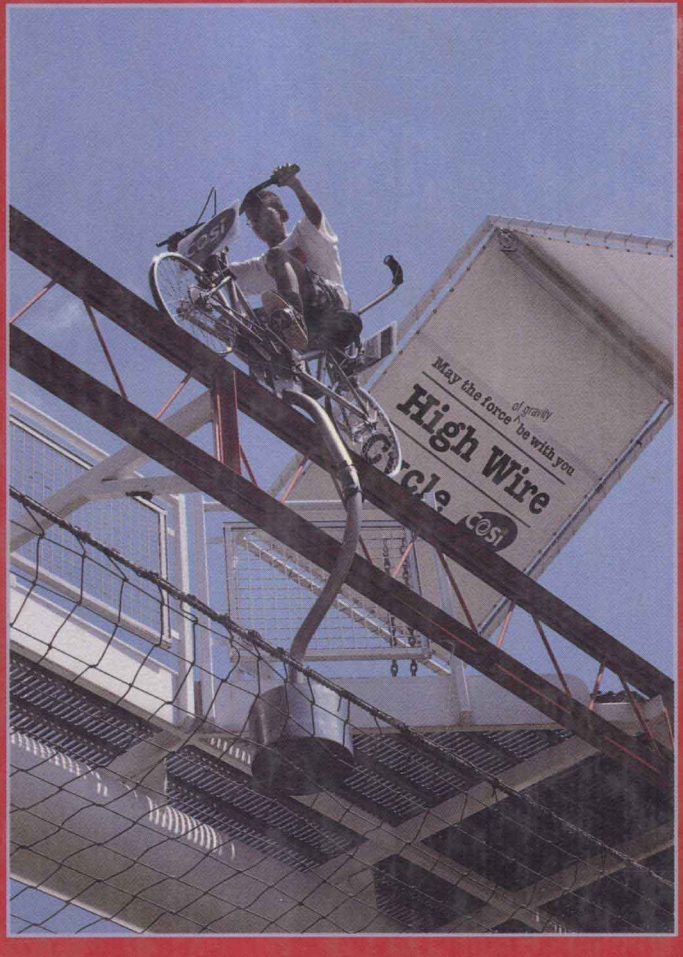
LEARNING TO TEACH SCIENCE

A MODEL FOR THE 21ST CENTURY



JAZLIN V. EBENEZER SYLVIA CONNOR

LEARNING TO TEACH SCIENCE

A Model for the 21st Century

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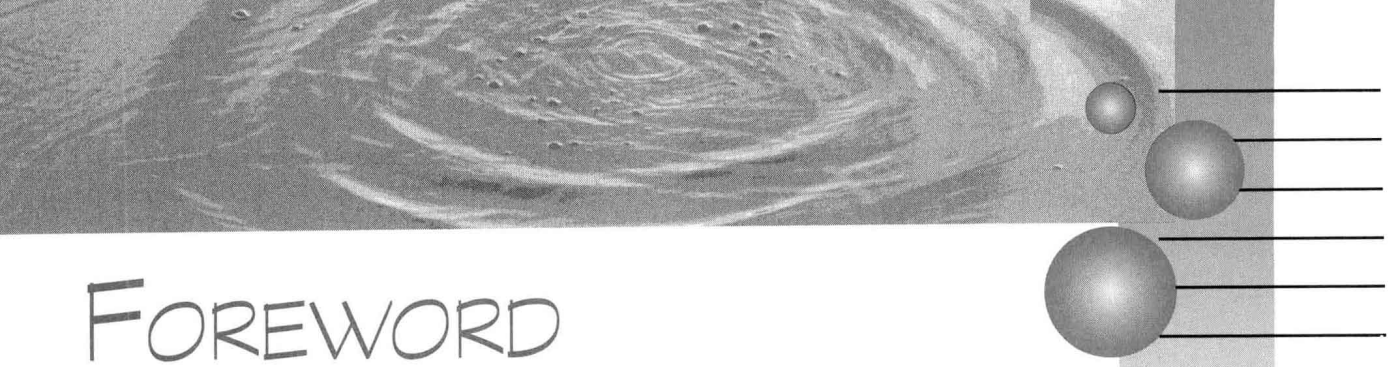
This text is dedicated to members of our respective families: Thambakara and Jane Jabez, Sudesh and Dr. D. Luke Ebenezer, and Robin Connor for their encouragement, unfailing support, and academic expertise; to preservice teachers and practicing teachers who have given us their work without reservation for the education of future teachers; and to all the eager teachers and their curious students who together explore the domain of science.

Jazlin V. Ebenezer
Sylvia Connor



FOREWORD

You have in your hands a very valuable resource. As a beginning teacher of science at the elementary grade levels, you are most likely very anxious about the science instruction you will provide for young children. Part of the anxiety likely stems from your own experience in science classrooms, an experience that was, and still is typically a vocabulary laden one with the goal of learning the 'facts' of science. If you were fortunate, in the elementary grades you did activities and investigations. Most likely though, the activities and investigations were demonstrations of scientific knowledge and not inquiries into the structure and function of nature.

Science is a way of knowing. Science is a process of asking questions about nature and creating tools and techniques to listen to the answers. Science is working from evidence, data, observations, and measurements and creating explanations and models. More often than not though, individuals and groups reason to different and, at times, competing answers to questions and solutions to problems. Science is about arguing and evaluating methods used, goals sought, and knowledge obtained. Science is a way of knowing that seeks to bring about via negotiation and argumentation a consensus of opinion within the investigating community. You and the students in your classroom will form just such an investigating community.

Jazlin Ebenezer and Sylvia Connor have written a wonderful book grounded in contemporary research that sets out a variety of strategies you will use for creating and sustaining investigating communities. Importantly, the book sets out ways to manage the materials and activities of science lessons. More importantly though, and a distinguishing feature of the book, Jazlin and Sylvia provide you with a set of tools and strategies to manage and monitor the flow of information, language and ideas found in investigating communities.

Here, then, you have a first step, an introduction to the teaching tools and instructional techniques a teacher of science needs for developing a learning environment that promotes and values consensus building and the communication, reflection, argumentation and evaluation of ideas. The text is one I am sure you will want to make part of your professional library. My advice is to refer to it often in the years to come—as you gain experience working with children and their ideas you will learn to listen in new ways and hear new voices. When the new voices appear you will have begun to make the transition from a teacher of science to a science teacher.

Richard A. Duschl
Vanderbilt University

PREFACE

In recent years, science educators have been working on reforming science education. This reformation has been based on a vision of teaching and learning science in which all students have a greater opportunity to become scientifically literate. To reach this goal, educators must alter the way science is taught and learned. Therefore, the purpose of this text, *Learning to Teach Science: A Model for the 21st Century*, is to help you transform the way you think about teaching and learning science. This text will help you explore your prior ideas about teaching science, understand the true nature of science and scientific inquiry, and provide you with a teaching methodology in which you will learn how to help students construct meaning through scientific inquiry and discourse.

CONCEPTUAL HIGHLIGHTS OF THE TEXT

To realize the vision of science for all, we emphasize that a teacher must acquire an adequate background of science content knowledge, grasp and understand how children learn, and develop an underpinning of the theoretical aspects of teaching science. In addition, we assert that a teacher must learn how to engage in continuous reflective practice. Throughout the text we provide you with many opportunities to engage in personal and collaborative reflective inquiry about teaching and learning science. Thus, through interaction with this text, you will accomplish the following:

Develop an understanding of how learning occurs and how you may facilitate learning in science. We believe that incorporating children's ideas, beliefs, and questions about science concepts and related societal issues in meaningful science lessons is an effective way to teach science. To accomplish this, you must first seek children's science conceptions. Then you can

learn to negotiate science ideas with children and conduct collaborative inquiry so that children will see the struggles and tensions that scientists go through as they invent scientific knowledge. In this manner, children will get a glimpse of the true nature of scientific inquiry.

Explore the nature of science. Modern as well as postmodern views about science presented in this text indicate how much has changed from the time of Bacon and Newton to the present day. However, the reason and logic of Bacon and Newton's day will continue to be practiced in school science, alongside the give-and-take of modern scientific discourse. Classroom discourse will enhance your construction of deeper meanings of scientific inquiry.

Examine curricular issues. Effective science curriculum includes planning for multicultural and gender equity, adapting activities for special-needs students, and utilizing technologies in science to create learning environments to meet the needs of all of your students. In this text, you will view science through a multiple-voice framework so that you may reach students with different backgrounds, interests, abilities, experiences, and motivations. A multiple-voice framework for science teaching enables you to develop learning objectives, review curricular materials, select teaching strategies and learning activities, choose assessment tasks, and engage students in a variety of ways to develop an understanding of science.

Enrich your science content knowledge. As an elementary teacher, you are most likely considered a generalist as you have probably taken only one or two courses in science before this methods course. You may be somewhat anxious about having a limited science background because you realize that to teach K–6 children you need a broad understanding of the major ideas in science. Thus, in this course you will be exposed to various science themes and the knowledge presented in them. You will also be taught *two learning tools,* Vee diagramming and concept mapping, to help you develop much-needed science content knowledge throughout your teaching career.

We do not expect you to have a deep understanding of all the sciences. Clarifying and deepening your understanding of science content, however, is part of your teaching responsibility. Hence, this is an area in which your knowledge can evolve through professional development activities even after you leave your university or college.

To have a sound foundation in science and an in-depth understanding, you must continue to seek scientific knowledge throughout your career. Participating in research at science workshops or field settings is a legitimate way to learn science and the nature of science. Why do we stress the importance of continuous learning of science? Teachers are ambassadors of the scientific community in the classroom. As ambassadors, it is important to present an authentic image of someone who engages in scientific inquiry, not someone who is a fountain of scientific wisdom.

Understand that your professional development is a continuous, active process for which you are professionally responsible. We suggest that once you begin your teaching career you seek professional activities that will provide

you with sustained and contextual participation and reflection in integrating your content and curriculum knowledge, learning, and teaching skills. As researchers and reflective practitioners, preservice and practicing teachers can make significant contributions to the advancement of knowledge of teaching and learning. And through this course you will indeed develop theoretical and practical meanings to shed light on the problems of teaching. You will also develop the skills (journal writing and using audio/video recordings, peer observations, and dialogue) to conduct research in your classroom and carry out a reflective practice.

ORGANIZATION OF THE TEXT

This text is organized into three parts. Part One consists of three chapters. It considers different world views of science teaching and learning. Essentially, it argues for and leads to a conceptual framework of science teaching and learning labeled the "constructivist" approach. Under this umbrella, Part Two, consisting of five chapters, argues for collaborative learning for young science learners. Accordingly, it outlines a teaching and learning model called the **Common Knowledge Construction Model** that consists of four phases. Many examples and case studies illustrate parts of the model. Part Three consists of four chapters and focuses on the often neglected areas of the science curricula that contribute to the development of a scientifically literate person. This part of the text outlines a framework for a multiple-voice, integrated unit plan and gives a detailed example. It discusses how learning to teach is a career-long process and offers suggestions and tools for professional development and change.

SPECIAL FEATURES OF THE TEXT

To help you learn to teach science, we incorporated a number of pedagogical elements including:

- Preparatory teaching activities for reflective practice including journal writing and peer interactions
- Sample lessons and unit plan
- Instructions for creating Vee diagrams, concept maps, and hypercard stacks
- Case studies of preservice teachers from exemplary practicum science teaching experiences
- Contextual language that the teaching community and researchers use to exchange ideas
- Margin notes that include definitions of boldfaced terms, reflections on teaching strategies, and National Science Teaching, Assessment, and Professional Growth Standards

Becoming an effective teacher is a career-long process. We hope, by reading this book and practicing suggested activities, you will feel adequately prepared to teach science. After extensive research with our own preservice teachers, we stand ready to develop your knowledge, understanding, and ability to teach science.

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Appreciation is extended to the 1991–1997 preservice teachers at the University of Manitoba for collaborating with us in preparing and sharing research-based lessons, activities, units, and strategies at the elementary level. The contributing preservice teachers' names are included along with their work throughout the text.

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