MAKING SENSE OF SCIENCE AND RELIGION

Strategies for the Classroom and Beyond

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Part III

Beyond the Classroom

Preface

Dr. Shane, you are not taking this seriously … and you need to.

—Preservice biology teacher, Shippensburg University, 2005

This class helped me to be less of a [jerk].

—Science-religion honors seminar student, Shippensburg University, 2015

For more than 10 years, understanding and addressing the complex interactions between science and religion has become part of my mission as a scientist, science teacher, and science teacher educator. I never intended to walk this path. Now, though, I embrace the role and I am grateful to a former student for, rather bluntly, initiating the interest that led me to this current effort to assist all teachers of science.

My first year at Shippensburg University in central Pennsylvania coincided with the 2005 *Kitzmiller v. Dover Area School District* trial (400 F. Supp. 2d 707, M.D. Pa.; see National Center for Science Education 2005), which is often referred to as Scopes II in reference to the well-known Scopes Monkey Trial from 1925 in Dayton, Tennessee. During the fall semester, a student in my science teaching methods class regularly came to my office hours to discuss the trial (the "this" in the first quote above). He was, to put it mildly, unimpressed with my knowledge of the proceedings, the legacy of the Scopes trial, other related Supreme Court cases, and evolutionary theory in general. He challenged me to take a more active role, and thus began my journey.

I first read Judge John E. Jones III's *Kitzmiller* ruling (National Center for Science Education 2005) where he determined the teaching of intelligent design to be inherently religious and thus in violation of the Constitution's Establishment Clause. After acquainting myself with the judicial history, I discovered vast areas of historical, philosophical, and theological scholarship devoted to nuanced understandings of science and religion that included, but also went beyond, specific scientific theories and concepts such as evolution, geochronology, climate, and genetics.

Since 2005, I have been fortunate to use these insights to better prepare my preservice science teachers. In 2007, the pastor at my church asked me to teach a three-week adult Sunday school class on science and religion, and I have been teaching similar courses ever since at regional Christian churches. I host an annual forum on science and religion at Shippensburg, and the director of our honors program invited me to teach a seminar in

2015. The 12 students were, as far as I could tell, divided into three groups from a religious perspective. Four were active members of various Christian denominations, four had been active Christians earlier in their lives, and the remaining students were devoted atheists. An interesting group to be sure!

During one of the final class periods, a colleague with expertise on the sociology of science and religion (and author of the concluding chapter of this book) spoke to the class about his work, and he asked the students about their experiences in the course. One student quickly proclaimed, "This class helped me to be less of a [jerk]." She used a more college-appropriate and slightly cruder word, and I wish she had written this on the course evaluation.

My efforts eventually led me to engage my primary professional group, the Association for Science Teacher Education, a National Science Teaching Association affiliate. I befriended several colleagues who were addressing similar issues in their regions and science teacher preparation programs. After some conference presentations and a journal article, we decided that a broader effort was needed. And that's how this book was born. Those colleague friends are Lee, Ron, and Ian, the three other editors of this book.

With this book, we wish to assist you, our colleagues at all levels of science education, with understanding science-religion interactions in a broad sense to complement your personal experiences with your students and surrounding communities. We have written this book specifically for an audience of our fellow science educators, but it will also be of interest to any advocates for good science and quality science education, including parents, administrators, elected officials, and other policy makers. As you will notice from the modest chapter lengths and overall book size, it should be read as a primer that encourages additional reading and discussion. We asked each contributor to write in a conversational tone that is engaging to read while providing excellent resources for continued study and consideration.

We understand that science teachers have long seen the teaching of evolution in particular as a tough issue and an almost intractable one in many regions of the United States. To respond to this, we urge you to step beyond evolution into bigger issues at the interface of science and religion. We want to guide you in exploring those broader issues to provide a framework to make better sense of how to teach evolution and other science concepts. To genuinely understand science-religion relationships requires some understanding of history, sociology, religious experience and theology, and the Constitution and case law, as well as principles of good communication of complex ideas. You may even need to brush up on your own scientific knowledge. The other editors and I are not experts in all of these areas, so we have tapped the wisdom of a great group of additional authors to lend their perspectives.

Science has progressed to the point where it is rapidly changing our notions of matter, space, and time as well as addressing questions once thought to be outside of empirical

investigation. Thus, it is no wonder we are challenged to reconcile scientific discoveries with our personal, often religious, beliefs. Sociobiology and neurology, for example, shed light on the fundamental aspects of human thought and behavior that can profoundly affect one's sense of identity and purpose. Physics, cosmology, and geology now contribute to our understanding of the origins of life. In this sense, science has grown far beyond isolated subdisciplines for the select few. Science is ingrained in our everyday culture, and it lends insight into and asks questions about topics of personal and universal significance, in a manner similar to literature, music, and other artistic expressions.

The chapter authors have demonstrated their ability to help navigate these waters. We invite you to do the same. We suggest that all teachers of science have some responsibility for understanding interactions between science and religion, two indisputably profound and durable cultural forces so often characterized as inherently in conflict with, or simply mutually exclusive of, one another. These all-too-familiar conflicting perspectives or simplistic dichotomies are inadequate in our view.

In Part I of the book, we introduce you to science-religion scholarship. We emphasize the historical roots and persistence of opposition to evolution given that it is the most prevalent science-religion theme in the United States. In addition to summarizing the relevant judicial and political history, we describe a precise framework for addressing science-religion issues in a legal, constitutional manner.

Part II is written for teachers of science at various levels: elementary/early childhood educators, middle school and high school science teachers, college professors and teacher educators, and colleagues who work in informal science education settings. We hope that you find this information useful not only for your work, but also for your collaborations with other science educators in your building, district, and beyond.

Part III recognizes that science-religion interactions often extend beyond our specific classrooms and other learning environments, and we offer advice for engaging other constituencies such as parents and families, administrators and school boards, legislators and policy makers, and faith communities. We include expert advice about how to best respond when issues of science and religion arise, and we look to the future regarding how controversies around teaching evolution might shift in the years ahead.

We have invited authors who are in many ways personally and professionally invested in these ideas. Some contributors are K–12 teachers and university professors. Some are science teacher educators like us. Others are from prominent organizations such as the American Association for the Advancement of Science and the Smithsonian National Museum of Natural History. We have encouraged them all to share memorable and illustrative stories along with their expertise, selected references that are most appropriate for all teachers of science, and take-home advice and recommendations for action. We are hopeful that you will find the concise yet comprehensive nature of this book useful to your everyday work and to your greater understanding of science and religion.

Dr. Joseph W. Shane
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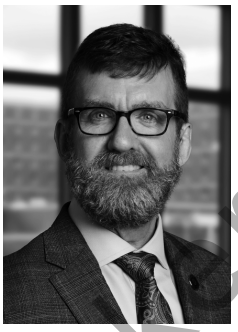
REFERENCE

National Center for Science Education. 2005. *Kitzmiller v. Dover*: Intelligent design on trial. *https://ncse.com/library-resource/kitzmiller-v-dover-intelligent-design-trial*.

About the Authors and Contributors

AUTHORS

***Joseph W. Shane,* professor of chemistry and science education, Shippensburg University (Shippensburg, PA).** As professor of chemistry and science education at Shippensburg University, Joe has responsibilities both to the chemistry department and to the programs, both undergraduate and graduate, that license preservice secondary (7–12) science teachers. In addition to teaching a variety of chemistry courses, he teaches pedagogical methods in science, supervises secondary science teachers, teaches an honors seminar, and conducts outreach on the intersections of science and religion.



***Lee Meadows,* professor of science education, University of Alabama at Birmingham (Birmingham, AL).** Lee is a professor of science education at the University of Alabama at Birmingham. A teacher at heart, he has taught high school chemistry, physics, and physical science as well as college chemistry, general teaching methods, and science methods. Throughout his career, Lee has written and spoken on the teaching of evolution in the American South, and he is the author of *The Missing Link: An Inquiry Approach for Teaching All Students About Evolution*.

***Ronald S. Hermann,* professor of science education, Towson University (Towson, MD).** Ron is the author of several peer-reviewed articles that explore the teaching and learning of evolution. He has conducted more than 20 presentations on the topic of evolution education and is the recipient of the Association for Science Teacher Education 2018 Award for Outstanding Science Teacher Educator of the Year in recognition of his work. Ron is a science educator at Towson University where he works to prepare preservice K–12 teachers of science.

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Science and Religion as Part of Our Professional Responsibilities

Joseph W. Shane, Lee Meadows, Ronald S. Hermann, and Ian C. Binns

Teaching is often more about establishing and building trust with our students and less about the conventional content and practices of biology, chemistry, Earth and space sciences, environmental science, and physics. Simply put, when there is mutual trust and respect in a classroom, enduring learning occurs. This is obvious to say, difficult to achieve, and marvelous when it happens!

Like many people, our students will sometimes come to us with religiously based understandings of the natural world and their roles in it. Other students may be antagonistic toward these perspectives. Others still will wonder what all the fuss is about and would just as soon stick to the science. As usual, our job is to convey and model science in the midst of all of our students' complex preconceptions, misconceptions, beliefs, values, joys, and social anxieties.

We believe interactions between science and religion are an inevitable part of teaching science in 21st-century America. As all good teachers do, we've learned to thoughtfully anticipate, and respond to, our students' prior knowledge and beliefs regardless of their origins or our personal perspectives. We do not, however, expect this to be easy, and the authors in this book will make their separate cases as to why you should care and what specifically you can do to, quoting a good friend that you will meet in Chapter 7, "bring the threat level down" when religion is brought up.

In this first chapter, we make the argument that addressing science and religion is, in fact, part of our collective job. We review four domains of science teaching to make our case, and to assist you in explaining, justifying, and defending your choices to your students, colleagues, and community. In our view, science-religion interactions are perfectly consistent with the well-known nature of science (NOS) literature, with professional standards, with general ethical principles and responsibilities of all teachers, and with scientific inquiry. Science educators at all levels have the potential to "move the needle" on how students understand similarities and differences between scientific and religious worldviews. We also have the professional responsibility for doing just that.

DISTINGUISHING SCIENCE AND RELIGION VIA THE NATURE OF SCIENCE

Before reviewing the various aspects of NOS, we need to ask a broader question—namely, what is science? As science teachers you may not ask yourself this question very often. But it is important because this understanding is a key part of addressing science-religion interactions, and basic misunderstandings about NOS are often central to the distrust in science and scientists that is expressed by people of faith.

One particularly concise definition states that science is "the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process" (National Academy of Sciences and Institute of Medicine 2008, p. 10). This definition includes key characteristics that distinguish science from other ways of knowing: empirical evidence, testable explanations and predictions, and natural phenomena. An additional characteristic is that science involves a scientific community. This reinforces the notion that scientific research is ultimately collaborative, reproducible, and subject to expert peer review. Each of these characteristics is an essential part of the development and acceptance of scientific knowledge.

With this general understanding, let's move to NOS, which is in essence "the epistemology of science, science as a way of knowing, or the values and beliefs inherent to scientific knowledge and its development" (Lederman 2007, p. 833). While there are many lists outlining aspects of NOS, the following characteristics are commonly cited:

- *Science requires empirical evidence*. This one is straightforward. In order for something to be accepted as scientific, there must be evidence based on observable, verifiable data. No scientific explanations are considered without empirical evidence. It is important to note that empirical evidence can be both quantitative and qualitative descriptions of the natural world.
- *Science is tentative*. Scientific knowledge is not absolute, meaning it is subject to change. This happens when either new evidence is discovered or new ways are discovered to evaluate existing evidence. This process may not always be quick, but over time when new instrumentation or new evidence comes to light, scientific explanations can, and will, change.
- *Science is subjective*. This suggests that scientists' backgrounds influence what they investigate, what they observe, and how they interpret evidence. To be a detached observer in a purely objective sense is simply not possible, even though many people think that is how science works.
- *Science is creative*. Scientists use creativity and imagination throughout the scientific process. This includes developing research questions, designing investigations, and formulating explanations of their findings.