Political science. Chemistry professor David Brown poses at the White House with Southwestern College students, including Hector Mendoza Solano (*second from right*).

U.S. SCIENCE EDUCATION

Two-Year Colleges Are Jumping Into the U.S. Research Pool

A growing number of community colleges hope to improve instruction and train a more diverse cadre of scientists by involving students in research

Growing up in central Mexico, Héctor Mendoza Solano never imagined talking to a member of Congress in Washington, D.C. And the idea that the conversation would be about his research would have seemed unthinkable to his family, which couldn't afford to send him to university. Yet in April 2008, Solano found himself doing exactly that.

Solano was attending the 2-year Southwestern College outside San Diego, California, and his research on glass materials with special optical properties was part of a "Posters on the Hill" event sponsored by the Council on Undergraduate Research (CUR), an organization formed in 1978 to foster undergraduate research. It was during that event that Solano—who crossed the border every day from Tijuana on an educational visa—learned he had been accepted into a chemical engineering program at the University of California, San Diego (UCSD). This June he received his bachelor's degree, and he plans to pursue a graduate degree in materials science after spending a few years in industry.

Solano's story is more than an uplifting tale of personal achievement. It's also part of a burgeoning effort to train more scientists by offering research experiences to a huge but previously neglected pool of talent. The pool consists of students like Solano who attend so-called community colleges. There are more than 12 million such students—nearly half of all U.S. undergraduates—and each year about 25% transfer to 4-year schools. Although CUR was formed in 1978, community colleges are relative newcomers to its ranks and make up only a dozen of its 600 institutional members.

Last year, CUR began running workshops to help them integrate research into their curricula. This month, the National Science Foundation (NSF), which has funded those workshops, gave $3.35 million to biologist James Hewlett of Finger Lakes Community College in Canandaigua, New York, to help 16 colleges that participated in those workshops take the next step by developing original research programs.

Online
sciencecareers.org
Profiles of community college researchers.

They face significant challenges. Southwestern College chemistry professor David Brown spends up to 18 hours a week giving lectures and running instructional labs, a typical course load for community college faculty members. In addition to lacking assistants, Brown must send students, who may be gone after 2 years, into the field before they have acquired a solid academic foundation.

Brown takes his students on field trips to UCSD because Southwestern College can't afford subscriptions to most specialized journals in his field. And community college faculty members can't really compete against larger, better-funded research teams. In 2003, Hewlett's students began a project to analyze DNA from local red-tailed hawks for segments that distinguished males from females. He's only now writing up the results, which essentially duplicate what two other groups have already published.

But Hewlett isn't trying to finish first. His goal is to get students excited about science, with the added benefit of being energized himself. "The faculty who get involved in research become better teachers," he says.

Learning by doing

Hewlett and his co-investigators on the NSF grant are still filling out their roster. They are looking for institutions like Portland Community College in Oregon, the state's largest educational institution with nearly 100,000 students. The NSF project will enhance what some faculty members are already doing, says biologist Josephine Pino, by offering salary support for faculty to reduce their teaching load and additional training to help them develop research-based courses. Such a course, Pino says, might make use of the college's 40 hectares of natural forest, stream, and wetlands.

Hewlett came to Finger Lakes in 1998 already convinced of the value of student research. "Even though I was expected to teach all these classes, at some point I was determined to figure out how to do research, which was what got me excited about science in the first place," says Hewlett, who holds a master's degree in molecular ecology from nearby University of Rochester.

His students don't just get excited when they do research, he says. They also learn better. "My students knew more about DNA from this [red-tailed hawk] project than any students I'd ever had in the past doing a general biology course," he says. A second course that lets them analyze how tart cherry juice reduces cell damage gives students a glimpse into the world of cell structure and function along with basic chemistry and the principles of experimental design. A course examining the bleaching of a tropical reef ecosystem teaches students about population ecology and the regulation of gene expression.

To be sure, it takes more time to guide

CREDIT: DAVID BROWN

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30 students through original research projects than to simply lecture them. So Hewlett has obtained grants to ease his teaching load, purchase equipment, and support a full-time technician. He's also helped to document the indirect benefits of research for the college, including the fact that an initial $24,000 investment in research generated $1.2 million in new industry collaborations, external funding, or free materials and supplies.

When M. Gita Bangera accepted a faculty position at Bellevue College outside Seattle, Washington, she assumed her students at the 2-year college would be perfectly capable of doing research. "I'd always done research, so I didn't see why that wouldn't be necessary," says Bangera, a molecular biologist who had completed multiple postdoctoral fellowships and worked as a senior scientist at a microarray manufacturer. In 2007, Bangera and fellow Bellevue faculty members Jim Ellinger and Chris Shelley obtained a $500,000 NSF grant to start a graduate school–type project called ComGen, in which students conduct research, write up a poster or manuscript, participate in journal clubs, and serve as teaching assistants in introductory biology courses.

The project teaches students how to maintain a lab notebook, isolate plasmid DNA, and run PCR while they sequence the genome of *Pseudomonas fluorescens* L5.1-96, a bacterium that fights off a fungus that attacks wheat. They also analyze original research articles. "The first time they do it," she says, "they're terrified." One common complaint is about having to look up every second word in the article to understand it. "And I say, 'Yeah, you're going to have to do that.' They learn to ask and answer questions, which is really what research is about."

Brown believes that the data his students collect are just as good as those generated at a major research university, even if the scope of the project may be more limited. And his students are more likely to work directly with a faculty member, he adds. "I think my students are probably getting at least as good if not a better experience as someone who's doing research at a [major] university," he says.

However, that experience comes with a distinctly community college flavor. At Delaware Technical & Community College in Stanton, biochemist Virginia Balke asks students to help with projects that vary from the characterization of soil microbes to the population genetics of local bat and fox populations. But they must stop work at 5:15 p.m. on Fridays and 2:30 p.m. on Saturdays, which is when the only building on campus closes. And the building doesn't reopen until Monday.

"You have to really plan the timing of your experiments well," Balke says. She also must prepare for contingencies: The school has no backup generator, so when the electricity went out last summer, Balke brought in dry ice to cool a refrigerator full of fox feces, a carcass, and some body parts.

Learning by doing. Finger Lakes Community College students work in the field and in the lab.

CREDITS: (TOP, LEFT TO RIGHT) JAMES HEWLETT; FINGER LAKES COMMUNITY COLLEGE; (BOTTOM) NIH/ THE *EUNICE KENNEDY SHRIVER* NATIONAL INSTITUTE OF CHILD HEALTH AND HUMAN DEVELOPMENT; MAGGIE BARTLETT/NHGRI

The broader impact

Hewlett and his colleagues hope to inspire their students not only to stay in school but also to view science as a viable career option. Their success could mean new opportunities for groups traditionally underrepresented in the sciences and engineering.

Some 30% are African American or Hispanic, and nearly 60% are women. There is preliminary evidence that community college students who engage in research are more likely to stay in science, transfer to a 4-year school, and pursue a higher degree. Those outcomes suggest to Hewlett and others that research experiences can be a valuable tool to broaden the U.S. scientific talent pool. "If we believe that an early research experience is something that attracts underrepresented groups and retains them in science careers, it makes sense to support that," says V. Celeste Carter, program director within NSF's division of undergraduate education in Arlington, Virginia.

Hewlett has found that students taking courses that include original research are more likely to transfer to 4-year science programs (62% compared with 51% before 2007). The percentage of those applying to graduate school in science after obtaining bachelor's degrees from another school has grown to 10%, from 4%. Also, 36% of his students said they planned to transfer to a 4-year science program because of their research experience, and another 36% said their research provided them with an internship or job they wouldn't have otherwise.

For Brown, the value of community college research is captured in Solano's reaction to his 2007 trip to UCSD to photocopy journal articles. Brown recalls Solano telling himself during the visit, " 'Okay, this is the place where I want to be.' "

Solano believes that his research experience was the key to being accepted by UCSD as a transfer student. That research is still opening doors as he seeks a job with industry. "I got a call the other day for a research position," he says. "And they were really interested in my research experience with Dr. Brown."

–ALISON MCCOOK

Alison McCook is a freelance writer based in Philadelphia, Pennsylvania.

FROM COMMUNITY COLLEGE TO NIH

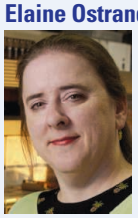
R. Douglas Fields

Developmental neurobiologist and section chief
National Institute of Child Health and Human Development

Started at a community college in Cupertino, California, and wouldn't have it any other way.

"Without question, I owe my career to the outstanding educational program at De Anza College." Doing research there was a great introduction to the profession, he adds: **"You can't learn science any other way."**

Elaine Ostrander



Chief of Cancer Genetics Branch
National Human Genome Research Institute

Began college at Yakima Valley Community College in Washington state because of its lower tuition. Working part-time to pay for classes didn't leave her any time to do research, she says, but community college students should have that option.

"I absolutely wish I had had that opportunity."

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