Leadership

by and for

Science Teachers

Rodger W. Bybee

nsta Press
National Science Teaching Association

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ARLINGTON, VIRGINIA

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Leadership by and for Science Teachers: Guides for the Journey

A Preview of This Book

The title of this book, *Leadership by and for Science Teachers*, suggests two complementary topics: leadership by science teachers and leadership by those who provide professional learning that enhances teachers' knowledge, skills, and ability to lead.

While developing this book, I wanted to provide science teachers with positive perceptions of themselves, their potential leadership, and their contributions to society. I also wanted to show support for science teachers as both learners and leaders. To address these goals, the book includes 21 profiles of leadership from science educators in a variety of positions and career stages. The stories describe different pathways to leadership, roles one may assume as a leader, and recommendations for effective leadership.

The next figures include brief previews of the book's parts, chapters, and profiles by contributors. There is a balance of personal stories by leaders, discussions of knowledge about teacher leadership, and insights and recommendations for those embarking on a personal journey of leadership.

PART I. Most Leadership in Science Education Is by Classroom Teachers

CHAPTER 1 ***My Science Teaching*** **Julie A. Olson** High School Science Teacher *Mitchell High School* *Mitchell, SD*	CHAPTER 2 ***My Classroom and a Vision of Where the Rubber Meets the Road*** **Kenneth L. Huff** Middle School Science Teacher *Williamsville Central School District* *Williamsville, NY*	CHAPTER 3 ***Leadership as an Early-Career Elementary School Teacher*** **Cassie Bess** Elementary School Teacher *Solana Beach School District* *Solana Beach, CA*	CHAPTER 4 ***Achieving Effectiveness as a Teacher Leader*** **Cynthia Rounds** Middle School Science Teacher *Fullerton, CA*	CHAPTER 5 ***From The Classroom to Leadership and Back*** **Felicia Ryder** Middle School Science Teacher *Wangenheim Middle School* *San Diego, CA*
▪ Trust in yourself. ▪ Recognize the worth of those you are leading. ▪ Model resilience.	▪ Have a vision. ▪ Be aware of your knowledge and abilities. ▪ Empower others.	▪ Have dedication. ▪ Self-reflect. ▪ Form connections.	▪ Be bold and prepared. ▪ Review where you are and want to be. ▪ Seek advice from mentors.	▪ Collaborate. ▪ Build connections.

PART II. Some Leaders Leave the Classroom to Support Science Teachers

CHAPTER 6	**CHAPTER 7**	**CHAPTER 8**	**CHAPTER 9**	**CHAPTER 10**
From a Science Teacher to Educational Leadership: Recognizing Common and Uncommon Opportunities	***Being a Teacher Leader***	***My Leadership Journey***	***Leadership for STEM Education***	***My Path to Education Leadership***
James Blake Director of Strategic Partnerships and Focus Programs, Science Focus Program Principal, Arts and Humanities Focus Program *Lincoln Public Schools* *Lincoln, NE*	**K. Renae Pullen** Elementary School Curriculum and Instructional Specialist *Caddo Parish Public Schools* *Shreveport, LA*	**Cynthia Long** Science Curriculum Coordinator, K–12 *School District of Osceola County* *Kissimmee, FL*	**Philip Johnston** STEM Coordinator *Central High School* *Grand Junction, CO*	**Maya M. Garcia** Supervisor and Chief Program Officer *Beyond100K* *Denver, CO*
▪ Embrace change. ▪ Seek mentors. ▪ Collaborate with colleagues.	▪ Care for others. ▪ Be brave. ▪ Learn from other leaders.	▪ Be a learner. ▪ Do your homework. ▪ Recognize different perspectives.	▪ Value personal relationships. ▪ Make learning meaningful. ▪ Have a vision.	▪ Begin with a clear vision and strategic plan. ▪ Listen to mentors. ▪ Do not lose sight of equity.

PART III. Some Leaders Support Science Teachers by Providing Professional Learning

CHAPTER 11 ***Challenges and Leadership in Science Teacher Education*** **Herbert K. Brunkhorst** Science Education Professor (Emeritus) *California State University, San Bernardino* *San Bernardino, CA*	**CHAPTER 12** ***Teacher Leadership: Personal Experiences, School Partnerships, and Professional Perspectives*** **Tammy Wu Moriarty** Associate Director *Center to Support Excellence in Teaching* *Stanford University* *Stanford, CA*	**CHAPTER 13** ***Leading Curriculum Reform*** **Dora Kastel** Director of Curriculum Instruction (Content Area) *New Visions for Public Schools* *New York, NY*	**CHAPTER 14** ***Six Stories From a Leadership Journey*** **John P. Spiegel** Director of Curriculum and Instruction *San Diego County Office of Education* *San Diego, CA*
▪ Put outcomes for students first. ▪ Pay attention to personal relations. ▪ Don't stop learning.	▪ Value relationships. ▪ Have a clear plan. ▪ Emphasize instructional practices.	▪ Before anything, set goals. ▪ Find opportunities for relationship building. ▪ Align professional learning with instructional materials.	▪ Find a passion. ▪ Serve others. ▪ Have confidence.

PART IV. Some Leaders Support Science Teachers by Guiding Professional Organizations

CHAPTER 15 ***Beyond the Classroom: Serving All Students*** **Stephen L. Pruitt** President *Southern Regional Education Board* *Atlanta, GA*	**CHAPTER 16** ***Led to Lead*** **Peter J. McLaren** Executive Director *Next Gen Education, LLC* *North Kingston, RI*	**CHAPTER 17** ***Learning to Lead Curriculum Implementation*** **James B. Short** Program Director *Carnegie Corporation of New York* *New York, NY*
▪ Emphasize equity. ▪ Value the individuals you are leading. ▪ Have courage and patience.	▪ Leadership requires courage. ▪ Leadership requires perspective.	▪ Recognize connections between leadership and learning. ▪ Pay attention to curriculum. ▪ Rethink professional learning.

PART V. Some Leaders in Science Education Have Long, Varied, and Valued Careers

CHAPTER 18 *Developing Leadership in Science Education*	**CHAPTER 19** *Fulfilling a Legacy of Leadership in Science Education*	**CHAPTER 20** *A Passion for Science and Teaching*	**CHAPTER 21** *My Evolution as a Teacher Leader*
Kathy DiRanna Director (Emeritus) *K–12 Science Alliance at WestEd* *San Francisco, CA*	**Bonnie J. Brunkhorst** Professor (Emeritus), Geological Sciences and Science Education *California State University, San Bernardino* *San Bernardino, CA*	**Arthur Eisenkraft** Distinguished Professor of Science Education, Professor of Physics, and Director of the Center of Science and Math in Context (COSMIC) *University of Massachusetts Boston* *Boston, MA*	**Harold A. Pratt** Director of Science (Retired) *Jefferson County Public Schools* *Golden, CO*
▪ Take responsibility for something you care about. ▪ Leadership is about people. ▪ Pay attention to the politics.	▪ Recognize opportunities for leadership. ▪ Listen to and learn from mentors. ▪ Show understanding and respect for those affected by your leadership.	▪ Speak up for yourself and others. ▪ Overcome fear and anxiety. ▪ Embrace the challenge.	▪ Focus on leading, not being a leader. ▪ Identify a mentor and listen to him/her. ▪ Be authentically enthusiastic.

This final chapters in the book (Part VI) offer my synthesis of ideas, recommendations from the contributors, and a brief conclusion. The profiles provide a variety of insights about leadership, difficulties leaders face, and contributions leaders have made to science education. I have also done my best to synthesize the many reflections on leadership. The synthesis was outlined using words that begin with the eight letters in PROFILES: Purpose, Relationships, Opportunities, Facilitation, Integrity, Learner, Equity, and Systems. I propose these words as guides for leaders, whether they are in classrooms, state agencies, colleges or universities, or professional organizations.

Conclusion

This book's title signals the relationship between science teachers' leadership and the professional learning provided by other leaders. Although science teachers, like any professionals, require opportunities to learn, they also need to recognize the possibilities of their role as leaders. Even more important, the larger science education community has an obligation to acknowledge science teachers as leaders.

Leadership in science education is distributed across the classroom, school, state, and national levels and through a variety of individuals and institutions, with this distribution ensuring the vitality of such

a large-scale system. It is impossible for one person or organization to lead all science education reform, but everyone from individuals to national organizations can assume leadership for some responsibilities. With states adopting innovative standards for science education, students returning to school after distance learning, and challenges we face as a country and the world at large, the answer to the question in this chapter's title could not be clearer.

The COVID-19 pandemic has made clear the essential role of both science teachers and science as a field for addressing the challenges we face. Science teachers' leadership is more important than ever.

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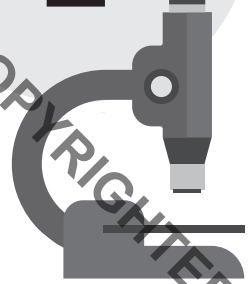

My Science Teaching

JULIE A. OLSON

Julie A. Olson is a high school science teacher at Mitchell High School in Mitchell, South Dakota.

NOTE FROM RODGER

The volleyball game began at 7 p.m. and Julie Olson was announcing the game. Before the game began, there was a teacher appreciation night for Mitchell High School faculty to show gratitude for how teachers lead students' academic lives and extracurricular activities.

I met and worked with Julie on the development of the *Next Generation Science Standards*. Julie has a bachelor of science degree in biology with a minor in chemistry, as well as a master's degree in biology, both from the University of South Dakota. In the late 1980s, Julie began teaching high school science and math in rural South Dakota. The majority of her professional activities have contributed to her expertise as a classroom teacher.

The following profile of Julie includes a portion that was first published in *The Science Teacher* (Olson 2019). She has adapted and updated it for inclusion in this book.

My Teaching

A small, rural school (750 students in grades 9–12), Mitchell High School offers a variety of common classes and dual-credit, online, and career and technical education (CTE) opportunities. We also have an alternative school that provides a self-paced, customized program for at-risk students.

I teach science for Second Chance HS (our alternative school). I have between 10 and 18 students at a time, each on a different course in a different spot. This situation might seem chaotic, but the one-on-one interactions, with small units making up the courses, allow me to discuss, explain, and problem solve in a short amount of time.

The required courses (physical science, biology, and chemistry) use the online Edgenuity platform, though I have chosen hands-on activities for each course. I developed elective courses in basic electronics, robotics, drones, forensics, applied biochemistry (drug, nicotine, and alcohol education), and anatomy to introduce career opportunities and spark students' interest. Our school also offers environmental science as a blended online and hands-on course.

About twice each month, we conduct classwide experiments and projects such as testing the water quality of the local lake, making cardboard box pizza ovens, studying the chemistry of pottery and glazes, and even using basic computer-assisted design to do three-dimensional (3-D) printing or laser

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cutting and engraving. We also have partnered with the school's culinary teacher to build and maintain a hydroponic system.

Thanks to flexibility in students' schedules, a small staff, and a central location for the approximately 80 students in the program, it is easy to collaborate with other teachers as well as engage many students in larger projects (e.g., stocking our classroom-raised trout through the Trout in the Classroom project) or community service projects (e.g., planting in the community garden, testing water quality).

I can also tailor electives and special projects to students' individual likes and needs more easily than I could in a larger standard class. For example, a physical science student who was also a very good artist built replicas of Leonardo da Vinci's inventions and studied Alexander Calder and his kinetic mobiles. The student then built a mobile based on his own hobbies and interests.

I also teach Bio-151, a dual-credit course with the Northern State University Rising Scholars Program that enables students to earn college credit. This course covers required biology concepts for the college course, as well as anatomy and student research opportunities. This is a "traditional" class in which all students have lectures and group labs and activities at the same pace.

Offering students a variety of opportunities and exposing them to a range of biology topics is one of my teaching goals. Students begin the course by researching and testing common plants for antimicrobial properties. When studying muscle physiology, students test human-to-human interface systems and get to "control" each other's muscles and movements, then engineer assistance devices for individuals with impairments. In the spring, students studying biomechanics and computers come together to create cyborg cockroaches. The advantage of this style of class is the ability to set up complex labs and research. When certain lab activities are set up, I can also offer them to the alternative school students.

After school and on weekends, I mentor students for the science and engineering fair or help Second Chance students lead Science Saturday activities for elementary students. On weeknights, I do announcing for the high school volleyball team or teach a secondary biology methods course for Dakota Wesleyan University.

Resources for Ideas and Inspiration

The communication and conferences offered by professional associations provide lots of ideas. I attend workshops and our annual state science conference, and I am a member of both the National Science Teaching Association (NSTA) and the National Association of Biology Teachers. *The Science Teacher* (*TST*) and *NSTA Reports* list many opportunities for professional development; these publications offer many ideas, so the ability to look at back issues is helpful for my own development. For instance, I wanted to incorporate engineering into a cardiovascular unit, so I modified an activity from a back issue of *TST*, as I do with many older activities to align them with the *Next Generation Science Standards* (*NGSS*). As the co-editor of the South Dakota Science Teaching Association, I am always looking for professional development opportunities to share. I have found that applying for professional development and committees and signing up for e-mail lists lead to getting more announcements and opportunities. The Second Chance and CTE staff also collaborate frequently during lunch.

One cannot be afraid to apply for committees or programs such as the National Council of Teachers of Mathematics/NSTA STEM Ambassador program or Innovation Collaborative. I was fortunate to serve on the writing teams for both the *NGSS* and South Dakota's science standards, and getting to work with other committed individuals is inspiring. Through these opportunities, I have not only learned how to promote STEM and CTE but also exchanged ideas and collaborated with creative individuals.

How to Engage Students and Encourage Innovative Thinking

I love doing hands-on activities that give students a choice of materials, procedure, or design. We conduct some prescribed labs, but the goal for these is to develop skills and knowledge that students will be able to adapt and use for open-ended activities later in the unit. Some of the best lessons are those in which students start to ask questions such as "Which is better? To dip a chip in salsa, then flip it over to dip again, or to double dip?" (This is an example from a discussion about bacteria.) As another example, when we start learning about the musculoskeletal system, I say that I cannot do push-ups because my arms are too long. Is there evidence they can gather to prove me right or wrong?

I conclude the year with a two-week "crime scene" activity. I set up a scene with evidence that all teams can sketch, tag, and photograph. Students analyze, ask questions (interrogations), look for patterns, come to conclusions, and write a scenario based on their evidence.

I have the alternative school students try 3-D printing and laser cutting, preferably using their own designs (Bio-151 students are always welcome to come in as well to investigate further and use these machines), but I have found that students need to see the capabilities first. Elective courses are designed to accommodate many career and personal interests.

Supporting and Guiding Students

When students see a purpose and have the necessary skills to pursue it, my job is to offer a problem to solve or a question to answer; make students aware of safety and ethical concerns; and provide necessary materials (or at least some of them). If students run into roadblocks, sometimes it is as easy as pointing them to a source or asking a simple question—or brainstorming with them while letting them know I have confidence in their abilities. Teachers should also realize there is merit to some projects that divert from the intended path; in those situations, my job is to support and guide students as needed.

The Most Important Big-Picture Takeaway

Science applies to everything students do. That is the important takeaway for all students. I want them to learn how to search for and analyze evidence and make sound decisions based on evidence—whether in a lab, the grocery store, or their homes, and especially as citizens.

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Reflections on Leadership

Parental Influence

My parents were great role models. My mother (a former head surgical nurse) coordinated the school carnival committee for many years and knows how to plan and to trust others to do their jobs—including us kids, who were expected to help by taking tickets, running the fishing booth, and even dressing as a clown. She also led our Girl Scout troops for many years. Being the second of six kids, I was all too happy to go to Girl Scout camp. I think this was one of my first leadership roles because I was not scared to be away from home or sleep in a tent, so the other campers looked up to me. Several years later, I became a junior leader and helped plan and carry out activities for younger Girl Scouts. I still volunteer to help lead activities for the local Boy and Girl Scout troops.

My father was active in the Jaycees organization and helped build our city's first baseball stadium and tennis courts, with my siblings and I tagging along to help. We learned how to give back and lead through our parents' example. They always did their best, and I wanted to make them proud by always doing my best and giving back.

Early Experiences

In high school, I was an elementary basketball coach and co-captain of the varsity basketball team. When I was in graduate school, I led first-year biology labs, but the event that stands out from that time is when I was asked to tutor a blind biology major. One cannot simply say, "See the …" I had to use my creativity to make cut-outs and change what I was saying to accommodate this student. This was also when I started to consider teaching as a profession.

Being a Science Teacher Leader

My first teaching job was teaching biology and physiology (for one semester) for a professor taking sabbatical at the local university. There were so many things I had never done before, but I was the teacher, so I had to show that I *could* do them—such as pithing a frog!

I applied to several places and got a teaching job in rural South Dakota as the science and math teacher for the entire high school. I always refer to this experience as "trial by fire" since I hadn't student taught in math or any of the science courses aside from biology. My mother will be the first one to say how stubborn I am and that the surest way to get me to do something is to say it can't be done. Having to prepare for six different courses wasn't going to stop me. I will always remember the first lab I conducted with the chemistry class. I said, "Go get some beakers and goggles." Well, the class just stood there. When I asked what was wrong, a student said, "We don't know what those are!"

Leadership occurs at many different levels, and leaders have to trust in others and their abilities to carry out their jobs and assignments. I have to trust that my students will do what is necessary to succeed, knowing that I have properly prepared them to take those steps. As a former department chair, I had to trust my ability to lead not by controlling faculty but collaborating and sharing ideas and techniques.

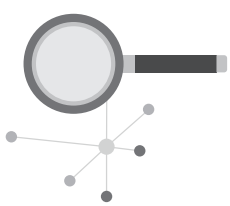
Taking on positions of leadership can be frightening! I can attest that I felt trepidation every time I signed up to be on a committee, spoke at an event, or took on a new position, but I have never regretted any of those times—even when I took over for my former mentor when he retired, the most worrisome task because I looked up to him so much. He was a great leader, so I knew I had good training.

I was asked many times to run for president of our state association but kept saying I needed to be available for my children and would run when they finished high school. I didn't fathom that they would soon grow up and I'd have to keep my word! I then encouraged others to do the same. As a team, those of us at the association worked hard to bring young teachers into the organization and give them opportunities to develop leadership skills so they could become our new leaders.

There are so many opportunities for new and young teachers to develop their leadership skills. They must not be afraid to fail. Every opportunity is a chance to grow and learn—even the "failed" applications for fellowship, grants, and committees. As a former principal told me, "You might not be successful every time, but if you are doing it with the best of intentions and in the best interests of your students, you will be okay. Just regroup and continue on." As a leader, you can model resilience, give back, and have passion for your job. Geek out!

My current foray is to learn more about global education and cross-curricular, collaborative, problem-based learning. I was fortunate to be chosen for the Fulbright Education for Sustainable Development program, which involved travel to Japan and an opportunity to collaborate with teachers from all over the United States and Japan. Two years later, we are still collaborating on topics such as water quality, hydroponics, plastics pollution, and agricultural practices.

I am also pursuing a doctorate in science curriculum and instruction and hope to lead professional development for all levels and integrate all subjects when I can.



RODGER'S INSIGHTS AND INTERPRETATIONS

Based on my time in Julie's classroom and my work with her on the *NGSS*, she is an excellent example of how a midcareer science teacher can lead. Julie's profile revealed several insights about leadership by and for science teachers:

1. Leaders have to trust in others.
2. Assuming leadership can be frightening and takes courage.
3. Leaders have to model resilience.
4. Leaders should continue to expand their experiences and bring what they have learned back to the classroom.

Julie continues as a classroom teacher but also leads the way in her school, at the state level, and in national activities.