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NSF GK-12 STEM: A Fellow's Perspective/A Partner Teacher's Perspective

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COMMENTARY

NSF GK-12 STEM: A Fellow's Perspective

By Peter F. Smith

The focus of a science graduate student in the throes of thesis research and writing is nearly singular. Between field and laboratory experiments, manuscript preparation, grant applications, and attendance at conferences, the world outside of scientific research can seem extremely distant. Science graduate students encased within the walls of academe spend most of their time with science faculty and other graduate students. As they work with other scientists they learn to communicate with scientists, sometimes at the expense of their ability to communicate with the rest of the world once they are finished with graduate school and enter the workforce. For some students, this probably will not present a problem, as they will become science faculty members and remain within the culture of academic science. However, fewer and fewer new doctoral degree recipients are entering the tight and competitive job market of academic science. And outside of academe a scientist is often perceived as being only as good as his or her ability to communicate effectively with non-specialists.

What better cure for tunnel vision in an advanced doctoral student, deeply enthralled with the minute evolutionary gradations in DNA signatures of African fish populations, than to spend a year in high school? High school students are not subtle; you need not guess whether you have bored them with a lecture on the structure of nucleic acids (you have—and they will tell you). High school students are also not easily impressed by academic credentials or achievements and are not readily excited by information that they cannot personally relate to. In fact, when it comes to science literacy, high school students are not all that different from most people you will encounter outside of academic life. I have been able to use my experience with the NSF GK-12 program as a survival guide for communicating with non-scientists. In the year that I spent with high school students, I probably learned more than I taught. The lessons that I learned were not really about science nor were they about teaching—they were mostly about people and how to be a scientist among non-scientists.

Working with the high school students and teachers in this program taught me to be humble, to have a sense of humor, and to earn people's interest by making my science accessible and relatable to them. These lessons are both harder to come by and more important than it may seem. Graduate students often view their pursuits as noble, but high school students are likely to view them as rather odd ("you went all the way to Africa to look at fish…don't we have enough fish here?"). From my experience, it is safe to assume that most people will agree with the high school students on this one. In graduate school, when you present to your colleagues or academic advisors a new approach to the statistical analysis of your DNA sequence data, they might be intrigued and fascinated. This is not an expectation that one can have in the world outside of academe. High school students, like most people, will ask, "So what?" and will not be sold until they can relate to the answer. I still use the "so what" test when I am presenting scientific information to non-scientists. If I cannot answer this question in a way that would satisfy a high school student, then I know I will lose my audience. This is not to say that high school students are not sharp thinkers or are unable to understand scientific information. To the contrary, I encountered many students who were able to understand the heart of a scientific issue or debate with very little background information. But they, like most people, have busy lives and busy minds, and science must compete for their interest. What I have found is that (hard as this is for an enthusiastic graduate student to imagine) most people, high school students and professionals alike, are either intimidated by or uninterested in science. If I want someone to understand and appreciate the work that I do, I need to sell it to them by making it important and accessible to them. This lesson has served me very well in my professional life so far.

The iconic view of academically trained scientists is that they are entrenched in minutiae, aloof and out of touch with "real" work. Since I have entered the workforce outside of academe, I have found that this caricature of a scientist is a common misperception. I have used my experiences from this program in my efforts to be a different kind of scientist than people may expect. I have welcomed the "whys?" and the "so whats?" and I have answered them in ways that I practiced back in the high school classrooms. I have also found that when I enter a new area of science in which I am not an expert, I am not afraid to challenge my colleagues by asking my own "so what" questions and expecting relatable answers. My experiences in the NSF GK-12 program made me a better scientist by forcing me to ask the tough

COMMENTARY

"so what" questions of myself and to be prepared to answer them for the toughest audiences in my memory. When I was working with high school students and I approached these questions with honesty and frankness, putting things simply, but not oversimplifying, I was usually well received. This also has been my experience years later in my career, and it has helped me be a better scientist in a world where scientists are only as good as their ability to communicate.

Peter Smith is microbiological supervisor at the Maine Centers for Disease Control. He was a member of the first cohort of GK-12 STEM fellows in 2000–2001. He graduated from the University of Maine in 2002 with a Ph.D. in zoology, specializing in molecular population genetics. He did post-doctoral research at the Maine Medical Center in Portland before joining the Maine Centers for Disease Control in 2005.

NSF GK-12 STEM: A Partner Teacher's Perspective

By Lauree E. Gott

NSF GK-12 fellows showed my students what science really looks like outside of a school and helped to eliminate many stereotypes about scientists (i.e., that they always work in a lab with a white lab coat and look into a microscope). My fellows taught the scientific method, and gave my students opportunities to practice it doing their own research. In one full-year project, students first studied fungi, then collected their own fungi from the forest around the school, made a hypothesis about whether their particular type of fungus would cause wood to decay, and finally set up their experiments. Terminology the students were introduced to included "control," "replication," and "variables." My students learned why we had controls, why we needed to replicate experiments, and how to control the variables. Instead of just telling them about these very important parts of science, they learned first-hand. When the students finished their experiments, they drew their conclusions and made posters to present their ideas to their classmates.

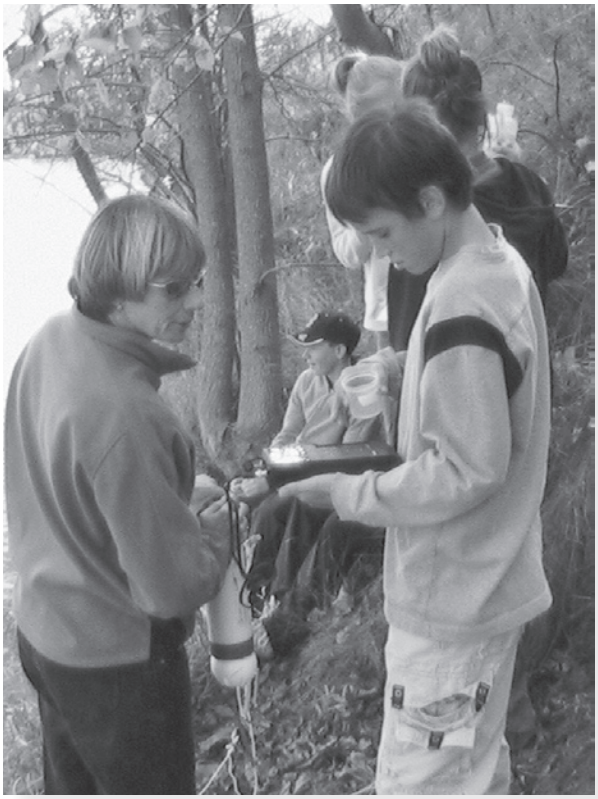
One of the projects we began with a GK-12 fellow continues on the Penobscot River bank behind our school. We have monitored the river and shore for three years and want to continue because our school is located just above the Veazie Dam, which is slated to be removed from the Penobscot River. We monitor the water (e.g., by measuring pH), and use transects (a sampling unit) to record plant and animal life. We also examine plankton from the river with light microscopes donated to our district by the GK-12 STEM program. Continuing these studies will allow future students to see how removing the dam will affect the river and the surrounding land. It is a project that shows my students the importance of science in their lives and lets them provide valuable information to their community through their own work. Research in science education shows that students learn better when they are actively involved in their education and can see the value of their learning.

The GK-12 program at the University of Maine was the most worthwhile professional development I have had in my 15 years of teaching. The lack of science content knowledge is one of the reasons elementary partner teachers give for why they do not teach science in the lower grades. This program provided opportunities for partner teachers at all levels to increase their content knowledge. During science camp, partner teachers were allowed to select areas of science they needed help with or that were of particular interest. Learning how to use the program's equipment was key to continuing its use after the fellows left the classroom. All of these experiences built increased confidence in partner teachers. The partnership between fellows and partner teachers was immeasurably important to success in the classroom. The combination of partner teachers' expertise in presenting information and the fellows' expertise in many fields of science, created a wonderful, collaborative environment for all students. The GK-12

COMMENTARY

program gave partner teachers opportunities to attend professional science conferences with their fellows; teachers sometimes attend education conferences, but rarely have an opportunity to attend science conferences. I made formal presentations of work done in my classroom at two conferences of the Society for Conservation Biology, and I gained a lot of knowledge about current research in conservation biology that I then passed onto my students.

A special benefit offered to a few partner teachers in the GK-12 program was participation in an international research project in Kenya or Japan, through a supplement to the NSF GK-12 program by International Programs at NSF. I traveled to Kenya to help with a bird research project and to do educational outreach in their national school system. This was my first experience doing authentic research and working with scientists who were trying to identify some of the endangered species in the Arabuko-Sokoke forest. I gained a lot of knowledge about how research is done and a greater appreciation for wildlife and what humans are doing to their environment. I also was able to provide professional development to teachers in Kenya while working with high school students in biology. It was an experience that allowed me to compare the educational philosophies in Kenya and the United States. After returning to the United States, I gave a presentation to all the students in my school, as well as to other groups, on the challenges facing the Kenyan people and wildlife. This presentation motivated my students to raise funds for mosquito nets for children in Kenya, to have a greater appreciation for what it means for a species to be "endangered," and to know how they can effect change throughout the world.



Partner Teacher Lauree Gott with students studying the Penobscot River and shore near the Veazie Dam.