Preface

Ambitious Science Teaching (AST) represents a vision for changing how children learn about the natural world. It focuses on the ideas and other diverse resources that they bring to classrooms every day, as building blocks for sense making and progressive knowledge building. This vision is built on a repertoire of teaching practices that cultivate student dialogue, community reasoning, and intellectual rigor, as well as the ability to learn how to learn. As promising as this sounds, we would prefer that when you read each chapter of this book, you be critical of our theories and tools—to be sure that the evidence is clear to you and is compelling enough for you to consider changes in your teaching. To accommodate this, we now share the origin story of AST, including the fits and starts that made the journey interesting.

Many years ago, long before the idea of Ambitious Science Teaching started to take shape, we were reading everything we could get our hands on about instruction that had significant impacts on student learning. Researchers in diverse fields of study were starting to describe how, under the right circumstances, children in science classrooms could explain, model, argue, design investigations, and problem-solve with one another, in ways that went far beyond the expectations built into common curriculum and standards. We became excited about the possibility of translating and applying outcomes from these studies, largely done under controlled conditions, to the dynamic environments in which science teachers work.

We were not the only ones trying to make these connections, but we felt confident about our prospects, in part because we had spent years as science educators ourselves and understood the challenges of teaching in underresourced schools with precious little time to experiment with peers about instruction. All three of us were at the University of Washington and in charge of preparing novice teachers for work in secondary science classrooms. We believed that our own courses on methods of instruction could be incubators for testing out innovative forms of practice and then seeing how these worked with young learners in local schools. Our preservice teachers were eager to learn about alternatives to the status quo, so we obliged them and spent months explaining in great detail what research indicated they should be doing to foster student engagement and authentic science activity. We later followed these novices into their host classrooms to observe the fruits of our labor. We were all disappointed.

Our exuberance about adventurous teaching and our novices' willingness to try out new and unfamiliar routines did not translate into eager student participation or the learning outcomes that the research literature had promised. Most of the exasperated teachers-in-training said things like "I knew *what* I wanted to have happen, but didn't know *how* to make it happen."

We realized then that we had relied on broad notions like "inquiry" and "hands-on work" to shape their attempts at teaching, and had failed to show our novices actual practices—that is, approaches that you could see and hear someone using in a classroom on a regular basis. What was needed were professional routines that were recognizable, principled, and improvable. This realization prompted us to specify instructional practices from the research literature, which required some inventiveness because they were not clearly identified there. We ended up selecting a small number that appeared critical for student learning and participation, gave them names, and aimed to get our novices proficient at them. Each of these practices was really a combination of tasks, talk, and tools that had to be used together to support knowledge building. At this point, we didn't want to repeat our earlier mistakes by simply *telling* our novice teachers what powerful practice was, we had to *immerse* them in it. So, we played the role of the teacher while our novices became the students. They then took their turn in the teaching role during what we and others call *rehearsals* (that's another book). In retrospect, we can clearly see that there is no substitute for live action in which our own instruction becomes public, responsive to the science ideas of everyone in the room, and open to critique. Weak spots in teaching, ours and theirs, became glaringly obvious, but the benefits were that everyone learned quickly what was possible, and how to improve. To our delight, these practices "traveled" much more readily into K–12 classrooms.

We are oversimplifying the story, but these events started a twelve-year run of experimenting with our novices, and increasingly with local teachers, around a set of core practices and the tools to go with them. These resources now get "tested" by hundreds of colleagues—both experienced and preservice educators—on a daily basis.

Other surprises followed. The core practices were originally designed for middle and high school instruction, but elementary teachers soon began pushing the limits of AST with five- and six-year-olds. We were astonished to see what was happening in their classrooms. Teachers had to adapt most of our tools, using fewer words and more pictures, but even the youngest of learners, they found, were capable of experimenting, making sense of data, and revising explanations over time. We recently observed boys and girls in a second-grade classroom create different claims for why a nearby town was nearly wiped out by a flash flood, despite only modest rainfall in the area. The diversity of their initial ideas was impressive enough, but then a few days later these young learners evaluated their claims using maps, evidence from readings, their own "sandbox" tests, data collected by scientists, and known science facts. Although such episodes never unfold without unexpected problems and require lots of support, teaching like this is still extraordinary—and slowly but surely making appearances in classrooms around the country.

The AST community is now more focused than ever on finding ways for *all students to participate* in challenging science, to make science *compelling to wider groups of learners*, and to *provide the means for students to show what they know*. If we are going to turn a corner on how science is taught, we have to be serious about including every learner in the classroom and recognizing that children *have many legitimate ways of making sense* of the natural world. Traditional teaching does not often accommodate diverse pathways to deep understanding. This stance about equity, we believe, sustains our colleagues through a lot of hard work—hard because it requires new knowledge and skills, but also because we are now trying to teach in ways that we never experienced ourselves as learners.

We dedicate this book, then, to professional educators around the country who have taken risks to make a difference for their students. Some of them use AST, some do not. We also wish to thank our current and former research assistants and postdoctoral researchers who have shared the frustrations and the joys of this ongoing project. You have been great colleagues: David Stroupe, Carolyn Colley, Sara Hagenah, Michelle Salgado, Karin Lohwasser, Christine Chew, Hosun Kang, Christie Barchenger, Kat Laxton, Biz Wright, Soo-Yean Shim, and Jen Richards.

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