TIPS, TRICKS & TECHNIQUES

Enhancing Interactions between Research Lab Students & Their Communities

RECOMMENDED FOR AP Biology

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ABSTRACT

We present a simple strategy that professors and research students can use to coordinate scientific education-outreach programs in the wider community. The focal points of this strategy are the use of preexisting community networks and the development of a simple but engaging educational program. Employing this straightforward model can help reduce the activation barrier for lab members who are interested in becoming involved in scientific outreach.

Key Words: *Outreach; undergraduate; community; education; laboratory.*

○ Introduction

Educating the public about scientific research and creating a STEM-literate society is widely acknowledged as an important goal for the research community (Leshner, 2007). Engaging the community in partnership and outreach programs encourages community members to learn firsthand what scientists do, how they do it, and why they do it (Brewer, 2002). With young students especially, the benefits of educating a generation of STEM-literate citizens are numerous, including greater comprehension of the importance of research to daily life and increased interest in the relevance of science to public issues (Cicerone, 2009; Richardson, 2010).

However, despite the benefits of scientific outreach, coordinating and executing such efforts can be challenging. As a member of a lab where most everything takes place on campus, it can be difficult to connect with the wider community. Additionally, many scientists feel unprepared to communicate effectively with the public (Besley & Nisbet, 2013; Varner, 2014). For many, the idea of creating an outreach program may seem to take more time and effort than is reasonable given demanding research schedules. With this in mind, we have established a straightforward model that enables research students to develop and implement a community outreach program.

To make connections to the community, research students can utilize preexisting community education and civic engagement networks.

○ Connection to the Community

To make connections to the community, research students can utilize preexisting community education and civic engagement networks. Most colleges have a campus civic-engagement office that facilitates interactions between members of the campus and the wider community. In addition to providing community contacts, this office can provide information about existing after-school programs that pair college students with local children for tutoring or college preparation. We collaborated with one such program to bring local high school students who regularly participate in an after-school tutoring and mentoring program to campus. Under the guidance of undergraduate research students, these high school students explored college classrooms, science buildings, and our research lab, where they learned about and participated in our research on plant disease. A second type of network is that of local organizations that focus on supporting young students from disadvantaged backgrounds. Often these organizations have developed programs that expose underprivileged children to the STEM fields and increase awareness about college. Typically, these groups have an established structure in which students meet at a certain time and place, usually with a teacher or monitor who can facilitate interactions. Research students can propose a module that fits within this programmatic structure and travel to the group to present this module. Additionally, research students can utilize their home networks (i.e., their childhood schools, programs, churches, etc.) to expand their outreach

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efforts and share their own research experiences with their personal communities. If community programming is not readily available, research students can contact local science teachers to arrange visits to middle school or high school classrooms. In all cases, it has been our experience that faculty members and program coordinators are very interested in STEM enrichment programming, especially that which comes from a college research lab.

○ Development of an Outreach Module

We employ an outreach module that has four steps that can be tailored as needed. In each step of our program, we have an interactive or hands-on activity to ensure that even high-energy students, who have difficulty listening quietly to a lecture, learn from our program. First, we explore why scientific research is important and relevant. We begin by explaining that scientific research addresses unanswered questions and ask students what kind of research questions they might like to have answered. We often get suggestions in the vein of "How do we cure cancer?" or "How will we stop global warming?" Some questions are more philosophical, such as "Does anything even exist?" or "Are we alive?" In this way, we easily involve the students, establish the relevance and importance of research to their everyday lives, and start teaching them about hypothesis-driven science.

Second, we teach students about our specific research system. Our lab studies bacterial wilt, a disease that affects hundreds of different plant species and results in crop losses. We tailor our introduction to the level of sophistication of the students involved. We have had students read aloud about the Irish potato famine and reflect upon the role this plant disease has played in human migrations and politics. We have devised a game to simulate the role of bacteria that block transpiration by having two children race to drink the liquid in their cup through a straw. One student emulates a "healthy plant" and drinks water through the straw, while the other represents a "diseased plant" and receives a cup of honey, rather than water, to represent bacterial blockage of the xylem. We have created flash cards that show images of plants and patho- gens to engage younger students and have asked them to reflect upon how this disease might affect their daily lives. Given that bac- terial wilt kills tomato crops in the United States, children often predict that this disease might affect the availability of ketchup. The role of these activities is both to teach students about a specific research question and to engage them with the material on a tangi- ble and personal level.

Third, we teach students to perform a simple lab procedure. Because laboratory research involves bench work, we want students to get a feel for this type of activity. We introduce students to a research technique that we currently use in the lab, which they then perform. This activity is meant to demonstrate that most research is neither difficult nor intimidating. We have chosen a technique that follows a few guidelines. First, the technique is easily explainedand demonstrated. Second, the technique is not too messy. Third, the technique can be performed in a wide variety of spaces, from a classic classroom to a public library to a church's common area. Finally, the technique is simple to prepare, so it can be taken to locations that lack lab access.

For our outreach program, students participating in our program plant germinated tomato seedlings onto square agar Petri plates that contain fertilizer (Figure 1). This is a simple activity in which students learn about the use and importance of media in the lab. The bacterial wilt pathogen invades plants through the root systems, and this activity allows students to examine root growth, which is often difficult because roots are typically submerged in the soil. Students can take home their planted plates and watch tomato plants grow from the seeds in just a few days. In one case, the teacher had students place their plates on the sill of a sunny window where they could observe all the plants growing over time (Figure 2).

Of course, the activity demonstrated in this stage of the program can vary among research disciplines. For example, undergraduates from a lab that performs ecological research could take students outside and catalog the different plant species they observe. Undergraduates from a microbiology lab may have students spit into bacterial growth Petri plates and observe what grows in a few days. The opportunities for creatively bringing lab work into the classroom are limited only by feasibility.

Finally, at the conclusion of the program, we reinforce the message that scientific research can be interesting, easy, and fun. With our encouragement, students reflect on their work, scientific acumen, and potential. We explain that all research can be straightforward and enjoyable and emphasize that answers to complex questions are devised from simple experiments done by researchers in the lab. In the course of this program, we hope to have encouraged students to become more involved with the research community in the future.

○ Benefits for Research Students

This program has been used by undergraduate research students to independently coordinate outreach events to the community. There are many benefits for undergraduate and graduate students who participate in outreach projects. Presenting research to a community audience allows students to discuss the relevance of their topic to a community far removed from their scientific field. This type of interaction can cause presenters to better understand their own science and improve their teaching skills (Stamp and O'Brien, 2005; McBride et al., 2011). Additionally, when communicating ideas to the general public, students experience what it is like to be an expert in the field, which can bolster their confidence in representing their STEM

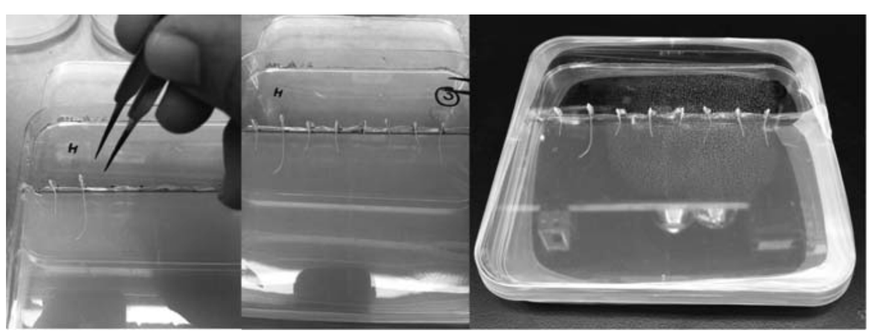

Figure 1. Germinated tomato seedlings are planted on fertilizer agar plates using forceps.

Figure 2. Fertilizer agar plates planted with tomato seedlings are placed in the window of a middle school classroom so that students can observe their own tomato plants growing, as well as those of classmates.

discipline (Laursen et al., 2007). Finally, because outreach is a valued mission of the scientific community, outreach efforts and skills are marketable and attractive to potential employers or graduate schools (Laursen et al., 2007). Outreach is, therefore, a valuable and rewarding mission for any research lab as well as the research community.

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