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Forging a 21st Century Model for Undergraduate Research

SUSAN MUSANTE

Not all biology students get to experience scientific research firsthand, but the National Genomics Research Initiative (NGRI) is working to change that, says its director, Tuajuanda Jordan. “The goal is to support educators and improve the number and quality of 21st century scientists,” Jordan says. The NGRI is the first initiative to spring from Howard Hughes Medical Institute’s (HHMI) new Science Education Alliance (SEA).

At present, a competitive application process determines which institutions become part of NGRI. The goal is to make the experience readily available to all who are interested within the next few years. Participating faculty receive curricular resources and a framework to infuse genomic research into a yearlong course, as well as connections to other faculty in the SEA network. Undergraduates taking part in the courses become bacteriophage “hunters,” sampling their local environments for novel bacteriophage species. In the first semester, students isolate, characterize, and purify phages, completing a preliminary characterization of the phages’ DNA before sending it to the sequencing center. The following semester, students annotate their phages’ DNA sequences and select one to submit to GenBank. They present their research to fellow students at their home institutions, and selected students give presentations at an annual SEA symposium.

“The program has shown that freshmen can be engaged in real research that is moving science forward,” Jordan says. Because resources are limited, she says, NRGRI replaced the one-on-one apprenticeship model with peer mentoring, where individual students assist entire classes. Many institutions use graduate student mentors, but at

institutions where this is not possible, upper-level undergraduate students mentor their peers.

Cabrini College became part of NGRI in 2009 through the initiative of science faculty members Melinda Harrison and David Dunbar. One of Dunbar’s senior advisees, Katie Mageeney, was a natural fit for the role of peer mentor. “It was self-evident she would do this. She has all of the skills needed and a great rapport with students,” Dunbar says. But he and Harrison had no idea how significant Mageeney’s influence on their students would be.

During the 2010 SEA symposium at HHMI, they shared their course evaluations. “One of the big items that came out of students’ responses,” Harrison says, “was that the students started thinking about science more seriously in terms of careers.” At the symposium, David Lopatto, a psychology professor at Grinnell College whose work includes research on the benefits of undergraduate research experiences, heard their presentation. Lopatto encouraged Dunbar and Harrison to explore Mageeney’s impact on the freshman students more deeply. “He helped us develop an instrument that would allow us to specifically evaluate the benefits and merits of peer mentoring on research in the classroom,” Dunbar explains. The results were striking.

According to Lopatto, there are two very different but equally necessary elements to successful research experiences for students: the structural environment and the emotional and social environment. Dunbar and Harrison provided the first element by setting the stage, integrating the research into the course, and ensuring the proper equipment and tools were available. According to the survey

results, Mageeney provided the other key element.

“Katie went beyond the call of duty,” Dunbar says. She was there for the students, available around the clock, both in person and through e-mail. Mageeney was not only an accomplished science student but also a resident assistant and athlete, and this, according to Harrison, inspired the students under her mentorship. “They loved Katie,” Harrison adds, “they clearly trusted her and felt more comfortable going to her rather than to their teachers.”

Dunbar and Harrison now realize the influence that having a great peer mentor has on the success of their program. But finding another Mageeney may be easier said than done. “It’s not simply putting an undergraduate student in the room with the freshmen,” Dunbar says. He and Harrison plan to outline the qualities necessary to identify future peer mentors for their course, and they hope to pay their peer mentor next time to compensate for the time commitment. That will require additional support from their institution.

Cabrini College’s example illustrates that, when the right elements are in place, undergraduate research can be transformative for the students. Assessment data across NGRI institutions show similar impacts, Jordan says, both on retention and performance, even in at-risk student populations. The SEA is building the case for administrative support for undergraduate research at all institutions. “We are trying to open the eyes of some of the administrators,” she says, while she allows that this will be a significant paradigm shift.

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