Bridging the gap: spanning the distance between high school and college education

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As graduate students, we are immersed daily in the practice of evaluating and critiquing research and we have a good understanding of the scientific mindset. Why not share this insight with others who would benefit?

In 2006, a National Science Board survey found that American adults lacked a solid foundation in scientific concepts. Even more worrying, those surveyed were ill-equipped to rectify this knowledge gap: when asked about a simple experimental design, fewer than half understood the value of using a control to calibrate observations (NSF 2008). The methods that scientists use every day have applications far beyond the research lab. Sharing our understanding of creative and systematic methods of inquiry has the potential to benefit more than just our scientific peers.

The National Science Foundation (NSF) views education and outreach as crucial to its mission. NSF supports projects designed to bridge the gap between young students (tomorrow's citizens) and educators (today's graduate students and professors) with a passion for their studies. Through collaborations with teaching faculty at public schools (Graduate Teaching Fellows in K–12 Education), over 140 universities nationwide provide graduate students with an opportunity to express their enthusiasm for science to an audience in desperate need of scientific inspiration. These "GK–12" programs span many disciplines, including science, technology, engineering, and mathematics.

Southern Illinois University Carbondale (SIUC) recently initiated a GK–12 program (www.siu.edu/~heartlandGK12/), to which the authors of this article (a pollination ecologist and plant biologist) belong. Other members of the first-year GK–12 team include graduate students in microbiology and geology. Working with students studying environmental science, anatomy, biology, and the physical sciences at all age and achievement levels, we facilitate learning both inside and outside the classroom and now have a better understanding of the challenges public school science teachers face. Without exception, public schools would benefit from increased graduate student outreach. Since we stand to gain as much as the public schools, the relationship is mutually beneficial. If outreach interests you, but you are unsure how to become involved, consider the following ideas.

Does your university have a NSF GK–12 program? The easiest way to become involved with youth science education is through previously established programs. Graduate students currently involved in outreach at participating universities will appreciate any ideas, assistance, or supplies you can provide. If your university does not have a GK–12 program, consider approaching faculty about setting one up.

Involve university science clubs. Set up a branch of your university's sustainability club for students, bring the insect collections of your entomology club to a classroom, or provide opportunities for club members to act as judges for local science fairs. Those involved in clubs are inherently enthusiastic about their organization, and their excitement can inspire youngsters in ways traditional teaching may not.

Be a liaison. The responsibilities involved in maintaining a classroom leave teachers little time to stay informed about upcoming events at local universities. Informing teachers about guest lecturers, exhibits, or other activities provides an opportunity for teachers to arrange for young students to experience science outside the classroom.

Volunteer to tutor. Public schools frequently provide after-school tutoring for students. Ironically, the students hardest pressed to find appropriate help are those in college-level classes. Many tutors are generally unequipped to help these advanced students. You, on the other hand, possess the appropriate knowledge base to help them understand complex science topics.

Engage teachers and students in fieldwork. If your fieldwork is carried out locally, invite teachers or students to volunteer their time; this is a valuable way for students of all ages to experience the joys of scientific discovery, and it means free fieldworkers for you!

Give school presentations. With your expertise in a particular field, you are well-positioned to bring not only enthusiasm and passion for science to the classroom, but also current technologies, applications, and real-world examples illustrating its value.

Volunteering time for outreach is not without cost. We ourselves have struggled to balance graduate and outreach pursuits. One of us (OM, the pollination ecologist) recently presented to a group of 4-H students. Even though the subject is one she knows well, it took time to prepare an engaging lesson with hands-on activities (they dissected flowers, found the sources of pollen and nectar, and discussed the importance of the spatial relationships between these two). Despite its success, she wondered later – as she scrambled to finish a paper

due for one of her own classes – whether she could have taught the same material with less effort. Obviously, prioritization is a challenge; you must be judicious in how you choose to spend your time.

Considering that, among graduate students, to-do lists are longer than attention spans, you might be justified in asking, "Why would any right-minded graduate student want to devote time to commune with younger students?" First, listing previous involvement in outreach on your résumé is beneficial in academia. Outreach is often viewed advantageously by grant reviewers, some of whom rank such "synergistic activities" as highly favorable attributes of submitted applications. Second, a future in academia at the university level often includes teaching underclassmen who are recent high-school graduates – the opportunity to practice the art of communicating science *before* you are in this setting will make your first years as a new professor easier. Regardless of your future plans, such an opportunity will give you confidence and opportunities to practice thinking on your feet. Finally, watching students engage, learn to inquire, and seek out answers is a refreshing reminder that discovery – the essence of science – is fun. Encouraging these activities in the classroom cultivates critical thinking skills that will serve students and teachers alike for a lifetime.

Acknowledgements

OM is supported as a graduate fellow by the SIUC GK-12 program (NSF GK-12 grant DBI 0638722). Many thanks to the teachers and other fellows who are making this a very successful program, and to the high school students who provide inspiration. We also appreciate the project's principal investigators (PIs) D Gibson and S Sipes for their valuable input and editorial comments.

Faculty response

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As co-PIs of an NSF GK–12 grant (#DGE-0638731), we can attest to the benefits and costs of graduate students undertaking outreach activities in public schools, as outlined above. As faculty members, we suggest several more outcomes that we have observed in graduate students who have participated in our program. We have heard similar outcomes from faculty at other institutions, who work with GK–12 graduate students.

Most notably, we have seen a considerable increase in the ability of our students to successfully explain their research to diverse audiences. Students are able to gauge the information suitable for each audience, and they understand how to present their research findings in an organized and clear manner. The experience of teaching fundamental science principles to children and their teachers has meant that graduate students have had to be certain that they themselves clearly understand the fundamentals to begin with. They are also better able to talk about science, since they practice doing this in the schools on a weekly basis. In a well-conceived GK–12 program, graduate students participate in seminars and activities that prepare them for their teaching role in the schools. They gain an understanding of pedagogy, learning styles, class management, and other skills that benefit their résumés, their job interviews, and their first college teaching experience. Some graduate students in the GK–12 program have produced publications as a result of their experiences.

We acknowledge the cost, in terms of time taken by outreach activities, but another important outcome of participation in the GK–12 program is that students improved their abilities in time management and prioritization of tasks. Our GK–12 students spend 15 hours per week teaching and preparing for class, yet they are no slower to complete their degrees than students who have not participated in the program.

There have also been some unanticipated outcomes. Students report that their association with school children and teachers has provided them with a valuable connection to the local community and added a dimension to their lives outside of academia. Our graduate students are essentially acting as ambassadors for our institution, which has had positive benefits in terms of how we are perceived in the community at large.

We have noted our experience with the benefits and costs to graduate students, but – as faculty – we could also make a similar list. The greatest benefit to faculty is that the GK–12 program provides graduate student funding and tuition. Just as importantly though, their participation in outreach produces a more well-rounded graduate student, who has additional opportunities for employment upon graduation. Finally, as Messinger and Schuette note, helping others to learn science can be fun and satisfying. As faculty, we know that, and by encouraging our graduate students to share their knowledge with others, we can help build a culture that values these activities.

References

NSF (National Science Foundation). 2008. Science and engineering indicators. Washington, DC: NSF Division of Science Resources Statistics. www.nsf.gov/statistics/seind08/toc.htm. Viewed 22 Feb 2008.