

The Inclusion of Environmental Education in Science Teacher Education

Alec M. Bodzin • Beth Shiner Klein
Starlin Weaver
Editors

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 Springer

Editors

Alec M. Bodzin
Lehigh University
Bethlehem, PA
USA
amb4@lehigh.edu

Beth Shiner Klein
SUNY Cortland
NY
USA
Beth.Klein@cortland.edu

Starlin Weaver
Salisbury University
Salisbury, MD
USA
sdweaver@salisbury.edu

ISBN 978-90-481-9221-2 e-ISBN 978-90-481-9222-9
DOI 10.1007/978-90-481-9222-9
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2010932326

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Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Imagine small groups of students scattered about a natural area adjacent to their school. One group is identifying local plant life using a field guide. They are choosing plants that will be part of their Nature Gallery that they will share with other students. Another group has a microphone connected to an iPod and is trying to record the sounds of cicadas for use in a podcast they are creating about how insects communicate. Finally, another group is using mobile technology to collect stream data. This data will be incorporated into a larger watershed management study that uses Google Earth tools. Ultimately, they are all engaged in place-based, meaningful, and active learning experiences.

As the students work, their teacher walks around the natural area observing, questioning, and advising the students on their projects. As she moves to the next group, she thinks to herself how lucky she was to have had rich pedagogical environmental education experiences during her preservice teacher preparation. These experiences prepared her to maximize learning for field trips in outdoor settings, supplied her with environmental education curriculum content, taught her that environmental education is interdisciplinary and that technology can be used appropriately to enhance outdoor explorations and investigations. This preparation really made the difference for her class. The students seem to grasp new concepts much more quickly when they are provided with active learning experiences and truly understand how many important science concepts, ideas, and learning approaches transcend discrete subject areas.

This vision summarizes the hope that the editors of this book and the Association for Science Teacher Education (ASTE) Environmental Education forum members have for the improvement of integrating environmental education (EE) into science teacher preparation. According to the NSF report, *Complex Environmental Systems: Synthesis for Earth, Life, and Society in the 21st Century* (Pfirman and AC-ERE 2003), in the coming decades, the public will be called upon more frequently to understand complex environmental issues, evaluate proposed environmental plans, and understand how individual decisions affect the environment at local to global scales. The report calls for raising the environmental literacy of the general public by providing quality environmental education and training. Support for environmental education (EE) in school curricula has been well established, with 95% of the general public supporting the teaching of EE in schools (NEETF/Roper 2001). However, there has been no significant progress in incorporating EE into K-12 school curricula (NEETF/Roper 2001; Ramsey et al. 1998).

Studies published during 1995–2005 and reviewed by the State Education and Environment Roundtable (SEER) have shown that schools that do manage to

incorporate EE programs demonstrate significant growth in student achievement and improved student behavior. For example, the SEER publication *Closing the Achievement Gap: Using Environment as an Integrating Context for Learning* (Lieberman and Hoody 1998) indicated that students in schools that incorporate EE improved in standardized test scores; science, mathematics, and literacy achievement; problem-solving and critical thinking skills; and improved overall grade point average. However, in order for such learning benefits to occur, teachers must be willing and able to support the integration of EE in the K-12 curriculum.

One of the reasons that the K-12 EE integration is rare is that many preservice teacher education programs do not incorporate EE into their programs of study (Rakow 1985; McKeown-Ice 2000). In a national survey of 715 teacher education institutions, McKeown-Ice (2000) found that only half of the surveyed students in preservice programs received exposure to EE. Barriers to including EE in preservice teacher education programs include a lack of faculty knowledge about EE, the inflexible structure of preservice teacher education courses, lack of EE standards in teacher accreditation and certification requirements, and curriculum time constraints in the teacher education curriculum (Scott 1996; McKeown-Ice 2000).

While studies indicate that there are many benefits to incorporating EE into preservice teacher education, the current extent to which it is incorporated is low. When preservice EE preparation is implemented, the treatment of EE is often shallow (Heimlich et al. 2004; McKeown-Ice 2000; Lane et al. 1995). These studies noted that teachers were not confident to enter classrooms and implement EE pedagogical methodologies, including curricular teaching and learning strategies after completing their education training. To increase EE curriculum integration in our schools, teachers must be confident and willing to incorporate EE pedagogical practices and learning activities in their classrooms.

Environmental education, when taught in school settings, is predominantly integrated into a school's science curriculum. Often, it is taught within earth and environmental science topic areas pertaining to ecosystems and environmental issues such as energy, climate change, pollution, and natural resources. EE teaching and learning also commonly occurs in life sciences topic areas that include biodiversity, endangered species, and genetic engineering. These discipline-based topic areas are covered in most basal science textbooks curriculum programs that are marketed to schools for adoption (McComas 2002; Wilson 2000). Most states incorporate EE-related content within their state science standards. While a few states such as Pennsylvania (Pennsylvania Department of Education 2002) and Wisconsin (Wisconsin Department of Public Instruction 1998) have academic standards for EE, such states do not require an EE course for high-school graduation nor do they prescribe how EE should be taught at the local level. In most states, EE-related content is integrated into science curriculum standards (No Child Left Inside Coalition 2009) and is assessed to some degree on high-stakes state science testing. That said, there has been a recent national resurgence of EE through the proposed *No Child Left Inside Act of 2009* legislation to advance environmental education in US schools through the creation of state environmental literacy plans.

Through the integration of EE within the context of science teacher preparation, preservice and inservice teachers can become aware of teaching and learning strategies for cognitive, affective, and behavioral goals of EE and can help their students with becoming environmentally literate. This book focuses on the inclusion of EE content and pedagogy in science teacher preparation as it applies towards instructional practices in K-12 science classrooms, early childhood settings, and other learning environments. EE goals include developing citizens that are aware of and concerned about the environment and its associated problems. To achieve these goals, science teacher educators need to prepare preservice and inservice teachers with knowledge of EE understandings and essential skills to ensure that their future students will have opportunities to acquire knowledge, values, attitudes, and commitment to protect and improve the environment. In science teacher preparation, this involves the teaching and learning of pedagogical approaches for creative problem-solving skills, scientific and social literacy, ethical awareness and sensitivity for the relationship between humans and the environment, making informed decisions, and commitment to engage in responsible actions.

About This Book

The purpose of this book is to share knowledge and ideas about EE pedagogy in the context of science teacher preparation as it applies to teaching and learning in K-12 science classrooms and their associated learning environments. The chapters in this book share, examine, and discuss EE foundations and pedagogical principles through theoretical and practical applications as it primarily pertains to the preparation of preservice and inservice science teachers. This book is designed to inform science teacher educators about the historical and philosophical underpinnings of EE, current trends in EE as it pertains to science teacher education, and EE-specific pedagogical practices and content-pedagogical knowledge as it applies to science teacher education. The book includes a series of case studies that highlight the teaching and learning of EE content and concepts in science teacher education. Some chapters highlight EE exemplary practice with K-12 and early childhood students in traditional classroom settings in addition to nontraditional instructional settings such as outdoor and field-trip settings. In addition, this book describes innovative science teacher preparation programs that have found ways to address the barriers to EE integration that are inherent to many teacher preparation programs.

A few key themes permeate across the book chapters:

1. *Inquiry-based teaching and learning is an integral part of EE.* EE instructional methods such as role-playing simulations, naturalistic inquiry, and field investigations incorporate essential features of inquiry (National Research Council 2001).

2. *EE is multidisciplinary and provides many applications for the teaching and learning of science.* In addition to developing science content knowledge and science process skills, EE incorporates a multidisciplinary approach to learning that incorporates problem-solving, critical thinking, and literacy skills, that are each inherent to other core school disciplines.
3. *It is important to provide preservice and inservice teachers with professional development experiences in outdoor settings.* Preservice teachers have a lack of comfort in outdoor settings as a location for learning, and most having no experience with learning outside of a traditional classroom.
4. *EE is a collaborative endeavor.* It is not necessary to include EE into science teacher education in isolation. EE educators based in a variety of settings are available to collaborate in innovative ways with science teacher educators to promote science and environmental literacy.

The primary audience for this book is science teacher educators. That said, the chapters in the book will appeal to a wide audience including faculty in teacher preparation programs, classroom science teachers, and environmental educators who work with preservice teachers, inservice teachers, and K-12 and early childhood learners.

What's in the Book?

The book is organized into two main sections: (i) *Introduction to Environmental Education* and (ii) *Environmental Education Pedagogy*.

Introduction to Environmental Education discusses the historical and philosophical foundations of EE, how environmental science is different from EE, and current trends in EE as it pertains to science teacher education with a focus on inquiry-based teaching and learning, learning environments including early childhood settings, service learning, and ocean and aquatic sciences.

In the chapter “The History and Philosophy of Environmental Education,” Carter and Simmons present the tumultuous history of EE and describe its relationship to other disciplines and fields of study. The chapter traces the historical and philosophical development of the EE field and relates EE as presently practiced to the mosaic of K-12 education with a focus on its relationship to science education. This chapter lays the foundation for further discussion of EE’s place in the education of teachers of science for the twenty-first century.

In the chapter “Professional Preparation for Science Teachers in Environmental Education,” McDonald and Dominguez discuss the importance of professional preparation for science teachers in EE. They describe reasons for why the professional preparation of including EE in teacher preparation programs has become a complex issue. The authors illustrate how the *National Science Education Standards* (NRC 1996) and the *Guidelines for the Initial Preparation of Environmental*

Educators (NAAEE 2000) provide guidance to how preservice teachers should be prepared to implement EE in K-12 classroom environments.

In the chapter “Approaches to Environmental Education,” Winther, Sadler, and Saunders provide an overview of various teaching and learning approaches that exist within the field of EE. Like science education, environmental education is an interdisciplinary and complex field that offers a multitude of strategies for learning, dependent upon the variables of resources, time, space, curriculum, student characteristics, plus a full range of factors that can affect any kind of educational implementation.

In the chapter “Environmental Education Within the Early Childhood,” Plevyak and Mayfield discuss incorporating EE into early childhood settings. They emphasize the importance of using EE as an integrated curricular context and provide many examples of how EE can be infused across the many different disciplinary areas taught in early childhood classrooms. Special emphasis is placed on acquiring knowledge about the environment, developing an environmental ethic, adapting EE activities for inclusion of students with special needs, and the use of assessment techniques.

In the chapter “Environmental Education Service-Learning in Science Teacher Education,” Phillipson-Mower and Adams explore the history, theory, and use of service-learning as it relates to EE and teacher preparation. The authors describe instructional methods that engage both preservice and inservice teachers as well as classroom students in citizenship through decision-making, research, and community-building skills that meet the goals for both science and environmental education.

In the chapter “Beyond *Terra Firma*: Bringing Ocean and Aquatic Sciences to Environmental and Science Teacher Education,” Payne and Zimmerman discuss the lack of ocean and aquatic science in environmental and science teacher education. The authors contend that such content is essential to global Earth systems science literacy. The chapter describes many resources designed to provide teacher educators and classroom teachers with tools to enhance the existing curriculum through the integration of ocean and aquatic sciences in their instruction.

The *Environmental Education Pedagogy* section is divided into three subsections that apply to science teacher preparation. These include (1) *Outdoor Learning and Place-Based Environments*, (2) *Instructional Strategies*, and (3) *Technology*.

Outdoor Learning and Place-Based Environments discuss teaching and learning in nontraditional learning environments. This section includes chapters on outdoor learning spaces, field-trip strategies, elementary teacher learning, and learning about local plant life. Three case studies are presented that include (1) EE classroom implementation of inservice teachers in an outdoor professional development program, (2) a service learning program, and (3) an urban education program.

In the chapter “Promoting the Use of Outdoor Learning Spaces by K-12 Inservice Science Teachers Through an Outdoor Professional Development Experience,” Bloom, Holden, Sawey, and Weinburgh describe a summer professional development program designed to encourage inservice elementary and secondary school teachers to use outdoor learning spaces (OLSs) as part of their curriculum. As part of the professional development design, the authors identify

the teachers' perceived and actual obstacles to integrating OLSs and then designed the professional development experiences to specifically address these. The authors provide recommendations for others who are considering developing professional development programs to promote the use of OLSs with K-12 teachers.

In the chapter "Integrating Environmental Education Field Trip Pedagogy into Science Teacher Preparation," Rebar and Enochs discuss how preservice science methods courses can make use of field trips to enhance EE integration into preservice teacher education programs. The authors describe a variety of research-based strategies for optimizing learning on field trips with secondary students. The authors provide practical implementation strategies and examples that illustrate that including field-trip pedagogy in the existing science methods courses may be accomplished without restructuring course objectives and without displacing other important materials to be covered.

In the chapter "'Eew! There's Dew On My Toes': Common Characteristics of Preservice Elementary Teacher Learning in Environmental Education and Instructional Strategies for Science Teacher Educators," Hug describes important characteristics of preservice elementary school teachers that science teacher educators should understand in order to consider integrating EE activities into science methods course work. Chapter vignettes focus on inadequate content knowledge, ecophobia, avoidance of minor physical discomfort, and a need for highly structured learning environments. Instructional strategies and learning experiences are discussed to address these characteristics.

In the chapter "Name That Plant! Overcoming Plant Blindness and Developing a Sense of Place Using Science and Environmental Education," Frisch, Unwin, and Saunders describe "plant blindness," a phenomenon that attempts to explain why botanical education is often neglected in the implementation of school curricula, and why people have so much trouble "seeing" plants. The authors suggest that plants can and should be an integral part of life science education. They advocate place-based pedagogical practices that provide teachers and students the chance to learn about and explore plant life in their communities to enhance their environmental awareness and sense of place.

In the chapter "Place-Based Inquiry: Advancing Environmental Education in Science Teacher Preparation," Sarkar and Frazier describe a 3-year professional development project for inservice science teachers to implement place-based pedagogy and EE in science classrooms. The authors provide a framework for planning successful place-based investigations. Case studies are presented where teachers with their students engage in inquiry-based, place-based investigations for an extended period of time. The authors also discuss how place-based pedagogy is important for the preparation of science teachers and how such a strategy addresses a range of science concepts through deeper inquiry.

In the chapter "Summer Methods in Summer Camps: Teaching Projects WILD, WET, and Learning Tree at an Outdoor Environmental Education Center," Eick, Carrier, Perez, and Keasal describe an innovative partnership program in which elementary and secondary science preservice teachers at Auburn University teach

EE to summer camp children at the university's outdoor environmental education center as part of their first science methods course. The preservice teachers receive training in the use of *Project* curricula including Projects WILD, WET, and Learning Tree from a Cooperative Extension Specialist. The chapter describes the camp experiences and how the *Project* curricula are integrated into instruction.

In the chapter "Teachers Connecting Urban Students to Their Environment," Brown, Votaw, and Tretter describe the *Science Beyond the Classroom* program, a 10-day *Hands-on, Minds-on Summer Science Camp* led by preservice and inservice teachers for urban, low-SES middle-school students to learn about environmental science concepts through site visits to environmental community-based venues. The program is designed to nurture positive attitudes of urban students toward environmental science learning by increasing awareness of science in their community. As a result of participating in this innovative professional development program, K-12 inservice and preservice teachers gained an enduring awareness of the impact that they can have on the environment.

Instructional Strategies discusses specific instructional strategies for the inclusion of EE in science teacher professional development. This section includes chapters on instructional methods to elicit learner EE conceptions, use of concept mapping to promote EE knowledge and understandings, Science-Technology-Society role-playing simulations with environmental issues, problem-based learning methodologies, and collaborative activities between science teacher methods instructors and nonformal environmental educators.

In the chapter "Exploring Preservice Teachers' Mental Models of the Environment," Moseley, Desjean-Perrotta, and Crim describe the development of the Draw-An-Environment Test (DAET), a survey tool designed to uncover preservice teachers' mental models of the environment and a rubric, based on the NAAEE *Guidelines for the Preparation and Professional Development of Environmental Educators* for scoring the drawings produced in the DAET. The authors present their implementation findings from a sample of preservice teachers. The authors describe how their data findings influenced programmatic changes in their certification program.

In the chapter "Pedagogy, Environmental Education, and Context: Promoting Knowledge Through Concept Mapping," Austin and Schmidt describe how they used regional environmental questions to model concept mapping for content learning and collaborative learning with their secondary science methods students. They describe how their project used concept mapping activities to incorporate collaborative learning to develop a curriculum that promoted EE learning with a focus on the interdisciplinary nature of science, while integrating discipline-specific content standards.

In the chapter "Unraveling the Scientific, Social, Political and Economic Dimensions of Environmental Issues Through Role-Playing Simulations," MaKinster describes the implementation of a United States Senate Subcommittee hearing role-playing simulation on the use of Bt (*Bacillus thuringiensis*) genes in corn in a college-level interdisciplinary science course that is taken by many preservice teachers. The simulation incorporated a wide variety of teaching strategies and topics that are

of current interest in science education including simulations, role-playing, driving questions, oral presentations, technology integration, portfolios, reflection, and concept mapping. The implementation findings demonstrated that environmental role-playing simulations can have a significant impact on students' understanding of how science is applied to environmental problems.

In the chapter "Exploring Environmental Education Through Eco-feminism: Narratives of Embodiment of Science," Spencer and Nichols discuss how care must be taken when teaching about the environment whether the underlying philosophical framework is one of sustainability, deep ecology, bioregionalism, or ecofeminism. The authors describe how problems-based learning as a pedagogical practice at first seems to be a logical way to learn about nature. However, the authors discuss problems with using this teaching strategy with EE topics from an ecofeminist perspective.

In the chapter "The Value of Nonformal Environmental Education-Based Professional Development in Preservice Science Teacher Preparation," Peffer and Bodzin describe the work of nonformal EE educators and discuss their potential role in science teacher preparation programs. Nonformal EE educators use a wide assortment of teaching methodologies in varying learning environments to encourage an environmentally literate citizenry. The benefits of collaborative relationships between nonformal EE educators and science teacher educators are discussed.

In the chapter "Using Environmental Education *Project* Curricula with Elementary Preservice Teachers," Schepige, Morrell, Smith-Walters, Sadler, Munck, and Rainboth describe the use of the *Project* curricula – Project WET, Project WILD, Project WILD Aquatic, and Project Learning Tree – as a means of introducing environmental education in preservice university courses. Four different case studies demonstrate diverse methods of integrating EE through the use of the *Project Guides* into preservice teacher coursework at four different universities. The authors describe how their instructional approaches strengthen elementary preservice teachers' science content knowledge, develop science process and inquiry skills, integrate literacy, and embed field work in educational settings.

Technology discusses the integration of technology to promote the teaching and learning of EE in science teacher preparation. This section includes chapters on instructional methods to incorporate geospatial technologies (including Google Earth and Geographic Information Systems), podcasts, and web-based inquiry activities in science teacher professional development coursework.

In the chapter "Situated Learning in Environmental Education: Using Geospatial Technologies with Preservice Secondary Teachers," Hagevik, Stubbs, and Whitaker describe how situated learning using Geospatial Information Technologies (GIT) in preservice teacher education courses can be used to study the environment. They describe how nature study and GIT were used in science teacher education courses on campus and through field experience courses in diverse natural locations. The courses promoted collaborative learning communities, where students became immersed in the natural world and were able to investigate their own investigative questions.

In the chapter “Using Podcasting to Address Nature-Deficit Disorder,” Klein and Weaver discuss the issues associated with the digital native student population and their disconnection with the natural world. The authors describe two preservice teacher education podcast projects that integrate technology to encourage student connections with nature. In these projects, preservice teachers develop podcasts that are used as learning tools for outdoor field settings with elementary and secondary school students.

In the chapter “Integrating Web-Based Activities and Site-Based Experiences to Investigate Environmental Issues,” Bodzin describes how an EE course at Lehigh University uses a hybrid approach of instruction using web-based activities and face-to-face site-based experiences to primarily focus on the study of environmental issues in the Lehigh River watershed. Course activities are presented that illustrate how technology can be used effectively to support EE teaching and learning with prospective and current science teachers. The chapter describes how course materials take advantage of easily available geospatial information technologies to foster spatial literacy in the curriculum and support learners with the ability to make use of data visualizations for analysis and interpretation when examining environmental issues such as sprawl and land use decision-making.

Bethlehem, PA
Cortland, NY
Salisbury, MD

Alec M. Bodzin
Beth Shiner Klein
Starlin Weaver

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Acknowledgments

We wish to thank the leadership team of the Association for Science Teacher Education (ASTE) for their generous support and assistance with the development of this book. We especially thank Bill McComas, Janice Koch, and Jon Pedersen for sharing their valuable insights, wisdom, and knowledge to help us through the development and editorial process for this book. We express our appreciation to the members of the ASTE Environmental Education Forum, many of whom are chapter authors, for their feedback during the conceptualization phase of this book. We are extremely grateful to the authors of the chapters in this book for their timely contributions and innovative work with integrating EE into science teacher education.

We express our deepest gratitude to the reviewers of the book chapters who helped guide us with enlightening and thoughtful comments: Diana Beck, Lisa Blank, Charles Eick, Leigh Ann Haefner, Bill Harwood, Tom Howick, Joseph Kerski, Emilie Kudela, Thomas Kromer, Michael Kamen, David Martin, Patricia Morrell, Teddie-Phillipson Mower, Irene Plonczak, Robert Reinsvold, Leonie Rennie, Gail Tooker, Peter Veronisi, Deb Molina-Walters, Bryan Wee, and Brenda Weiser. Our reviewers' feedback has helped to make this book a most valuable contribution to the fields of both science teacher education and environmental education.

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About the Authors

April Dean Adams is an Associate Professor of Science Education in the Department of Natural Sciences at Northeastern State University in Tahlequah, Oklahoma. She teaches undergraduate and graduate science content and science methods courses. She holds an Ed.D. in Curriculum and Instruction from the University of Houston and an M.S. in Biology and a B.S. in Physics from Purdue University. Her research interests include teacher education, inquiry-based instruction, and the nature of science. She is a member of the Association for Science Teacher Education, the National Association for Research in Science Teaching, the American Educational Research Association, the National Science Teacher Association, and the American Association of Physics Teachers.

Barbara Austin is an Assistant Professor of science education at Northern Arizona State University. She has done industrial research and development and is co-author on several patents for electrochromic devices. She has worked in the standardized testing industry, and as a secondary physics and mathematics teacher.

Mark A. Bloom, Ph.D., is an Assistant Professor of Science Education in the Andrews Institute of Mathematics, Science & Technology Education at Texas Christian University. He teaches elementary and secondary science methods courses as well as graduate courses in science education. Prior to teaching in the College of Education, he taught for over 10 years in Colleges of Science and Engineering (at TCU and Tyler Junior College). He holds a Bachelors Degree in Biology from Dallas Baptist University, a Masters Degree in Biology from Baylor University, and a Doctorate in Science Education from TCU. His research interests include nature of science, environmental education, and professional development for teachers.

Alec M. Bodzin is Associate Professor in the Teaching, Learning, and Technology program and Lehigh Environmental Initiative at Lehigh University. Dr. Bodzin's research involves the design of web-based inquiry learning environments; learning with spatial thinking tools including GIS, Google Earth, and remotely sensed images; design and implementation of inquiry-based environmental science curriculum; visual instructional technologies; and preservice teacher education and teacher professional development. He has co-developed 20 peer-reviewed instruc-

tional science and environmental education curricular projects including recently developed carbon cycle and remote sensing educational modules as part of a NASA Earth System Science Education grant. Dr. Bodzin is currently the Primary Investigator on the Toyota USA Foundation's *Web-enhanced Environmental Literacy and Inquiry Modules* (WELIM) project that will create, implement, and evaluate instructional modules for middle-school learners for energy, global climate change, and environmental issues using interdisciplinary environmental science instruction via geospatial information technologies and the web. He can be contacted at amb4@lehigh.edu.

Sherri L. Brown is an Associate Professor of science education at the University of Louisville where she has been since 2002. She earned her doctorate in science education from the University of Tennessee - Knoxville. Prior to that, she taught middle- and high-school Biology, Chemistry, and Physical Science in Tennessee.

Sarah Carrier teaches elementary science methods courses at North Carolina State University. Her research focus is on informal science instruction, primarily schoolyard science strategies. These strategies help students learn about environmental science concepts, providing inquiry opportunities in authentic settings. One of her goals is to help preservice teachers experience the potential for outdoor environmental science in their future classrooms. She is also involved in studies that explore the relationship between science and music, supporting interdisciplinary connections in the pursuit of developing science literacy.

Robert L. Carter serves on the graduate faculty in the Department of Teaching and Learning at Northern Illinois University at its main campus in DeKalb, Illinois. As part of the faculty in Outdoor and Environmental Education, he teaches graduate courses leading to the M.S. Ed. with a specialization in Environmental Education and a Certificate of Graduate Study in environmental education. Bob also teaches a senior-level undergraduate course required for all elementary education majors in which future teachers experience and practice outdoor education, environmental education, community-based education, and service learning. Coming from a background in resource interpretation, Bob has spent over 20 years teaching in and about the environment. He began his post secondary teaching career at Northern Illinois University's Lorado Taft Field Campus in Oregon, Illinois, where he became involved with the National Project for Excellence in Environmental Education (NPEEE) as a Project Assistant. He continues to provide workshops on NPEEE materials as need arises and time permits. Bob is presently a Consulting Editor for the *Journal of Environmental Education*. While becoming more immersed in academia, Bob has maintained strong contact with his roots in the field of resource interpretation as a regional representative of the Environmental Education Section of the National Association for Interpretation.

Courtney Crim received her doctorate in Curriculum and Instruction with an emphasis in Gifted Education from The University of Houston. She currently works at The University of Texas at San Antonio in the Department of Interdisciplinary Learning and Teaching in the areas of early childhood/elementary education. She

has experience as both a teacher and as a trainer of teachers in the public school system. Her research interests focus on the connection between differentiation and professional development for both preservice and inservice teachers. Specifically, this line of research intersects the practice of differentiated instruction for university and elementary learning environments and provides a foundation for programmatic changes and the development of transformative leadership in the field of education.

Blanche Desjean-Perrotta is Associate Dean for Teacher Education and Associate Professor in the Department of Interdisciplinary Learning and Teaching at the University of Texas at San Antonio. Dr. Desjean-Perrotta's research focuses on early childhood teacher preparation, particularly in the areas of science and environmental education. Dr. Desjean-Perrotta has been a primary investigator for Eisenhower Grants for environmental education of classroom teachers, and she also conducts research in the public schools investigating the effectiveness of expeditionary learning models on young children's perceptions of the environment. Presently, Dr. Desjean-Perrotta is a co-investigator in a research project examining early childhood preservice teachers' perceptions of the environment and the impact of formal environmental education programs on their mental models. Dr. Desjean-Perrotta is actively involved in the North American Association of Environmental Education as co-chair of the Preservice Teacher Advisory Council.

Lynn A. Dominguez is an Assistant Professor in the Recreation, Parks, & Leisure Services Department at Central Michigan University in Mt. Pleasant, Michigan. She was an Interpreter in the Virginia State Park system for 5 years prior to completing her Ph.D. at Michigan State University. Lynn teaches Outdoor and Environmental Education Methods classes, Outdoor Recreation classes, and Environmental Interpretation classes at CMU. She has been conducting environmental education workshops for teachers since 1990. Her research interests include: the use of service learning for developing environmental empowerment; preservice teacher development in environmental education; nonformal educator development in environmental education; and constraint negotiation in outdoor recreation.

Charles J. Eick is Associate Professor in Elementary Education at Auburn University. His background is in Biology and Soil Science. He regularly teaches undergraduate and graduate curriculum and methods courses where he features a variety of EE curricula including Projects WILD, WET, and Learning Tree. Charles first became interested in environmental science as a middle grades student where his sixth-grade science teacher had him monitoring water quality and visiting with local company executives about their pollution control measures. Today, he uses a similar water-monitoring approach in his work with his teachers and the Alabama Water Watch Association.

Larry G. Enochs is currently Professor in the Department of Science and Mathematics Education at Oregon State University. His Doctorate in education is from Indiana University and also holds a Master of Science degree in earth science education from the University of Rochester. During the past 20 years, he has been

involved in several teacher-enhancement efforts, as principal investigator, project evaluator, and advisory board member. In the area of science teacher development, he has published numerous articles on science teacher beliefs and earth science education. Prior to joining the faculty at Oregon State University, Dr. Enochs served as Director of the Center for Mathematics and Science Education Research at the University of Wisconsin - Milwaukee. Enochs also served 2 years as a Program Officer for the Teacher Enhancement and Research on Teaching and Learning Programs at the National Science Foundation. Prior to his NSF appointment, he was an Associate professor of science education at Kansas State University.

Richard Frazier is Associate Professor of Science Education at the University of Central Missouri. Dr. Frazier taught middle-school science for many years in the United States and abroad. His international experience includes teaching at schools in Sierra Leone, Saudi Arabia, and Singapore. As a returned Peace Corps volunteer from Sierra Leone, he still works with teachers there.

Jennifer Kreps Frisch has a B.S. in Biology, an M.S. in Environmental Education, and a Ph.D. in Biology Education. She has learned and taught in Florida, Thailand, New Mexico, Colorado, and Minnesota, and is currently an Assistant Professor of Biology Education at Kennesaw State University near Atlanta, GA. Her goal is to be able to name all of the plants in her yard by the time you are reading this in print.

Rita A. Hagevik, Ph.D., is an Assistant Professor of Science Education in the Department of Theory & Practice in Teacher Education at the University of Tennessee in Knoxville. She received her Ph.D. in Science Education and Forestry from North Carolina State University. Her teaching and research focuses on Geospatial Information Technologies, nature of science, conceptual change, and environmental and outdoor education. She has been teaching GIS integrated courses and developing curricula for GIS in environmental education for preservice and inservice teachers for over 10 years.

Molly Holden, M.S., P.G., is a professional geologist and environmental consultant, adjunct geology faculty at Tarrant Community College, and doctoral student in Science Education at Texas Christian University. She has nearly 20 years of experience in the environmental industry performing site cleanups and water resources investigations. She has been a part-time instructor in the Andrews Institute of Mathematics, Science, and Technology Education and the College of Science and Engineering at TCU, and currently teaches environmental health and safety for a private Fort Worth company, and introductory geology at the community college level. An active member of the ASTE, her research interests include teacher professional development and teacher efficacy pertaining to environmental issues and outdoor education.

J. William Hug is Assistant Professor and Director, Center for Excellence in Elementary Science & Mathematics Education at California University of Pennsylvania. His academic work focuses on elementary science teacher education,

environmental education, and place-based education. Dr. Hug teaches undergraduate and graduate teacher education courses such as elementary science teaching methods, place-based and environmental education, and educational research methods. Dr. Hug's research focuses on preservice elementary teachers' understanding of environment, ecology, and natural history content; place-based curriculum design, implementation and evaluation; and citizen actions in the service of sustainability goals.

Doyle E. Keasal is an Environmental Education Specialist with the Alabama Cooperative Extension System at Auburn University, Auburn, Alabama. His primary focus is working with educators to develop school-based outdoor classrooms and supporting curriculum as a means to extend the traditional four-walls of the classroom to include the outdoors. In addition to helping educators develop outdoor classrooms, he conducts numerous EE professional development workshops for educators throughout the year and also makes a variety of presentations to children regarding our natural resources. Prior to his employment with the Alabama Cooperative Extension System, he taught at the elementary school level for 22 years where he worked to integrate EE into the curriculum through a multidisciplinary approach that also included the development of an outdoor classroom that contained a nature trail, butterfly garden, stream-side water-quality monitoring station, vegetable garden, and greenhouse.

Beth Shiner Klein is Professor in the Childhood/Early Childhood Education Department at SUNY Cortland. Dr. Klein teaches undergraduate elementary science methods and educational technology, and graduate courses in environmental studies and integrated math, science, and technology. Dr. Klein has published in the areas of environmental education, elementary preservice and inservice education, and educational technology. Dr. Klein has been involved in a number of environmental education grant projects that include curriculum development, using technology to connect environmental experiences, to students and teachers, and inservice and preservice teacher professional development. Dr. Klein is a pioneer on the use of collaborative technologies in her teaching and was on the SUNY Cortland pilot team to integrate the use of podcasting and iTunesU into her instruction. For the past 9 years, she has co-led a team of faculty in a model environmental themed learning community for preservice elementary teachers that includes outdoor and environmental learning experiences.

James G. MaKinster is an Associate Professor of Science Education and Environmental Studies at Hobart and William Smith Colleges in Geneva, NY. His teaching and scholarship focus on scientific inquiry, geospatial technologies, and teacher professional development within science and environmental education.

Amy Mayfield Field Service Associate Professor of Teacher Education, has served as a faculty member at the University of Cincinnati since 2002. Her interests include working with preservice teachers in their field experiences and teaching students how to use scientific inquiry in their teaching. She can be reached at Amy.Mayfield@uc.edu.

James T. McDonald is Associate Professor of science education in the Department of Teacher Education and Professional Development at Central Michigan University in Mt. Pleasant, Michigan. He was a classroom teacher at the elementary and middle level for 10 years prior to receiving his doctorate from Purdue University. He has been conducting environmental education workshops for teachers since 1992. His research interests include children's conceptions of earth science topics, science and service learning problem-based learning, and the pedagogical content knowledge of preservice science teachers.

Patricia D. Morrell is an Associate Professor in the School of Education at the University of Portland. She received a B.S. in Forest Biology from SUNY ESF and an M.S. and Ph.D. in Science Education from Oregon State University. She has focused much of her work on the preparation and professional development of preservice and inservice science teachers, K-16; as well as designing science curricula and experiences for elementary-aged students. She is active in environmental education consortia in Oregon.

Christine Moseley is Associate Professor of Interdisciplinary Studies in the Department of Interdisciplinary Learning and Teaching at the University of Texas at San Antonio. Dr. Moseley's teaching and research centers around the impact of the implementation of environmental education into teacher education courses and programs on the perceptions and beliefs that elementary education preservice teachers have regarding the environment. She is actively involved in the Texas Association of Environmental Education (Vice-president) and the North American Association of Environmental Education as co-chair of the Preservice Advisory Council.

Miriam Munck is an Associate Professor at Eastern Oregon University. She has been a science educator and science teacher educator for 25 years. She holds a doctorate degree from Boise State University; her undergraduate work is in Chemistry. Her work has centered on encouraging preservice teachers in science teaching, developing curriculum for K-8 students, and improving science teaching skills and content knowledge of inservice teachers. She belongs to an environmental education for preservice teacher's consortium.

Sherry E. Nichols is an Associate Professor of Science Education at the University of Alabama. She teaches elementary and secondary science teacher education courses. Her research has focused on understanding science teaching as a community-based practice. Her current work explores uses of graphical representations for science and new literacy learning, and children's engineering at a local public housing afterschool club. She has drawn on case-based pedagogy, feminist philosophies, visual ethnography, and narrative inquiry methodologies to inform her teaching and research.

Diana L. Payne serves as an Assistant Professor in Residence and the Education Coordinator for Connecticut Sea Grant. Her research focus is on the professional development of teachers in a variety of settings, with a particular interest in the

marine and aquatic sciences. Recent research projects include investigating the effects of teacher research experiences in marine science laboratories and aboard research vessels on teacher instructional practices and on student attitudes toward science. She earned a Ph.D. in Educational Psychology from the University of Connecticut, and holds B.S. and M.S. in Biology as well as secondary teaching certification (grades 7–12) in multiple subjects.

Tamara E. Peffer is a graduate student in Learning Sciences & Technology doctoral program at Lehigh University. Her research focus is the application of technology in environmental education efforts to improve both preservice teacher preparation and student environmental literacy. She has worked as an environmental educator in formal and nonformal settings through Nolde Forest Environmental Education Center, PA DCNR for over 14 years. She served as Watershed Education site coordinator for 7 years and developed a technology-integrated model for watershed education. Tamara also teaches introductory environmental science, biology, and social science technology as an adjunct instructor at Reading Area Community College.

Karni Perez has an undergraduate degree in German and Biology and a teaching credential. She has done graduate study in German, Biology, and Environmental Studies within the California State University System. She received a Master of Science in Sociology and a Graduate Interdisciplinary Minor in Environmental Studies from Auburn University in 1993. Karno has held a number of elementary teaching positions since 1976 and taught as part of the Environmental Volunteers, a volunteer EE organization in California. After receiving the M.S. in 1993, she worked in sociology of fisheries and forestry and as volunteer Education Director at the Southeastern Raptor Center. She has written an extension handbook on solid waste management, articles on various topics, and a book on the history of the Alabama catfish industry. Karni has volunteered in various capacities at the Forest Ecology Preserve and has been the Education Coordinator for school programs since 2002.

Teddie Phillipson-Mower is an instructor and Director of the UofL Center for Environmental Education in the Teaching and Learning Department of the College of Education and Human Development at the University of Louisville. She is a Ph.D. candidate in Science and Environmental Education at Indiana University Bloomington and hopes to defend in the spring of 2009. She holds an MAT in Biology from Indiana University, and a B.S. from Northern Michigan University in Biology, Chemistry, and Sociology. Teddie's research interests include environmental education, intellectual and ethical development, nature of science, and service learning. She is the Chair of the Four Year University Section of the National Association of Biology Teachers and a strand coordinator of Strand 14: Environmental Education of the National Association of Research in Science Teaching. In addition, she is also active in the North American Association of Environmental Education, the Kentucky Association for Environmental Education, and the American Education Research Association (Environmental Education SIG). She thinks everyone should have a rain garden.

Linda Plevyak, Associate Professor of Teacher Education, has served as a member of the University of Cincinnati faculty since 2000. Her research interests include a focus on environmental science in elementary education with emphasis on the development of children's knowledge, skills, and attitudes toward environmental education. She is also interested in scientific inquiry and how preservice teachers incorporate this concept into their teaching. Dr. Plevyak can be reached at Linda.plevyak@uc.edu.

Donna Rainboth is a Senior Instructor at Eastern Oregon University. She has been involved in science education for 20 years. Over the past 14 years, she has developed and coordinated numerous science curricula projects focused on science inquiry and environmental education.

Bryan M. Rebar is currently a doctoral candidate in Environmental Sciences with a specialty in environmental education at Oregon State University. Under the same program, Bryan completed his master's thesis with a study of changes in children's conception of nature following a residential environmental education program. Bryan has considerable career experience working with teachers, chaperones, and students as a naturalist, outdoor educator, adventure trip leader, outreach specialist, and residential science center program director.

Kim Cleary Sadler is an Associate Professor of Biology at Middle Tennessee State University in Murfreesboro. She received a B.S. and M.S. with a focus on Plant Ecology from Middle Tennessee State University and an Ed.D. in Curriculum and Instruction from Tennessee State University. Teaching primarily nonmajors biology content courses for general education and preservice teachers, she uses active learning strategies extensively in her classes. Her current research interests are related to informal science education practices in after-school programs and nature centers. She also serves as director for the Center for Cedar Glade Studies and works closely with schools regarding education about this unique ecological system.

Somnath Sarkar is a Professor of Chemistry at the University of Central Missouri. He has a Doctoral degree in chemistry with an emphasis in organic chemistry and chemical education. He has been offering professional development workshop in sciences for K-12 teachers for many years. He provides services for school improvement for predominantly minority schools. He teaches secondary science methods in addition to regular chemistry courses. In addition, he has taught courses such as "Risk and Benefits of Environmentalism," "Chemistry of Cooking," and "Chemistry of Art and Archaeology."

Gerry Saunders is a Professor of Education at Unity College in Maine. He has degrees from the Universities of Northern Colorado, Idaho, and Nebraska-Lincoln. He taught high-school biology, environmental science, and human physiology for 18 years. Currently, he is Director of Teacher Education and Coordinator of EE at Unity College. He also teaches courses in Science and EE and Biology.

April T. Sawey, M.Ed., is a doctoral student in Science Education at Texas Christian University. She has 12 years of experience as a science teacher and administrator and

holds an undergraduate degree in Biology and a Master's degree in Curriculum and Instruction – both from Texas Wesleyan University. Her primary research interest involves teacher's conception of inquiry and the role of inquiry in the classroom.

Adele C. Schepige is a Professor of Science Education at Western Oregon University. Her doctorate is in Curriculum and Instruction from Portland State University. She has taught biology, earth, and physical science courses for both preservice and inservice elementary teachers for 20 years. She has been involved with a variety of environmental education consortia and is developing global climate change education professional development and curriculum materials for K-8 teachers and students.

Nina Schmidt is an Environmental Health Specialist with over 20 years of experience in the field of environmental technology. She has worked as an analytical chemist, regulator, community college instructor, and wastewater system designer. She recently completed a master's degree in sustainability education.

Bora Simmons serves as the founding director of the National Project for Excellence in Environmental Education. The Project has drawn on the insights of literally thousands of educators across the United States and around the world to craft guidelines for top-quality environmental education. After 20 years as a professor of environmental education at Northern Illinois University, Bora retired in 2007 and moved the Project to the Institute for a Sustainable Environment at the University of Oregon. Bora has been actively involved in environmental education research, evaluation, and professional development for over 30 years. She has taught courses, given presentations, and facilitated workshops throughout the United States and Canada as well as in Europe, Asia, Africa, Middle-East, and Latin America. She was chair of the NCATE environmental education standards writing committee. She served as president of NAAEE; serves on numerous steering committees and boards of directors, and is an executive editor of the *Journal of Environmental Education*. For her achievements, Bora received the Walter E. Jeske Award for Outstanding Contributions to Environmental Education, and the NAAEE Award for Outstanding Contributions to Research in Environmental Education.

Cindi Smith-Walters is a professor of Biology at Middle Tennessee State University and co-directs the MTSU Center for Environmental Education. She received a B.S. in Biology from East Central State University and both an M.S. in Curriculum and Instruction and Ph.D. in Environmental Science from Oklahoma State University. She is interested in formal and informal science teaching and learning and in 2007 received the Tennessee Environmental Education Association's Distinguished Service Award. When she isn't teaching or learning, you can find her outside playing or reading.

M.E. Spencer is a secondary science specialist with the Alabama Math, Science, and Technology Initiative and adjunct assistant professor at the University of Montevallo where she teaches environmental education for teachers among other graduate courses. Her research focuses on embodiment of science and science

education, ecofeminist thought, and environmental education with particular attention to teachers and middle-school students throughout the state of Alabama.

Harriett S. Stubbs, Ph.D., is an Associate Professor Emerita, member of the Department of Mathematics, Science and Technology Education since 1988, and located in the Office of Professional Development at North Carolina State University. She is Director of the SCI-LINK/ GLOBE-NET Projects, author of books and articles, presenter of methodologies and strategies for professional development of educators and environmental topics of interest for teaching and learning. In the past 5 years, she has developed and coordinated international professional development experiences for educators in Brazil and for more than 25 years in the USA.

Thomas R. Tretter has been an Associate Professor of science education at the University of Louisville since 2004. He earned his doctorate in science education from the University of North Carolina - Chapel Hill. Prior to that, he taught high-school mathematics and science in North Carolina, South Carolina, Sudan, Africa, and Gabon, Africa.

Matthew M. Unwin is an Assistant Professor of Biology in the Department of Biology and Physics at Kennesaw State University. He holds a Ph.D. in Botany with research interests and experience in plant biodiversity, conservation, and systematics. At KSU, he teaches both introductory biology and advanced botany courses.

Nikki L. Votaw has been an Assistant Professor at Johnson Bible College since 2008. She earned her doctorate in science education from the University of Louisville. Prior to that, she taught elementary middle-school science and mathematics in Tennessee and Kentucky.

Starlin Weaver is a Professor of Science Education at Salisbury University. She teaches graduate and undergraduate courses in middle and secondary science education and classroom management. She also supervises science interns. Dr. Weaver serves as an NSTA program reviewer and NCATE Board of Examiner member. Her current scholarly interests include using technology to teach science methods, incorporating environmental education into science methods courses, and integration of content area reading into science methods courses.

Molly H. Weinburgh, Ph.D., is the William & Betty Adams Chair of Education and the Director of the Andrews Institute of Mathematics, Science, & Technology Education at Texas Christian University. She directs the Ph.D. in Science Education, teaches courses in science education, and teaches the Honors section of a nonmajors biology course. Her service to science education includes: President of the ASTE, ASTE Board of Directors, Strand Coordinator of Culture, Social and Gender Issues of the NARST, and Policy Committee of the SSMA. Her research interests include equity issues, inquiry science, and professional development for teachers.