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One Scientist's Struggle to Be a Better Writer, and a Plea for Undergraduate Science-Writing Engagement

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Abstract

In an age where we are saturated with online information, effective communication is more important than ever. Unfortunately, many scientists are ineffective, unskilled, and/or not interested at communicating their research to the general public. Moreover, at some universities, undergraduate science students do not receive adequate training in writing and outreach, thus perpetuating the problem. Here, I recount my own battle to become a better science writer and communicator and how I have tried to integrate public outreach and popular writing into my undergraduate teaching and research.

Keywords

public outreach, undergraduate engagement, science education, science journalism, popular science writing

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A First-Person Account of Effective and Ineffective Science Communication

In elementary school, I struggled with reading and writing. Thus, it is not surprising that I avoided these two tasks at all costs in high school, choosing sneakers over Shakespeare, gymnasiums over good grammar, and bikes over books on poetry.

Given my passion for all things extracurricular, it is no small miracle that I squeezed into an undergraduate science program at a small university in northern Ontario. Luckily for me, Biology majors did not have to do much essay writing, and the little writing that was required, such as lab reports, was not judged too critically on grammar or style. Mind you, I can still recall the cutting criticisms that I received from one professor on the writing of my Honors thesis: "There are too many typos to count, and I'm referring to the first page." Thankfully, I graduated with a BSc and then found myself enrolled in a PhD program in genetics—a field based almost entirely on the correct sequence of letters—and that is when I knew I was in big trouble.

I quickly discovered that a graduate degree in science involves a lot of reading and writing. In addition to performing experiments, I was expected to spend hours a week at the library writing—writing thesis proposals, essays for graduate courses, scholarship and conference applications, poster presentations, and most important, peer-reviewed papers, which are the hard currency for any graduate degree.

Terrified that I would flunk out of the PhD program, I went back to the basics, back to the lessons that I should have learned in junior high. I marched straight to the campus bookstore and bought myself a dictionary, a thesaurus, and a pile of books on grammar and style. I also went to the library and took out a variety of classic novels as well as some poetry and plays. Knowing nothing about literature, my selection of books was quite random. When I got home that evening, I fixed myself a quick dinner and then dumped all of my new books on the bedroom floor and began reading.

Being an avid distance runner and triathlete, I approached reading and writing like training for a sport. I tried to read for 3 to 4 hours a day (mostly in the evenings) and also made sure I did some creative writing each morning. I made a conscious effort to focus on the works of great writers rather than just reading books and papers about science. At first this felt like a colossal waste of time. As I was slowly plugging away through Strunk and White's *The Elements of Style* and Hemingway's *The Old Man and the Sea*, my colleagues were devouring complicated research articles on molecular genetics. I was embarrassed to admit that I, an aspiring scientist, was spending my

mornings and evenings learning the difference between an Oxford comma and an em dash.

As one might expect, the more I read the better I got at writing. Who would have guessed that my high school English teachers were telling the truth? My writing training also resulted in some other positive changes. I started to really enjoy reading fiction and poetry, which in turn enriched my life and improved my mental well-being far beyond merely becoming a better writer. A steady diet of literature also stimulated my creativity, making me a more innovative and inventive researcher—and at times insufferable as I recounted all of the books I was reading to family and friends.

As I became more adept at discerning good writing from bad, I was able to make what appeared at the time to be a profound observation. I realized that the most successful and well-regarded scientists in my field were not necessarily the best experimentalists or theoreticians but instead tended to be the best and most prolific writers. Indeed, if you ask a random person on the street to name a famous geneticist, they will likely say Richard Dawkins, Craig Ventor, or James Watson—three brilliant scientists who have all written best-selling popular science books (Dawkins, 1976; Venter, 2007; Watson, 1968). More recently, American geochemist and geobiologist Hope Jahren has grabbed headlines with her popular autobiographical novel *Lab Girl* (Jahren, 2016).

Equipped with this new insight and wanting more than ever to be a successful scientist, I trained even harder at writing. Soon my lab bench contained faded Graham Greene paperbacks and biographies of long-dead Russian authors stacked alongside boxes of pipettes. My lab book too bore the marks of my activities—half-finished poems and amateur short stories were scribbled alongside methodological data from my experiments. All of this provided a modest level of amusement for my lab mates, but as long as I remained relatively productive, my PhD supervisor was supportive of my newfound literary endeavors. In fact, my supervisor eventually recounted to me his own struggles with writing and how hard he had worked at becoming a clear and effective communicator, which he is.

I never wrote a novel, received a poetry prize, or won a short story competition during my PhD, but I did read a lot of great books, published a number of research papers, and wrote an entire thesis. I also spent countless hours editing and revising my work, and still editors and reviewers would often tear apart my writing, but ultimately the energy I invested in becoming a better writer served me well. Of all the skills I learned throughout my dissertation work, I would argue that those related to being a stronger communicator were the most important and the ones I lean upon most heavily today.

Being a Better Scientist and Teacher Through Public Outreach

When I started a postdoctoral fellowship in evolutionary genetics, I made sure to keep improving my writing. The transition from PhD to postdoc only reinforced my belief that great writers make great scientists, and that most professional scientists write a lot. As a postdoc, I was required to write more than I ever had before and with less guidance from mentors and less time to complete the assignments. In addition to research papers, I was writing review articles, grant proposals, and academic job applications, and helping edit my colleagues' work.

Around this time, I also began writing popular science articles. At first I wrote short essays highlighting recent discoveries in my field of genetics, which I sent to small magazines and websites. These stories had titles like "One Microbe's 15 Minutes of Fame" and "Playing with Genes" and were humorous and light-hearted in tone. Later, I branched out into broader topics in science and academics, writing lay summaries of recent *Nature* papers ("DNA Exposes Ancient Island Love Affair Between Polar and Brown Bears") or career advice pieces ("Keep Your Job Talk Short and Simple"), not that I had had much of a career to advise about. As my experience grew, I pitched stories to larger magazines, resulting in a slew of terse rejections and the odd glorious acceptance letter, which quickly made its way onto the fridge door.

Apart from the rare piece that paid 25 cents/word, my foray into popular science writing was mostly for fun and to gain writing experience. But as some of my colleagues pointed out, a long list of popular science pieces was not going to get me more grants or a tenure-track job. That said, writing for a broad audience honed my research writing skills, allowing me to make my results and conclusions more accessible, relevant, and impactful, which arguably did help advance my career.

By writing for online magazines and blogs, I exposed myself to some negative and even abusive criticisms—much more criticism than I was accustomed to from my experiences with academic writing and publishing. The anonymous online comments beneath my articles would sometimes belittle and poke fun at my opinions, which in hindsight prepared me well for undergraduate teaching and the course evaluations that come with it. I can still recall the kind soul who suggested that I return my postdoctoral scholarship because "anyone so ignorant about biodiversity does not deserve to be working at a university and writing about science." Thankfully this anonymous comment was eventually deleted. But I also received some positive encouragement from readers. After publishing an article in *The Scientist*, one well-known researcher e-mailed saying,

> David. Not remotely my field, but a very nice piece! Few scientists can write so lucidly, using irony, humor and logic. I encourage you to keep developing your unique style and particularly to extend it your research publications—don't worry about the inevitable criticism.

Of course, I showed this e-mail to everyone within a 1 km radius of my laptop.

Engaging Undergraduates in Science Writing

My popular science output slowed when I started a faculty position in the Biology Department at the University of Western Ontario. Although I was bogged down with teaching, grant applications, and other duties, I still took every opportunity I could to read novels and write essays. Being the new kid on campus, I received many e-mails from undergraduates asking about potential volunteer research opportunities. Because my lab group was just getting going, I unfortunately did not have many opening for undergraduates. Moreover, most of my research is done on computers, and it can be challenging and time consuming to train a first- or second-year biology student with little computer science background on how to use bioinformatics software. Nevertheless, I still wanted to take on undergraduate volunteers.

During one interview with a potential volunteer, I asked the student, who was called Dennis, if he had any computer programming skills. He answered no. I then asked if he had any experience at all with using bioinformatics computer programs. Again, Dennis answered no and added that he was more of a "pen and paper" type of guy and really enjoyed creative writing. "Well," I said, "how about we do some popular science writing." And so started the Smith Lab undergraduate writers in residence program.

I asked Dennis to brainstorm about some general topics that he would be interested in writing about and to do some online research for recent advancements related to those topics. A week later he returned with a list of ideas, and together we whittled them down to one idea—the one that we felt was the most interesting and straightforward to write about: crowdsourcing a cure for cancer. By the end of the following month, I was polishing a final version of the article.

Building on the connections I made while writing popular science stories during my postdoc, we sent the article to a small online-only magazine called *Guru*, and it was published by the end of the semester. Dennis and I had so much fun getting the article published that we repeated the whole process again, eventually publishing a piece on the human brain project titled "Firing on All Neurons."

Word travels fast on university campuses, especially when you are dealing with premed students looking to boost their CVs. Soon I had enquiries from other undergraduates interested in science writing. Over the following 2 years, I would work with over a dozen students on popular science stories. Some of these pieces were published in national magazines, such as *Above and Beyond, Canada's Arctic Journal*; others appeared on the Biology Department or Faculty of Science websites, including one of my all-time favorites, "A Green Algal Love Story." I had students who wrote about science events on campus and students who highlighted the research achievements of various faculty members. Some of the articles required very little editing or input on my end, whereas others I needed to entirely rework before they were publication ready. Certain students never followed through with their writing commitments, and sometimes I got too busy to provide proper feedback in a reasonable amount of time. But overall, the undergraduate writers in residence program was (and continues to be) a success and a heck of a lot more fun than getting volunteers to wash laboratory glassware. It has also provided me with the perfect opportunity to keep writing articles for the general public while still providing a useful service to my department and university.

Every month, I receive more and more requests from students who want to write. The biggest challenges for me are finding the time and energy to edit the articles and provide constructive feedback as well as choosing an appropriate venue for the final product. Recently, I have considered creating a website, blog, or online magazine to showcase undergraduate popular science writing. Such a site would be particularly useful for featuring stories that remain unpublished, giving them a chance to see the light of day, and for posting previously published work. The problem is that creating, maintaining, and regularly updating a blog or website is time consuming and a task for which I have little experience, not to mention the challenges of attracting an online readership in a world where two million blog posts are written every day. Fortunately for me, today's social media–savvy undergraduates are pretty good at tackling these problems and challenges.

One of the students who recently joined my team of writers is a 19-year-old Sri Lankan who has already helped develop and design two different online magazines and is a guru at navigating the online publishing world. Another student on the team is a computer expert and a website designer, and nearly all of the science writers in residence are active on Twitter and Instagram. There is also a visual artist who is keen to use her drawings for online communication. In other words, all of the talents needed to develop, maintain, and promote an online publication are already available to me; I just need to find the best way to harness them.

A Plea for Undergraduate Engagement

There are many reasons why faculty should engage with students on science writing projects. In my opinion, science majors do not get enough writing experience during their 4 years at university. But if they carry on in science (or most other fields for that matter), strong writing and communication skills are paramount. Moreover, if undergraduates are able to publish an article during their degree (be it a research paper or popular science piece), it gives them something tangible to include on a job, graduate school, or medical school application, undoubtedly increasing their chances of success. And by working with professors on writing projects, students provide those professors with a lot of fodder for writing wonderful reference letters. In fact, a recent study (Pelger & Nilsson, 2016) showed that when undergraduates write popular science articles about their research projects they develop a better understanding of the subject matter.

It is crucial that we as a society have a scientifically literate public—a public that can make informed decisions about where and how taxpayer money is spent on science. It is therefore necessary that scientists actively and openly engage with the public, communicating their research in an accessible and effective manner. What better way to achieve such a goal than by training and involving university students (the next generation of great researchers) in public outreach?

In addition to the moral arguments for scientific outreach, it is likely that public engagement activities, including those integrating students, will become a progressively more important determinant of research funding success. Grant applications to the U.S. National Science Foundation now need to include a section on the broader impact of the project. Applicants need to outline how the proposed research will promote teaching, training, and learning; how it will attract participants from underrepresented groups; and how it will broadly enhance scientific and technological understanding. Similarly, the National Sciences and Engineering Research Council of Canada, which supports discovery-based research, is becoming more and more interested in how the work it funds helps train highly qualified personnel. Certainly, proficiency with scientific writing and communication are central to training such personnel.

As social media services expand and take on increasingly dominant roles in our lives, it should only get easier to communicate science to the general public. Admittedly, it can be hard to be heard among all the online noise where seemingly everyone is Tweeting, Facebooking, and blogging about their every move. But when used in a strategically targeted approach, online tools can allow scientists to reach thousands (even millions) of people. In my

own field of evolutionary genetics, there are a number of researchers that have garnered large online followings and have used this audience to promote public engagement and foster change. For example, the evolutionary biologist Jonathan Eisen (who blogs at phylogenomics.blogspot.ca) has been influential in the open science movement and in championing women in science. Similarly, anthropologist John Hawks, who writes at johnhawks.net, and microbiologist Vincent Racaniello, who writes at www.virology.ws and founded the popular Website and podcast series www.microbe.tv, have successfully blended world-class research programs with effective online outreach. Indeed, renowned science writer Carl Zimmer has admitted to regularly visiting these sites, and other blogs by career scientists, for story ideas (Zimmer, 2016).

I recently attended a small evolution conference at the University of Toronto. The keynote speaker on the final day was Hannah Hoag, a Toronto-based science writer. In her talk, Hannah described her journey from the lab bench (she completed an MSc at McGill University) to being a full-time science journalist who has written for *Nature*, contributed to television series, and produced radio shows. She emphasized that a career in science communication can be equally as fulfilling as one at lab bench and that both avenues can serve as a tool for change.

Listening to Hannah, I could not help but feel that of all the students sitting in the large lecture hall—many of who will go on to do great research—at least a few were inspired toward a career in communications. Maybe some of my own undergraduate volunteers will go on to become as influential as Hannah Hoag. Or they may, like me, use science writing as a source of enjoyment and challenge in equal measure, providing fulfillment in the knowledge of time well spent.

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