Preface

Scientists are great communicators—with other scientists. We are schooled in the exacting art of talking to our professors and colleagues, people deeply steeped in both the importance and the nuance of our topic. We can talk about the incredible details of modern science in an efficient way, condensing complex arguments into short discourses. But once we go out into the work world to make an impact, scientists from every discipline face a brand new challenge—communicating science to decision makers.

Decisions about which scientific endeavors are advanced and how they are pursued usually get made by people who are not experts in the field. Corporate chief technology officers, elected officials, government program managers, venture capitalists, heads of nongovernmental agencies, and, often, senior management have the power to award funding and support new discoveries. These decision makers are well educated, hardworking, sincere, and extremely busy. Over the course of a day, they may be expected to make important decisions on topics spanning a myriad of unrelated fields. It is incumbent on us as scientists to quickly and effectively make our case. We must learn to talk about our work in succinct and compelling ways that convince the people who are pivotal to our success to take action.

From my work as a scientist and a manager of large-scale projects at a major national laboratory, I am acutely aware that most scientists could use a crash course on how to champion their science. Amy has

dedicated her career to teaching corporate executives how to communicate effectively with their employees, investors, customers, and the public. She's helped her share of scientists and technologists create powerful messages and layer technical information in a compelling, understandable, and actionable way. Her motto is "Words Matter." When I met her, I realized that she would be the perfect coauthor (we ultimately married, but that is a different story!).

Throughout this book, I offer the perspective of a scientist. Amy provides the nuts and bolts of how to improve communication. You will quickly note the juxtaposition of her clear and direct style with my more baroque inclinations. The collaboration brings our distinctly different experience and interests to bear as we give stories and examples from our respective careers. We share the belief that it is now more important than ever for scientists to become better communicators.

The Internet has introduced a new challenge for talking about science. In a world where simply saying something online has impact—whether it's true or not—scientists compete not only with other science and other belief systems but also with deliberate falsification. We must convince decision makers that the information we are providing is both important and correct. They must trust us. This gets complicated when decision makers are overwhelmed with information from multiple sources and can't begin to parse what they should believe. The "what you should eat to be healthy" problem in the popular press is a dramatic example. Scientists eager to get their research into the public eye make limited or even flawed studies that seem to carry the same weight as multiyear studies with thousands of participants. The public only sees that scientists seem to say different things on different days. And so, rather than try to work out what is right or wrong, people often make decisions based on what fits their worldview. Investing the time to shape that view of the world and build a trusted relationship is central to becoming a champion for your science.

To convince today's decision makers, you have to establish your credibility and make the case for why the problem you are addressing matters *before* you can talk about the opportunity and ask for support. Constructing and presenting your case must be done masterfully and efficiently. During our research for this book, we interviewed people who can help you do this by providing their voice of experience and examples of effective science communication. Relevant excerpts of these interviews are woven throughout the book. The full interviews can be found at www.championingscience.com.

Amy and I wrote this book to teach science students and professionals how to use words and visuals to compel action. We want to arm scientists with proven techniques for communicating more powerfully so they can continue to change the world for the better.

Roger Aines
Livermore, California

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Becoming a Champion

Robert Millikan had a problem. In the early 1920s, the established titans of California learning, Stanford and the University of California, Berkeley, had thwarted his attempt to put his new university on a solid footing through state funding. Millikan was chairman of the Executive Council of the California Institute of Technology (Caltech), and his plan was to aggressively recruit top-notch scientists to launch Caltech into the first rank of U.S. schools. Experimental physics, Millikan's specialty, was to be the centerpiece of that effort. George Hale, Millikan's collaborator in this plan, was drawing attention with his bold new science using the Mt. Wilson telescope, one of the largest in the world. Hale was sure that he could surpass that one-hundred-inch instrument, which he had made for the Carnegie Institute, by building a record-shattering two-hundred-inch telescope. His article in the *Atlantic Monthly* extolling the scientific discoveries that would be possible with such a behemoth captured the imagination of a public just discovering science—and the post–World War I growth of American education guaranteed that many of the magazine's readers would have the knowledge to follow and discuss such advanced topics.[1]

Millikan was a brilliant scientist. In 1923, he received the Nobel Prize in Physics for measuring the charge on the electron. But perhaps his greatest talent was as an organizer and champion for science. He knew that Hale could change the world with his huge new telescope, and he knew that many of his faculty could match that accomplishment.

Ultimately, three of the original Caltech professors took home the Nobel Prize. As he looked around his home in Pasadena, he knew that the wealth of Southern California, launched by gold, solidified by railroads, and now being multiplied by oil, movies, and airplanes, was clearly enough to support a major university. How could he inspire the investments that this wealth could support?

The answer, as often happens, lay in dinner and discussion. The new faculty of Caltech met regularly for dinner at a traveling table of twelve. The discussions, and responses from friends occasionally invited to fill the table, suggested to Millikan that the way to encourage interest, and ultimately investment, in science was to invite wealthy residents of Pasadena to dinner. Let them sit in on the excitement and share in the anticipation of new problems and approaches to solving them, and in the course of that intellectual thrill they would realize that they held the key—the funds—to make it happen.

With a fortunately timed $500,000 donation of stocks that Caltech sold just before the crash of '29, Millikan was able to build the Athenaeum, advertised as a combined faculty and private dining club for Caltech; the Huntington Library, whose founders built the transcontinental railroad; and the Mt. Wilson Observatory. His regular dinners with the Pasadena elite enabled Millikan to fund his new institution without the help of the State of California, despite the desire of Stanford and Berkeley to keep Southern California firmly out of the academic limelight.

By 1936, the institute had established itself as a center for aeronautical (and soon space) science and engineering. Hale and Millikan were able to build the two-hundred-inch Mt. Palomar telescope—the largest telescope in the world for nearly half a century, and still one of the great scientific instruments—without any government funding by convincing the Rockefeller Foundation to finance the project. The discovery of the positron (Carl Anderson), the elucidation of the nature of the chemical bond (Linus Pauling), and the creation of modern seismology (Charles Richter) were all made possible not because the United States Congress felt that the military or the economy needed some scientific groundwork laid but because Millikan was able to share the excitement and promise of new science with wealthy individuals who were inspired by this real-world Buck Rogers. This champion of science would no doubt be just as adept at convincing a politician or some federal agency if he were alive today. His ability to involve others in the thrill of scientific discovery serves as a consummate example of how scientists can bring our excitement and our breakthroughs to key decision makers.

MISSILES, RADAR, AND NUCLEAR DETERRENCE: THE BEGINNING OF BIG GOVERNMENT SCIENCE

Up until the late 1930s, big science remained the bailiwick of the Robert Millikans of the world. Government made sure that agriculture, mining, and the technologies of the industrial revolution got the educational attention they required for safe and somewhat sustainable resource utilization. The land-grant schools taught us how to keep our soil from blowing away. But the physics breakthroughs of the beginning of the twentieth century were made largely without the support of the world's governments. World War II taught us another lesson: big science led to incredible advances, which ultimately translated into better lives at home—at least once we recovered from the destructive power of advanced weapons.

Suddenly, government was in the science business, led by brilliant minds like Vannevar Bush, who spearheaded U.S. research during World War II and helped create the National Science Foundation with his report *Science, the Endless Frontier,* which was the beginning of a new approach to government science not just in the United States but around the world.[2] The new mantra was "Government support of science equals better lives for all." Without question, that has been true from the eradication of polio to the economic advances of a world where, now, for the first time in history, the majority of the world's people soon will be middle class.[3] (For more on Vannevar Bush, see chapter 16, "High-Impact Examples of Championing for a Cause.")

During the postwar period, the enormous expenditures of the National Institutes of Health, the National Science Foundation, the U.S. Department of Energy, and their equivalents around the world changed the face of science. Science was now a larger fraction of the world's investments. With this came the need to ensure that the torrent of money created things of value, and that led to formal processes for funding—calls for proposals, peer reviews, funding panels, and agency oversight.

The burden of excitement shifted in this world. Now, the scientist was more responsible for making sure that other scientists thought his or her ideas and practices were solid and defensible. The job of being champions for science fell to politicians, cabinet secretaries, and industry leaders. The president himself was called on to champion the U.S. charge into space in 1961, and a massive bureaucracy was created not only to justify and enliven the idea of space science but also to see it executed in an effective, safe, and, when university or industrial research funding was required, fair manner.

So the task of championing science was taken up by leaders who were often just as interested in creating a boon for their district as in making the world a better place. Scientists were trained to be eminently accurate, fair, and honest—to the betterment of the overall scientific enterprise, which needed a huge cadre of reliable workers to advance the great science of the age. The benefits to humanity were clear. From those dependable hordes of scientists came the transistor, giant growth in food production, and continuous increases in longevity worldwide. Scientists happily let others drive the agenda and champion the need for science and knowledge.

THE NEW AGE OF SCIENCE CHAMPIONSHIP

Many scientists continue to be content living in the world of science agency proposals and careers built on hundreds of publications in their field. Others no longer find this path financially or intellectually satisfying. Venture-funded technology, the demands of dealing with difficult diseases, and the challenges of bringing the benefits of developed nations to the entire world while keeping our climate in check mean we need to move beyond the postwar model of science funded only by giant government programs.

Science is, and must be, much more than providing the best response to the latest call for proposals or, for more mature and influential scientists, participating in writing the text for that call. Science once again needs champions who are scientists—champions who will make the pitch for funding new inventions or advancing the fight against hazards that impact humanity. If scientists can explain why science matters with the accuracy, enthusiasm, promise, and capability of people like Millikan, they can compel decision makers to provide support.

Certainly there is self-interest in this activity. Scientists love science. They love to be paid to practice science and love to have the funding to make incredible scientific advances. But just as Robert Millikan did, scientists must elevate their efforts to bring greater benefits to the world. Millikan's passion attracted a faculty who were willing to risk oblivion by leaving established positions on the East Coast, San Francisco, and Europe for the orange groves of Pasadena. He brought his enthusiasm to bear on physics, aeronautics, and the exploration of the universe. Along the way, he built a considerable university, but he never made that his primary goal—it was just one of the things that would help make the science happen. For promoters of science, that is one of the

great challenges. *Successful advocacy without excessive self-interest equals championship*.

Calls for proposals that are intended to compare the ideas and capabilities of scientists who are very much alike will never be adequate for this new age. And yet that is what scientists are trained to do in graduate school. It remains the gold standard for "scientific" response. This book is intended to help increase any scientist's ability to make the case for excitement and bring decision makers and colleagues along to become a part of doing great things. Our goal is to unleash a little of Robert Millikan's spirit in all of us. We can be better at convincing our sponsors, our management, and our collaborators that there is much, much more to be accomplished. We can all be champions of science.

TALKING TO DECISION MAKERS

Robert Millikan spent more than a decade building a new institution, drawing together a community of like-minded scientists, gaining support from new sources, and creating scientific advances on a scale and level of impact much larger than what he saw in the other universities of his day.

While we hope that this book inspires some of you to take on enormous scientific crusades, you are more likely to pull it from the shelf for the common task of preparing to influence someone who can help you advance science that you believe is important. This book is not about communicating science to the general public. It's about motivating the decision makers and colleagues who can help support, fund, and implement your work. We think you will find our advice useful when talking to a program manager at a science agency, but we see greater value in helping you talk to less technical audiences, like the leaders of your organization, philanthropists, investors, industry partners, politicians, or government planners. The concepts in *Championing Science* will also help you communicate effectively with colleagues in your own field or from different disciplines.

This book is a comprehensive guide to helping students and scientists build vital communication, influence, and emotional intelligence skills. We introduce and build on a five slide approach as a foundation for succinct communication. Through instruction, interviews, and examples, you will learn that inspiring decision makers to act requires extracting the essence, crafting key messages, simplifying visuals, bridging paradigm gaps, and creating compelling narratives. In the last chapter,

we reinforce our principles for championing science through the story of Vannevar Bush's transformation of the relationship between government and scientists, the first medical application of accelerator mass spectrometry, and the arranged marriage between Caltech and MIT, which led to the discovery of gravity waves.

We have structured *Championing Science* in four parts:

1. Fundamental Concepts for Championing Science
2. Mechanics of Championing Science
3. Honing Your Communication, Influence, and Emotional Intelligence Skills
4. Applying the Championing Science Skills

Rather than take a sequential walk through the subject, we highlight the most important aspects of championing science first and then add more detail and examples to help you understand and master these principles.

What's at stake if you don't become a better communicator? The scientific contribution you are poised to make could be left to someone else or, worse, never happen at all. Your ideas are always in competition, and not just with other scientific developments but also with all the other things that decision makers could support with their money and influence. We want to help you carry your ideas across the finish line.

ELEVEN TENETS OF CHAMPIONING SCIENCE

What are the basic actions you should take to make your science understandable and compelling? We know Robert Millikan only from historical records, but we think he would agree that there is a basic set of principals—tenets—that are at the core of being an honest and influential champion. Executed well, these eleven actions can help every scientist communicate ideas to change the world. Throughout the book, we develop these concepts in detail, but if you get no further than absorbing this list, you will be on your way to becoming a more effective communicator and science champion.

1. **Be passionate.** Palpable enthusiasm is contagious. It will carry people along for the great ride of science. Sharing what inspires you about your work will help others see its potential.

2. **Build the big picture first.** Resist the temptation to dive into the details. Frame what you say by succinctly explaining what exists today, the future possibilities, and how your work will fill the gap.
3. **Know who's listening.** Think carefully about what your audience knows and their prevailing sentiment. Determine what you want them to think, do, and feel after they hear from you. Find out how they like to receive information and adapt accordingly.
4. **Spend more time on why it matters and less time on how you do it.** Never promote science for the mere sake of science. Always demonstrate the value to people and the planet we inhabit.
5. **Extract the essence.** Formulate your overarching messages and support points. Tell that story. Never dumb it down.
6. **Be understandable.** Use plain, common language. Avoid or translate acronyms. Start from where your audience is, not from where you are. Use iconic references to anchor scientific concepts to everyday, familiar experiences.
7. **Balance precision with impact.** Choose language carefully to be clear and directionally accurate. Long phrases bog down the listener. Think and speak in short sentences. There is no need for hype. Learn to deliver a compelling narrative.
8. **Be human *and* credible.** The integrity of your word must be unquestionable. Verify your facts. Evaluate your sources. Be yourself. Make an emotional connection by showing up as a person first and a scientist second.
9. **Influence patiently.** Convincing decision makers is a process, not a single act of persuasion. Use information as a gift. Engage often to build understanding and show the value of supporting your science. Learn what matters to your audience.
10. **Collaborate thoughtfully.** Advancing your ideas doesn't mean you have to go it alone. Seek out advisors, influencers, and partners who can help carry your science further.
11. **Enable your listeners to act.** Know the purpose of your communication. Make the ask every time. Leverage each conversation and presentation to build support for advancing your work. Remember that you are ultimately building relationships for the long run.