to be a major focus of education, and assessment has become an increasingly important part of teachers' professional practice. Educators have extended responsibilities for not only setting educational goals and objectives but also for instructing and assessing in ways that help students meet these goals and objectives. State assessments bring additional pressures for students to perform well, and this also is a driver for teachers to ensure that their students are prepared. Stiggins (1994) noted that teachers make decisions about how to interact with their students at the rate of 1 out of every 2 to 3 minutes, and they base those decisions on their own assessments of student learning. Preparing students to do well in the classroom and on the measures used to make this determination are keys to making valid and reliable decisions about how to instruct and what and how to assess.

Instruction and assessment should be planned together and interconnected. Assessment practices have often focused on the use of set questions that have provided a limited number of options for student responses. While this assessment approach may be representative of some tests, teachers of science realize that students should develop deeper science understandings. Continued emphases on assessments at local, state, and national levels mean that educators must persist in changing and refining the assessments that are implemented in classrooms. Assessment can be viewed as a pathway to address the following questions:

- Should assessments tell us what students cannot do or what each student can do?
- Should assessments set targets for learning or merely sample the present curriculum?
- Should students be evaluated only on their individual work or also on their abilities to work together for the benefit of a larger group?
- How can assessments encourage and recognize inventive, imaginative responses that, although unexpected, are constructive and appropriate?
- To what extent can students evaluate data, understand concepts, demonstrate process mastery, and apply what has been learned to new situations?

- How does one assess that each student can actually do what the instruction intends for him or her to do? What evidence is used to document that a student has met the learning targets?
- What can be done to help students become successful learners?
- How can students attain the desired achievement levels?

Effective educational programs are linked to assessment schemes that help students grow, develop, and succeed, and such assessment schemes should be designed to meet the stated instructional goals and objectives or learning targets of both the teacher and the learner. *Assessing Student Understanding in Science: A Standards-Based K–12 Handbook* provides both guidelines that are based on research and examples from educators who have drawn on their own work in settings that range from kindergarten through university. *Assessing Student Understanding in Science: A Standards-Based K–12 Handbook* addresses the assessment of student performance and the establishment of criteria on which to base student progress in the six domains within science. These domains relate to concepts, processes, applications, attitude, creativity, and the nature of science.

Each domain is described, and a rationale is provided for assessing student learning in that domain. Chapter 1 provides an overview, supported by the research literature, for each of the six domains of science. In Chapter 2, assessment is set in the contexts of teaching, and in this chapter, the interconnectedness of instruction and assessment is discussed. The importance of formative assessment and feedback is emphasized in this edition, and assessment practices beyond the traditional paper-and-pencil test are included. Some examples of assessment alternatives that can be implemented include concept mapping, clinical or structured interviewing, portfolios, video recording, journaling, brainstorming, open-ended questioning, and a self-report knowledge inventory.

The context for Chapter 3 is the evaluation of teaching practice, and possible ways to examine teaching practice are identified, which include action research, video records, and journals. Instrumentation to evaluate classroom practice and surveys are components of this chapter. Samples of student and teacher forms of the science-as-inquiry surveys have been designed so that perceptions can be compared.

Rubrics and scoring guides are found in Chapter 4, which describes ideas for designing schemes to assess student work. Some examples of rubrics that have some design issues have been purposely included in this chapter to illustrate some of the difficulties in the design process. Not every rubric or scoring guide is exemplary, and rubrics should be designed to capture the most important attributes to be measured or evaluated.

Chapter 5, which is new to this edition, focuses on science notebooks and sets out some background on notebook implementation. Notebook usage has been embraced by numerous science teachers across the country, and one of the strengths of the notebook may be that it does not lend itself to a one-size-fits-all approach. Teachers and students can identify the approaches that work best for them. Whatever the implementation approach, notebooks have power in that students develop a sense of ownership through providing evidence of their personal science learning. The notebook is also a context in which teachers, students, and parents can have productive discussions about student understanding.

Chapters 6, 7, 8, and 9 set out assessment examples for multiple grade levels, but often, ideas can be modified for use at various grade levels. In these chapters, the assessment examples address the six domains of science. Chapter 6 has assessment examples that have possibilities for use across all grade levels. Chapter 7 targets Grades K through 4, and Chapter 8 has examples recommended for Grades 5 through 8. Chapter 9 presents some ideas for assessment in Grades 9 through 12.

This assessment handbook has a history to which many educators have contributed, and many of the initiatory ideas and samples were generated by Iowa teachers and students in their science classrooms. Many of these ideas and samples have undergone an evolutionary process in the hands of those who have edited these samples and ideas in attempts to clarify the thinking and communication intended by these instruments. The refinement process and the task of improving assessment practices have been guided by the assessment tenets that follow.

ASSESSMENT TENETS

- Assessment design is guided by the purpose of the assessment.
- Assessment includes multiple measures that are used to inform instruction.
- Preassessment of student understanding is vital in determining preconceptions and should be completed and documented by the teacher prior to the introduction of each new concept.
- Evidence of student learning is documented throughout the year.
- Assessment provides information about what the student can do rather than what the student cannot do.
- Assessment is viewed in terms of the growth in learning of each student.
- Students are assessed both on an individual basis and on their involvement in group work.
- Assessment tasks should be meaningful, challenging, and engaging throughout instructional activities.
- Assessment tasks are set in a real-world context and should have relevancy for the student.
- Central to any assessment scheme are process skills, concepts, attitudes, creativity, understanding the nature of science, and applications to the real world.
- Process skills and cognitive behaviors are assessed throughout learning or instructional activities rather than at the completion of a unit or chapter.
- Responsibility for assessment is shared with the students.
- Assessment is implemented throughout each lesson and includes all student activities that relate to the six domains of science.
- Outcomes of various student assessments, including student interest, direct and drive instruction within learning situations.