Preface

OVERVIEW

To become an accomplished science teacher in today's classroom environment requires a specific set of abilities and knowledge that combine deep understanding of science content, pedagogy, and familiarity with standards and research on student learning. Teachers with these abilities and knowledge are grounded in science content, the vision of national science standards, and cognitive research. They combine this interconnected knowledge base with the wisdom achieved through their practice to provide all students the opportunity to learn and enjoy science. Accomplished teachers recognize that achieving science literacy for all students requires substantive changes in the science content taught, how and when it is taught, and the need for continuous professional development connected to their work. These are teachers who deliberately seek out ways to gain new knowledge and the ability to implement their local and state standards by "standing on the shoulders of giants"—in other words, drawing upon and using the collective consensus-driven work of hundreds of educators, scientists, researchers, and science education specialists who developed the national standards and contributed to the research base on student learning. They see standards and accountability testing not as the end points in and of themselves, but as ways to help teachers stay on the path to achieving science literacy for all. While they recognize the imperative of meeting their states' articulated standards, their overarching goal is not to raise test scores and teach only to the standards listed in their state standards documents. Their ultimate goal is to ensure that all students develop a deep understanding of the important interconnected knowledge and skills of science identified in the national standards and that they can draw upon these knowledge and skills when needed.

Who are these teachers? Several are Maine, New Hampshire, and Vermont teachers, along with science specialists and colleagues I have had the honor and pleasure of trying out the Curriculum Topic Study (CTS) tools and processes with in the Northern New England Co-Mentoring Network, funded by the National Science Foundation (NSF), the Maine Governor's Academy for Science Education Leadership, and various other professional development projects. I have seen these teachers and leaders significantly transform their beliefs and knowledge about science teaching and learning and professional development through the use of CTS practical tools and processes for putting the vision of the standards and the findings from cognitive research into practice in the classroom and professional development settings. CTS has moved national standards documents, as well as state standards and frameworks, beyond rhetoric and off the shelf and into the hands and minds of science education professionals who use them regularly and purposefully in their practice.

As a result of seeing the impact of using the CTS process with educators I have worked with, combined with the encouragement of my national professional development colleagues, a proposal was submitted to the NSF's Teacher Professional Continuum Program. This proposal, *Curriculum Topic Study: A Systematic Approach to Utilizing National Standards and Research,* was awarded to the Maine Mathematics and Science Alliance (MMSA) in May 2004. The MMSA and our partner for the proposal, WestEd, are working with several national organizations, teachers, and teacher educators over the next 4 years to develop CTS into a set of science, mathematics, and professional development materials that will be available nationally. In addition to this book on science curriculum topic study, mathematics curriculum topic study and a facilitator's guide to using curriculum topic study will be produced for the science and mathematics education community during the period of the NSF-funded grant. There is also a companion Web site at www.curriculumtopicstudy.org. The NSF-funded Curriculum Topic Study Project will provide the "missing link" for implementing national standards and utilizing cognitive research to help teachers and professional developers improve and deepen their understanding of science teaching and learning.

By using CTS to understand the important concepts, skills, and instructional implications within the topics they teach, teachers at all levels of experience, from preservice to accomplished teacher leaders and professional developers, can improve their practice in order to positively impact student learning. It is hoped that this book will provide the bridge as well as the solid support structures that all teachers need to make substantive changes in their practice, while engaging in opportunities for continuous, intellectual professional growth.

KNOWLEDGE BASE

The CTS approach was adapted from the author's experiences working with the American Association for the Advancement of Science's (AAAS) Project 2061, using a procedure for the study of a single benchmark. The original procedure utilized Project 2061's resources, including *Science for All Americans, Benchmarks for Science Literacy,* and *Atlas of Science Literacy.* This study procedure was modified and expanded to create a set of study guides, with preselected readings linked to a specific purpose, used in a process called "Curriculum Topic Study." CTS focuses on topics, instead of a single learning goal, and includes additional reference materials, such as the *National Science Education Standards,* a sourcebook for cognitive research, an adult science content trade book authored by credible scientists, and numerous Web resources.

This book leverages and extends the work of AAAS/Project 2061 and the National Research Council's (NRC) national science education standards development and distribution by building a bridge between the dissemination of standards and their purposeful use. It is an example of how professional developers have been able to draw upon the excellent research and development work done by AAAS and the NRC and connect it to the immediate needs and contextual issues of teachers and professional developers. CTS draws upon the current knowledge base on effective professional development for science teachers—addressing the need for greater focus on relevant content, standards, and research in how students learn.

NEED

Engaging science educators in scholarly thought and purposeful use of standards and research on student learning is key to improving student achievement. National and state standards and an expanding body of cognitive research have been available to teachers since the start of the "standards-based" wave of science education reform. However, a systematic, flexible process and unified set of tools to collectively and deliberately utilize them in practice have been missing.

In addition, the new "highly qualified teacher" requirements set by the "No Child Left Behind" legislation make this a critical time for teachers to have the tools and processes they need to continuously develop as professionals. In this No Child Left Behind age of standards and high stakes accountability, it is not enough to be guided only by a list of state standards.

If your goal is to become a standards- and research-based educator, you need the right tools and processes to reach your goal. Rich explanations of content and learning goals, background information on instructional implications that impact student learning, specific examples of the content in a learning goal, and vignettes that make standards and research come to life are needed to help teachers implement standards and research. This book is intended to fill that need by providing you with an intellectually rigorous and invigorating process for examining the science topics you teach so that you can make well-informed decisions to improve your students' learning.

AUDIENCE

The primary audience for this book is K–12 teachers, preservice teachers, preservice higher-education faculty, professional developers, and science education specialists. Other audiences that may find sections of the book and the CTS process useful include administrators, scientists working on curriculum development and science education reform projects, parents (especially homeschoolers), museum and science center educators, standards revision committees, and curriculum and assessment developers.

ORGANIZATION

The book is divided into six chapters. Chapter 1 provides an introduction to CTS and a description of the knowledge and research base that anchors the development and design: standards, research, professional development theory and practice, and science teachers and teaching. It includes a rationale for the importance of studying a curricular topic and why topics were chosen as the focus.

Chapter 2 takes the reader on a "tour" of a CTS guide. It describes the different features of a CTS guide and provides descriptions of the resources that are used in the process.

Chapter 3 describes the ways users of CTS engage in the process. It describes how to get started and defines the different purposes and outcomes a user must identify before beginning the process. It describes an instructional model for adult learning used in the process, based on the learning cycle. Individual and group use are addressed, and guiding questions are provided to accompany the resources.

Chapter 4 describes the various contexts for professional use in which CTS can be used. Embedded throughout this section are various examples and tools that can be used by teachers, such as improving content knowledge, curriculum, instruction, assessment, and professional development and leadership.

Chapter 5 describes how CTS has been used in actual practice. Real-life vignettes are described that illuminate the different ways CTS users have been informed by the process.

Chapter 6 is the core of the book. It contains the 147 CTS guides arranged in 11 different categories. The study guides are reproducible for use with groups. The Resource sections A and B contain additional resources that complement CTS as well as some of the worksheet templates described in the chapters.

HOW TO USE THIS BOOK

The primary goal in writing this book was to provide educators with ready-to-use study guides that utilize a common template to identify vetted sections in the content, standards, and research resources for reading about, studying, and reflecting on a science topic. It is an essential companion to help you utilize the standards you may already have access to as well as help you incorporate the use of other professional science education resources as you build your professional science teaching library. For educators who are familiar with the CTS approach, you can immediately access and use the guides in Chapter 6. For others, it is helpful to read Chapters 1 through 5 first, to get a clear sense of how and why the guides were developed, and ways to use them effectively. This is not intended to be a "How to" book for professional developers who are interested in ways to facilitate use of CTS in their professional development settings. This book will be developed in the second year of the Curriculum Topic Study Project. In the meantime, professional developers can use this book to learn about the process and practice using it. Higher-education faculty can encourage their students to use this book to plan their lessons and gain a deeper understanding of standards- and research-based teaching and learning in preparation for the reality of teaching.

CTS provides tools and processes to use in improving teachers' understanding of the topics they teach. It is not a "How to" book about curriculum, instruction, and assessment. It is intended to be used to deepen teachers' understanding of how to use standards and research within the context in which they are working. Rather than providing the answers, CTS promotes inquiry among educators in discovering new knowledge about teaching and learning connected to the content they teach.

ACKNOWLEDGMENTS

This book is the pinnacle of working with teachers and professional developers in New England and nationally. In 2000, the first Maine Governor's Academy for Science Education Leadership was developed by the Maine Mathematics and Science Alliance, with support from TERC's Eisenhower Regional Alliance for Science and Mathematics Reform, to support science teacher leaders in Maine. The first set of CTS tools were developed for leaders in the Governor's Academy, who helped me think through their development and use. I want to thank all of the Governor's

Academy Fellows for their contribution to the evolution of this project. I would especially like to thank Steve Deangelis, Anita Bernhardt, and Nancy Chesley, for sticking by me right up to the deadline for submitting this manuscript. This book would not have been possible without your friendship, professional contributions, and unwavering support.

The Northern New England Co-Mentoring Network (NNECN), an NSF-funded science and mathematics mentoring project, has been a major test bed for this project. I wish to thank all of the mentors and their mentees in our network for piloting many of the guides and processes used in this book. In particular, I would like to thank Judith Allard for her high school and preservice insights. Instrumental is my NNECN partner, Susan Mundry, who encouraged me to "go national" with these tools. Susan: You are my mentor and inspiration, and I remain indebted to your support and confidence in my work. Your wisdom and contributions to sections of this book are gratefully acknowledged.

Hundreds of teachers have piloted and field-tested the CTS tools and processes, and I remain indebted to all of you. In particular, I would like to thank Sharon Gallant, Kate Slattery, Andrew Njaa, Mary Whitten, Nancy Chesley, Barbara Fortier, Wes Marble, Jim Chandler, Sandra Ferland, and Laurie Olmstead for your help right up to the manuscript submission deadline in refining the field-test products.

The guidance and support from my MMSA colleagues helped me refine the processes for professional development and shape the ideas for this book. Thank you to Lynn Farrin and Henrietta List for being my sounding board and contributing your teacher and professional developer wisdom. I also wish to thank Deb McIntyre, Beth Small, and Cheryl Rose for their help in reviewing the manuscript. I am extremely grateful to my director, Dr. Francis Eberle, for his unconditional support in allowing me the time and freedom to publish my first book and his affirmation that this work can make a difference for Maine and beyond. I am indebted to my dear friend Janre Mullins, for her "comma coaching" as well as clever and kind words of encouragement throughout this process. You are my pillar of support! I also wish to thank Jan Spencer for her help in pulling together the resources I needed, and her humor when times got rough. Thank you to Nate Keeley for your multitalented work in creating the graphics and developing the CTS Web site, and taking an avid interest in your mom's work! And of course this book would not have been possible without the dedicated, hard work of Brianne Van Den Bossche, project assistant extraordinaire!

I wish to thank all my other professional colleagues for their support and contributions—there are too many to name all individually. In particular, I would like to thank Soren Wheeler for his extraordinary knowledge, way with words, and advice for shaping sections of the book. Thank you to Joyce Tugel and Mark Kaufman for helping me build a professional community of CTS users in New England. Many thanks go to Dr. Richard Audet, at Roger Williams University, for your collaboration and connection to the higher education community. I would also like to gratefully acknowledge Project 2061 and my colleagues in the early days of the Project 2061 Science Literacy Leaders group for pushing my thinking about the multifaceted components that contribute to science literacy and the critical importance of studying standards and research. Many thanks go to Claire Reinburg and David Beacom for having the insight to copublish this book with the National Science Teachers Association (NSTA), reaching thousands of committed NSTA members. I would be remiss if I didn't go all the way back to my days as a fellow in the first National

Academy for Science Education Leadership and acknowledge my role models and mentors Susan Loucks-Horsley, Susan Mundry, Kathy Stiles, Nancy Love, and Nancy Kellogg for guiding me along the path of leadership and vision that made this book possible.

I gratefully acknowledge my editor, Rachel Livsey, for keeping me on track and helping me navigate new waters in the publishing world. I also wish to thank CeCe Sisneros, at Corwin Press, my very first contact at Corwin, who provided encouragement and support throughout this project and others. Finally, I would like to thank my NSF Program Officer, Dr. Michael Haney, for his role in the NSF Teacher Professional Continuum Program support for this book and the two others that will follow.

The contributions of the following reviewers are gratefully acknowledged:

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Boston, MA

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St. John Fisher College
Rochester, NY

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