Foreword

More than 10 years ago, a new vision and guide for reform in science education appeared in the form of national standards. Several important documents followed the lead of the mathematics community a few years earlier. The forerunner of the movement in science was the eloquent and somewhat revolutionary *Science for All Americans* from Project 2061 at the American Association for the Advancement of Science (AAAS). This was followed in 1993 by the *Benchmarks for Science Literacy,* derived from *Science for All Americans,* and it provided standards for four grade-level spans. In early 1996, the National Research Council (NRC) released the *National Science Education Standards.*

With this repertoire of resources, the science education community seemed armed and ready to make major improvements in science teaching and learning. But it has been slow in happening. There are many reasons for this, but one significant one is the lack of clarity on how to use the standards. These were new documents; new in concept, with a new approach to what content should be taught and how it should be presented. We had not been confronted with standards before; they were new, and we didn't know their role and how to use them.

As a member of the content working group for the *National Science Education Standards* and later the staff responsible for producing the standards, I learned, along with my colleagues, that our first, and sometimes our most important task was to introduce the concept of what a standard was and what it wasn't. It was easier to say what they weren't than what they were. Standards were not behavioral objectives so familiar to many educators. They were not a curriculum to replace the ones in place in most states or local districts. Describing how to use them was more difficult; none of us at that time had ever used them to guide curriculum development, select the content for a lesson, or determine the contents of an assessment instrument.

Since the advent of the standards, much has been written about the use of the standards but often in a self-serving manner, to rationalize the content in a local curriculum guide, commercial textbook, or exam. Too often the use is after the fact; a look back to see whether there is a match, alignment, or even just a reference in the standards, after limited or little attention to using them as a guide for the work from the beginning. This book turns that around and places the standards and their supporting documents squarely at the heart of the improvement effort through a process called Curriculum Topic Study (CTS).

By developing the CTS, the author provides the first comprehensive and detailed guide for using standards as the starting point to improve the quality of a wide range of science education activities for multiple audiences, which include K–12 teachers, preservice teachers, preservice higher-education faculty, professional developers, curriculum developers, and science education specialists. These audiences will benefit from the CTS study processes, in their goal to improve their own

understanding of science content, identify and clarify the "big ideas" for their instruction that come from their state or local standards, identify potential learning difficulties and misconceptions associated with a topic, apply effective teaching strategies to the ideas or skills associated with a topic, and improve coherence of topic development within a grade or across grades in a vertical curriculum.

Although the above examples do not begin to do justice to the multiple uses the CTS process provides science educators, one result of using the study process is notable enough to merit an elaboration. The results of the Third International Mathematics and Science Study (TIMSS) and other analyses have pointed out the lack of coherence in the U.S. curriculum, resulting in the "mile wide and inch deep" characterization. Much of this is the result of continuing to write curriculum and teach as we always have and then look to see whether our topic is mentioned in one of the standards. The result is a padded, incoherent, and less effective curriculum.

The question that is not asked that CTS requires of the user is, "How much of what I have included is not in the big ideas in the standards?" The author has designed the CTS process to create coherence by asking and helping the user answer questions from the start, such as, "What are the big ideas I should include? At what level? How are they connected to the other ideas in the curriculum? And how can I most effectively help students learn them? The answers to these and many more essential questions are available through a well-developed study process, supported by vignettes from users and a set of study guides on 147 science topics.

By helping the reader answer these important questions and many more, the author and her team have given the standards, whether they are the national standards listed above or the state or local standards in immediate use by the reader, new vitality and enhanced value in our effort to improve the quality of science teaching and learning.

Harold Pratt
President, 2001–2002
National Science Teachers Association