Most people outside academia don’t understand what we do or why it matters. Frustratingly little funding goes to research, and reading the newspaper shows blatant misunderstandings of science from public figures. Yet we are also to blame; we are part of a community that de-emphasizes public communication. In order to secure our scientific future and create a more literate society, we must empower scientists to talk about their work starting at the graduate level.

At best, talking to the public is other people’s job: we rely on non-researchers to defend the scientific enterprise from the nuisance of “little smatterers,” in the words of Sir Isaac Newton. Talking to the public is viewed not just neutrally but negatively – a futile distraction from research. It would seem academia’s ideal world is one in which the public trusts us, gives us money, and doesn’t ask questions because they won’t understand the answers.

This is not sustainable in a world that relies increasingly on science and technology – it is no longer enough to do good work without explaining why it matters. Science and the public need each other, and that relationship requires a great deal of communication. Public perception of science impacts all researchers, affecting our freedom to do our work, the funding of our research, and the policies that shape our world. When we stay silent on the sidelines, we yield the conversation to those with the most money, not the most information. That is a failure of our responsibility as knowledge experts.

Yet we can go through graduate school without taking a single class in science communication. Our education does not prepare us for the evolving definition of what it means to be a scientist. Our vision is to empower researchers to explain their work to the public, policymakers, and their grandmothers.

We propose that graduate education should include science communication

We propose that universities would establish centers for science communication that offer classes, workshops, and practice opportunities. Students would graduate with formal documentation of their studies to present to future employers. Centers across the country would share best practices at an annual conference. We are piloting these ideas at Carnegie Mellon University through a professional development group called Public Communication for Researchers (PCR). We work with journalists, professors, deans, and other science communication programs to develop workshops and seminars on communicating science. After a promising first year, we are now writing a 5-year plan to propose to the university, including a long-term curriculum. Some classes will be taught as early as next fall. We hope our development process can serve as a model for programs around the country.

Our own experience suggests that training in science communication has potential for success. Students vote with their feet, and our seminars are attended by a mean of 43 graduate students from across 17 STEM departments and all class years. Several similar programs have gained traction across the country, including the Center for Communicating Science at Stony Brook and Washington University’s Engage program. Their growth speaks to the viability of public communication programs in graduate education.
Public communication prepares us to meet the modern challenges of scientific careers

Incorporating communication in graduate education will make us better citizens, better scientists, and better prepared for alternative career paths:

**Communication training cultivates our academic careers**

Communication techniques cultivate our careers in traditional settings: effective communication is necessary for publication, collaboration, and presenting our work.

**Public communication skills improve scientific presentations** Scientists travel thousands of miles to be introduced to ideas at conferences; it’s worth investing the time to allow those ideas to cross the last twenty feet. Public communication skills can help: learning how to talk about our work on camera translates to more engaging and fluent presentations. Likewise, improv techniques improve stage presence, and learning to distill a message helps us prioritize the bigger picture for interdisciplinary audiences.

**Public communication skills improve scientific writing** Graduate training does not prepare us for the reality that a scientific career is a career in writing. Writing is an act of external cognition that trains our most fundamental scientific skills: systematic thinking and the ability to structure an unstructured problem. More tangibly, our careers live and die by our ability to write persuasively about complex topics. In order to publish, Ph.D. students are expected to write at a level competitive with established professors. No other institution expects novices to produce expert-level products without the benefit of experience or formal instruction. Instead, we learn writing through an apprenticeship model: students write independently and receive limited feedback from PIs, which can feel like trial and error. What’s worse, PIs are not trained to be teachers of writing. And since they write much more often than graduate students, they can develop “expert blind spots,” making it even harder for them to teach writing.

A more effective way to learn writing is by formal instruction. STEM programs must teach scientific writing, not as an addendum, but as a fundamental part of the scientific process. Public communication training can play an essential role in this instruction. A key component of public communication is the use of rhetorical techniques to adapt a message to different audiences. Learning these techniques translates to clearer academic writing and the ability to write for a wider variety of contexts, both academic and otherwise.

**Communication training expands our role as researchers**

In addition to helping with traditional academic roles, public communication helps us take on the changing role of scientists in the 21st century. Researchers increasingly need to engage with the public to defend research, muster support, and contribute to a culture of science literacy. We believe this is part of our responsibility as researchers, can lead to new collaborations across fields and with industry, and improves our ability to articulate the broader impacts of our work.

**Communication training expands our career options**

In an environment where tenure-track positions are increasingly scarce, our community must embrace non-academic careers. The fact that these careers are deemed “alternative” belies a prevailing attitude that professorships are the only legitimate outcome of a Ph.D., and other career paths are deemed inferior. This attitude is to our detriment, and ignores the utility of these careers, their match to our skill-sets, the economic reality, and what makes us happiest.

Incorporating science communication into the STEM curriculum expands our career options. First, it makes it easier to move into lateral career paths such as science policy, journalism, media, public relations, and management. Second, as demand for public communication training increases, there will be an increased demand for scientists well-versed in these skills.

**What skills do we need to explain our work and why it matters?**

Over the last year we’ve been developing and testing a curriculum to teach public communication. In collaboration with many science communication professionals, including staff from the Carnegie Science Center and Stony Brook’s Center for Communicating Science, we’ve converged on the following curriculum:
Graduate students need training in adapting science to public audiences

Most scientists communicate in a way that is ineffective outside academia. Academic audiences typically share an interest in their work, share technical knowledge, and expect the speaker to be impersonal and objective. None of these assumptions holds true for public audiences. To reach the rest of the world, we should incorporate the following components:

- Why the work is important
- Audience-appropriate language and level of detail
- Specific and vivid examples, metaphors, and images
- An emotionally compelling story
- A framing that affirms the values of the audience
- Depiction of both the scientific process and product

Graduate students need media training

Television, newspaper, radio and podcasts are key channels to explain why our work matters and to put a personal face to science. Interviewing requires training at the graduate level, not the week after our research falls under public scrutiny. Graduate students should also learn how to attract the interest of journalists in their work.

Graduate students need theater training

Theater games aren’t just for acting – they teach us to stay authentic and personal when we’re behind a podium. With effective improv training, graduate students can reach their audiences by revealing the human curiosity that brought them to their work, without reducing the importance of evidence.

Graduate students need to understand why their ideas may meet resistance

We often assume that those who deny science are simply misinformed; if we could just explain the facts clearly, everyone would think the way we do. Unfortunately that’s not how science understanding works. Research consistently shows that more information does not always persuade – it can polarize people, depending on how that information threatens or affirms their values and group identity. [1] What’s worse, people dismiss the expertise of those who disagree with them. [2] To get through cultural filters, scientists should be able to identify the values of archetypal worldviews, and to talk about science without threatening those worldviews.

* * *

We hope that by training the next generation of scientists to be proactive in talking about their work, we can improve the trust, support, and funding for research. We can empower the voting public as informed participants in policy debates. We can create a culture that places more value on facts and data and expects the same from its leaders. Most importantly, we can share the wonder and excitement of discovery.

Acknowledgements

We are profoundly grateful to Judy Swan, Dan Kahan, Jennifer Briselli, the Yale Cultural Cognition project, John Radzilowicz at the Carnegie Science Center, Stony Brook’s Center for Communicating Science, Liz Neely at COMPASS, Emily Stark, Suzie Laurich-MacIntyre, The Eberly Center for Teaching Excellence, and Carnegie Mellon University for their support, conversation, and fantastic work.

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