Preface

I recently joined my six year old at school in the Southwestern part of the US to eat lunch. I was surprised to witness the large amounts of food and waste generated by just one school lunch at one school. From Styrofoam trays and plastic water bottles to paper cups and plastic silverware, it all went into the garbage. I wondered how this could be different. Suppose my daughter’s teachers instead incorporated sustainability ideas in their curriculum and modeled sustainable practices. In the US, the National School Lunch Program feeds more than 30 million students each year. Studies have shown that kids throw away anywhere from 24 percent to 35 percent of the food on their school lunch trays (Smith and Cunningham-Sabo, 2013). Maybe, instead the food options could be grown locally or, better yet, school grown and the resulting waste composted instead of sent to the local landfill. When children grow and cook their own food, they value it much more. Gardening and culinary education increases students’ knowledge of nutrition as well as the variety of foods served at lunch. When students play a part in producing the food they eat and can choose the food they want on their tray, food waste in the school cafeteria decreases (Cluss, Fee, Culyba, Bhat, and Owen, 2014). Schoolyard gardens are prime locations in which students can engage in many problem-based learning activities. Students develop a sense of place as they learn about geographic seasonal changes and relationships to plant growth. Learning the importance of reducing waste, reusing materials and recycling equips students to live sustainably.

An example of a school doing this in the Southern part of the US is Green Charter School. The teachers at Green Charter School decided to include a unit on water use in their curriculum. In science the students learn about the sources of water in their community, how water is treated for domestic use, and the waste water system including how treated water is
reused. The science students designed a rain garden system to capture rain water for the school garden. Students in the culinary arts classes grow some of the food that they later cook, and as part of the unit, are keeping track of the amount of water they use in the garden (for growing the food) and in the kitchen (to prepare the food). The art teacher has the students engaged in a project, in collaboration with the water authority, to educate citizens about fertilizer use and run-off. In social studies the students investigate how policy decisions about water use have influenced development in the region. At the end of the unit the school has an open house in which the students make presentations about how water is used in their city and make recommendations regarding methods they have found to ensure that the citizens will have sufficient high quality water that will continue to support them as well as the diverse habitats and natural areas in the region.

This short vignette of what education for sustainability (EfS) could look like is not fiction. There are schools in the US and elsewhere that this is happening (see for example Barr, Leigh, and Dunbar (2011)). In it we see some of the goals of EfS including the development of citizens that are aware of and concerned about learning ways of promoting an understanding of living within human and environmental needs and constraints (Connelly, 2002). While this school has been able to incorporate EfS into the daily lessons of many of the classes, there are other schools in which this happens but in a less systematic and concerted manner.

The focus of this book is the education of science teachers so that they can engage in EfS practices like those described in the vignette. We realize that for science teachers to be able to help educate students about the science of sustainable practices, science teacher educators will need to prepare preservice and inservice teachers with adequate knowledge of the science behind sustainable living to ensure that their students will have opportunities to acquire the knowledge,
values, attitudes and commitment to sustain a healthy planet. Unfortunately, this is not a simple or a direct task. The idea of sustainability is dynamic and evolving with many interpretations. It includes the environment, society, politics, economics, the built world and a discussion of sociocultural issues, values and beliefs (see the introductory chapter for more details). Current paradigms for educating for sustainability include many topics that are controversial, value-laden, and complex (Corney, 2006; Winter and Firth, 2007) and can be difficult to teach (Spiropoulou, Antonakaki, Kontaxaki, and Bouras, 2007). Yet at the same time, many scholars agree that it is imperative for teacher educators, and specifically science teacher educators, to promote an awareness that will achieve a sustainable society (Corney and Reid, 2007; NGSS Lead States, 2013). Now is the time to begin!

About this Book

The purpose of this book is to share knowledge and ideas about educating for sustainability including historical and philosophical analyses, and pedagogical and practical applications, in the context of science teacher preparation as they apply to formal and informal educational settings. This book is intended to be an international discussion among science teacher educators and scientists about how to approach the topic of EfS through multiple lenses including formal and informal settings, global voices, science teacher preparation, equity and diversity, college level science courses for sustainability, and ethnoscience.

Educating for sustainability requires crossing borders and the cooperation of multiple groups from countries around the world. It is a joint effort among research in the STEM (science, technology, engineering, and mathematics) disciplines, the social sciences, and education (Khalifa and Sandholz, 2011). This book provides theoretical frameworks for researching and educating for sustainability. In addition, we illustrate pedagogical approaches to teaching the
interrelations between humans and the global environment by demonstrating approaches to teaching about the values, behaviors and lifestyles required for a sustainable future and positive societal transformation.

Some themes that have revealed themselves in these book chapters include:

1. *EfS is a global endeavor that requires global citizenship.*

   Today, due to many factors including advances in technologies, we live in a global society. Western culture, as presented in school curricula today, exhibits many obstacles to EfS, but at the same time presents countless possibilities as well. Science educators need to employ global thinking, using multifaceted approaches, to address global challenges related to sustainability. An attitude toward global learning and global education for sustainability will need to be developed throughout educational systems as well as on an individual level through concrete examples.

2. *Preservice and inservice science teachers and science teacher educators will require professional development around how to engage meaningfully in EfS.*

   Science teacher educators and science teachers lack a clear understanding of EfS and most have little experience from either their formal or informal education with addressing sustainability in the classroom (Feinstein and Kirchgasler, 2015). Since many EfS topics are socioscientific in nature and have moral implications, many more experiences at many levels of science teacher preparation will be needed to address this challenge.

3. *EfS is a transformative and emancipatory pedagogy.*

   Educating for sustainability represents a new paradigm for the preparation of science teachers. It will require a new curricular vision that addresses the fundamental social purposes of education in the context of uncertainty and change. EfS stimulates a conversation about the role of science teacher education and teacher education in general in the creation and solutions of global environmental and social justice challenges.
4. **Values and ethics in the science classroom will need to be addressed in an integral manner in order for EfS to become the norm in science teacher education.**

Science teacher educators and science teachers overall are often uncomfortable and even refuse to discuss controversial or sociocultural issues in their classrooms (Griffith and Brem, 2004). However, the organizing idea of sustainability is that the current generation will be able to meet their needs without jeopardizing the ability of future generations to meet their needs at the same or a better level than currently exist. Sustainability in science refers to the carrying capacity of an ecosystem or a balance between human systems and the natural environment and considers all living things as having equal rights and access to these resources. Inherent in this definition is the need for teaching values and ethics in science education. Ways to do this effectively will need to become a more integral part of science teacher education.

**What’s in this book?**

The chapters that follow demonstrate a variety of pedagogical approaches to teaching science teachers about the interrelationships between humans and the global environment. This book is unique in that the focus is exclusively on science teacher education.

The first section of the book is an introduction to the field of education for sustainability and provides a theoretical framework for understanding EfS and its relation to sustainability, sustainable development, and environmentalism. The second section focuses on the preparation of science teachers to teach for sustainability in school settings. The ideas of a sense of place, sustainability literacy, ecojustice philosophies, ecology disrupted, and field-based, project-based experiences for science teachers are introduced in this section. These views expand our understandings of the importance of representing the interdependence of science learning and
teaching within the cultural, social, and contextual factors of our complex world. Chapter 2 is particularly positioned to introduce how preservice elementary teachers view sustainability in the US. This is followed by Chapter 3 and a discussion of science teacher education preparation programs that prepare these teachers to teach from a sustainable viewpoint. Chapters 4, 5, 6, and 7 then provide examples of courses and programs in science teacher education that use education for sustainability as a framework for educating science teachers. Finally, in Chapter 8 of section two, the strategy of using learning progressions and scientific argumentation to facilitate science teachers’ understanding of sustainability as a way for teachers to evaluate the views of their students and their own views is discussed.

The third section of the book emphasizes science teacher education for sustainability in out-of-school settings. Chapters 9 through 15 provide examples of science teacher education for sustainability in a variety of settings, exchanges with other countries and contexts in regard to sustainability, and uses of technology tools to explore the complexities of sustainability. In these chapters we find examples of science educators creating their own stories and identities as educators for sustainability as they deal with the controversial, value-laden, and complex issues that comprise EfS.

In the fourth section of the book science teacher educators bring to the forefront international perspectives on educating science teachers for sustainability. While various chapters in sections two and three of the book are authored by individuals from a variety of countries, in section four we focus on particular viewpoints from the perspectives of authors from Australia, Sweden, Cambodia, United Kingdom, and Ireland. In the chapters from Australia, Canada, the UK, parts of Europe are found examples of a critical approach to sustainability that takes into account contextual and political factors affecting people’s lives
(Dillon, 2014), which is often missing in discussions in the US. International perspectives are especially important as we consider ways to educate science teachers for sustainability because of its complex topics such as poverty alleviation, human rights, peace and security, cultural diversity, biodiversity, food security, clean water and sanitation, renewable energy, preservation of the environment, and sustainable use of natural resources, all of which require a global approach (Kilinc and Aydin, 2011).

Finally, in the last section of the book we, the editors, further elaborate on the themes represented and brought forward in these book chapters. We consider multiple ways to frame the discussion of educating and preparing science teachers for sustainability. We reference U.S. standard documents such as the Next Generation Science Standards (2013) and discuss global perspectives on science teacher education (Lederman and Lederman, 2015) as related to EfS. We raise challenges as well as offer possible counter perspectives when thinking about EfS. One such counter perspective is addressed in the afterword. It is our hope that this book and these book chapters will encourage a continued conversation around educating science teachers for sustainability. We believe that only through a broad and diverse conversation that draws on different sources and conclusions can we can address the critical and urgent need for a new paradigm in science education in which science teachers understand ways in which they can bridge the gap between science and education by educating for sustainability (Tilbury and Mulà, 2009).

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References


