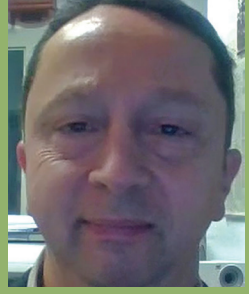

GUEST COMMENTARY

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Immersing Yourself and Students in Classroom Research: One Teacher's Voyage

I began my career just like many of you with a passion for teaching the fundamentals of biology. However, along the way I realized that as I grew as an educator, I also wanted to offer my students as many authentic experiences as possible. Now, ten years after that realization, I have a story to tell that might offer some inspiration and even a challenge to my fellow science teachers.

This story started when I attended a two-hour professional development workshop several years ago, focused on how to perform polymerase chain reactions (PCR) in the classroom. I was not immediately engaged since I had performed the assay numerous times before as a former molecular biologist. However, an hour into the presentation, as our reactions were incubating, I experienced what I now see as a career-changing moment. Our instructor went "off script," touting some of his innovations in his Midwest school district. In the next few minutes, we learned how he literally gained funding and ultimately erected a two-story laboratory facility! I was captivated by the resourceful ways he approached friends, business acquaintances, and even strangers to finance the laboratory supplies for his students' research endeavors. Who says one person can't make a difference?

That same evening, I started to dive into the online pool of science teacher resources, trawling the internet for summer research possibilities and grant opportunities that might allow me to create a similar laboratory-like culture in my classroom—even if I have not yet helped to construct a new building on campus. For the past ten years I have participated in and benefitted from a wide variety of summer research programs offered to teachers. These experiences covered a wide range of topics including the assembly of electrical circuits and writing code to execute simple robot maneuvers. I have even collected and graphed data in real-time with wireless sensors to quantify the impact of environmental conditions on respiring yeast.

As both a biology teacher and our school's research program instructor, my personal growth in learning new gene expression regulating mechanisms and innovative techniques such as flow-cytometry and quantitative PCR has enabled me to more effectively fuel my students' research dreams. Over the years student projects have ranged from improving soil conditions for more robust flowering of roses to measuring the damaging effects of acidity on germinating legumes at the gene transcriptional level. Another project focused on developing a more cost-effective and environmentally friendly means of producing Copper (I) Chloride, a widely used catalyst for producing fungicides among other applications; that student was just recognized as a *Top 300 Regeneron-STS Scholar*!

These interests extend to the classroom where I frequently give students opportunities to run experiments and answer their own questions just like real scientists. For example, some have designed their own protocols to optimize growth conditions and employed spectrophotometers and carbon dioxide sensors to quantify doubling and respiration rates of *Saccharomyces cerevisiae*. This project was a product of working alongside professors from the *Cloud-enhanced Open Software defined MObile wireless testbed for the City-Scale deployment* (COSMOS), a National Science Foundation's PAWR program.

As my confidence and storehouse of experiences expanded, I have leveraged my growing network of research mentors and laboratory staff contacts into summer internships for my students who benefited from equipment or expertise that I would not ordinarily be able to provide. Thus far I have been awarded over $50,000 in education grants along with many all-purpose instruments and valuable reagents for my students to perform these types of molecular biology experiments (e.g., shaking incubator, spectrophotometer, cDNA synthesis kits, and gel electrophoresis apparatuses). As a result, I can now host and support a wider range of students' research questions.

The goal in sharing this is to suggest that you too can follow this path and initiate a culture of research in your classroom. There are summer outreach programs that encourage teachers to attend conferences and sponsored workshops to extend one's knowledge of emerging biological systems, meet new people, and create engaging project ideas. Similarly, in-person or online teacher-supporting communities can be quite helpful for the young and eager educator. As an example, a recent *Math for America* (MFA) fellowship (https://www.mathforamerica.org/) provided me with guidance in designing inquiry-based projects supported by more effective assessments. To support this program, I regularly facilitate workshops connected to my research experiences.

I am very pleased to have established and maintained an after-school science research club for many years. Although the number of participating students is not huge, their interests in employing molecular biology strategies is genuine and has resulted in an exponential expansion of a community-wide project, "*Be your health-yeast!*" Students from across New York City will be invited to learn about their own health needs through experimentation and communicate those results monthly with us and other schools with a goal to produce an annual online journal!

Of course, I can only report on my perspective and cannot guarantee that every workshop you attend or grant for which you apply will be equally inspirational or successful, nor will all your students become inspired researchers. I can promise you, however, that they will never forget the experiences you provided. Additionally, you will be grateful for the growth you will see in yourself as a teacher. Therefore, I hope to have convinced you that by immersing yourself and your students in the wider world of research you will go far in developing a research culture in your classroom!

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