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**The Importance of Undergraduate Research**

Sarah Webb  
United States  
6 July 2007

Matthew Paoletti was lucky enough to have a role model in the family--a grandfather who had been a physicist--and he loved his high school advanced placement physics course. But when he entered Bucknell University in Lewisburg, Pennsylvania, he had little idea what a career in physics would be like. "I didn't know what you did with a degree in physics," he says. So the summer after his freshman year, he applied for a Summer Undergraduate Research Fellowship at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland.

Paoletti didn't stop working when the summer ended. NIST was just 20 minutes from his parents' home in suburban Washington, D.C., so he spent his holiday breaks at the lab and returned the following summer. Now that he's a graduate student at the University of Maryland in College Park (UMCP), he can see how "my notions of what I wanted to do were shaped by that first summer doing research."

Not long ago, it was rare for an undergraduate to become involved in real scientific research, but today Paoletti's experience is fairly typical. These days, most grad-school-bound undergraduates do laboratory or field work beyond what's required. Undergraduate research gives students a taste of what a career in science would be like and an edge in applying for graduate schools and jobs. But the edge isn't what it used to be--many graduate schools and employers have come to expect it.

**THE GROWING IMPORTANCE OF UNDERGRADUATE RESEARCH**

"If you have already learned how to function independently in a laboratory environment by the time you graduate from your undergraduate institution, then you are really well-prepared for graduate school."  
--Chris Burge

Fifteen years ago, a record of research went a long way toward boosting a grad-student prospect to the top of the grad-school application pile, says Marty Ligare, a professor in the physics department at Bucknell. But these days, undergraduates participate in research all the time; in chemistry, 72% of graduates had some research experience, according to a recent study sponsored by the National Science Foundation (NSF). In environmental science, the study found, 74% of undergraduates had research experience. "Now, I think, if they don't have a [recommendation] letter talking about successful undergraduate research experience, that's probably a handicap."

**OPPORTUNITIES NEAR ...**

During the school year, it's very common to find undergraduate students doing research for college credit, so they don't get paid. But summer research is a different story: Many undergraduates take paid summer research positions in lieu of a summer job.



Matthew Paoletti

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Most universities and colleges offer their science majors the opportunity to gain some sort of research experience. Some have a formal process for placing undergraduate majors in research labs, but the best approach, usually, is to find a professor whose work you're interested in and approach her or him directly.



Chris Burge

Acceptance, of course, isn't automatic. In many ways, finding an undergraduate research lab can be a lot like looking for a job, says Chris Burge, a biology professor at the Massachusetts Institute of Technology (MIT) in Cambridge. "[At MIT] on average, you need to contact five labs to find a position," Burge says, so be persistent.

Often there's an interview process during which the faculty adviser evaluates the fit between the undergrad and the lab. Taking the right courses or having some prior research experience can help get you hired, Burge says, but enthusiasm goes a long way. "They may be unfamiliar with some of the background, but if they're excited, that's worth a lot."

One thing that won't get you hired is sending a massive e-mail to every faculty member in that department, says Michael Doyle, former president of the [Council on Undergraduate Research](#) and [chemistry professor at the University of Maryland](#). This doesn't work for job applications either, by the way.

### ... AND FAR

Research opportunities aren't limited to your home academic institution. Research universities (and other types of institutions) offer summer research programs that are open to outside students, many of which are supported by NSF's Research Experiences for Undergraduates ([REU program](#)). The programs last 8 to 10 weeks, include a stipend, and usually offer (or help to arrange) student housing. Some offer a housing allowance. Each REU-funded institution administers its own REU program and its own application process, but one feature that these institutions all share is they reserve at least a few spots for students from outside the institution.

### MAKING THE MOST OF A RESEARCH EXPERIENCE

Independent research offers students a taste of the culture of research and life as a scientist. It's a short-term, risk-free way to investigate whether a research career or a particular field is a good fit.

"What we hope they will get--and what they seem to get--is hands-on involvement in a research activity," says Corby Hovis, coordinator of the NSF's REU program. Along with a faculty mentor, students will be "designing their research, deciding what research questions to ask, and deciding what topics to work on," he says. The idea is that students should establish a personal connection to the work and a feeling of ownership. "If you have already learned how to function independently in a laboratory environment by the time you graduate from your undergraduate institution, then you are really well-prepared for graduate school," Burge says.

"It's an introduction to the culture of doing science as much as the subject matter," Ligare says. Besides learning research techniques and problem-solving skills, students can use the time to chat with graduate students, postdoctoral researchers, and faculty about science and scientific careers. Another layer of exposure to scientific culture often comes when undergraduate students travel to scientific meetings to present their work.



Michael Doyle

### STANDING OUT MEANS STARTING EARLY



Corby Hovis

With so many undergraduate research opportunities--and so many students taking advantage of them--it takes more than the obligatory summer of research to stand out in a crowded graduate-admissions pool or in a competition for graduate fellowships. The last 15 years have seen students starting research at younger and younger ages, Doyle says. A longer commitment, particularly if it's to a single laboratory, translates into better preparation for graduate work and better odds of having at least one peer-reviewed publication. Unlike a grade point average (GPA), which only helps you for a few years, Doyle says, "a publication lasts a lifetime."

Publications are great, but the main thing, most faculty say, is the experience, the relationships formed (especially with a faculty mentor), and the skills learned. Without those things, today's top-tier graduate programs may not even look at you. "If you're going to be doing research full time in graduate school," Burge says, "why would you go through your whole undergraduate experience and never try it?"

## A CAREER REHEARSAL

From a student perspective, undergraduate research opportunities provide a safe, short-term way to gauge whether the investment in graduate school makes sense. In her 4 years at Furman University in Greenville, South Carolina, Laura Glish, a 2006 graduate, worked on collaborative projects in two different laboratories and explored a variety of experimental techniques, from atomic force microscopy to synthetic chemistry and molecular modeling. She presented her work at conferences and published three peer-reviewed publications, with more to come.

Still, she decided that a research career didn't fit. "I looked at my other chemistry- major friends who were so excited about grad school and about research," she says, and she decided "that's just not me. I'm not nearly as excited as I should be to commit 5 years of my life." So Glish spent last year teaching English in France, and over the next few months, she'll be doing medical volunteer work in Ghana, South Africa, Nepal, and China. Her most likely next move, she says, is a master's degree program in public health.

Undergraduate research isn't helpful only for the grad-school bound. A substantive undergraduate research experience can help recent science grads land interviews (and even jobs) in the industry and compensate for the "years of experience" listed in a job advertisement, Doyle notes. In clinical medicine, applications for residency positions include a section for research experience, Doyle adds--work a young doctor often would have done as an undergraduate.



Laura Glish

## RESEARCH DIVIDENDS

Paoletti used his undergraduate research opportunities to compare research environments and to explore physics fields that interested him. After his time at NIST, he worked almost one-on-one with Tom Solomon studying nonlinear dynamics in the physics department at Bucknell. He even used an additional summer experience at NIST, after graduating from college, to explore an alternative area in physics so that he could make sure that nonlinear dynamics was the right field for him. After experiencing both environments, Paoletti decided to pursue an academic science career.

The American Physical Society awarded Paoletti the 2005 LeRoy Apker Award for excellence in undergraduate research at an undergraduate institution. More importantly, his experience and, he says, a letter of recommendation from Solomon, opened the doors of graduate schools in ways a higher GPA wouldn't have. "You go to graduate school to do research," Paoletti says, "so they want to know that you can do research and that you'll be good at it."

<p>Sarah Webb has a Ph.D. in bioorganic chemistry. She writes from Brooklyn, New York.</p>	<p>Comments, suggestions? Please send your feedback <a href="#">to our editor</a>.</p>
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