

## Erin Dolan

Erin Dolan's major research interest is not what goes on atop the bench but what happens among those standing nearby. Although she is a trained neurobiologist working in a biochemistry department, Dolan's current field of inquiry is the complex triangular relationship among the undergraduate making a first foray into research, the graduate student learning to mentor, and the PI who believes in mentoring students in research but may never have sought empirical evidence about the benefits to students or faculty. Her steadfast interest in science education research will propel Dolan into a new role this month when she takes over as Editor-in-Chief of the ASCB journal *CBE—Life Sciences Education (CBE-LSE)*; [www.lifescied.org](http://www.lifescied.org)).

Dolan is one of a new breed of researchers bringing the perspectives of scientist and science education researcher to the study of how scientists actually become scientists. Many of these new science education researchers are active in the ASCB. Their influence led the Society in 2002 to start *Cell Biology Education* (which later became *CBE-LSE*) under editor Sam Ward. In August, Dolan takes over the *CBE-LSE* editorship from Bill Wood. Hers will be the fourth editorship if you count as one the reign of co-editors Malcolm Campbell and Sally Elgin.

Dolan's academic home is in the Biochemistry Department at Virginia Polytechnic Institute & State University (Virginia Tech), a very large (30,000 students), land-grant university in Blacksburg, VA. Her research, which focuses on science research as a context for learning and the dynamics of mentoring in research, is not the traditional fare in biochemistry departments. But Peter Kennelly, the department head, says he was delighted when Dolan agreed to accept a tenure-track appointment in 2005 and was equally pleased to see her promoted to associate professor last year.

It's the combination, Kennelly explains, of Dolan's bench background and her meticulous research standards that give her credibility with "hard" science faculty who are typically suspicious of social scientists and education specialists. "When she talks to a university faculty member about education or about outreach, she's not viewed as an outsider, someone for whom the day-to-day life of a faculty member in a biochemistry or a cell biology department is an abstraction. Erin is someone who knows what we are about."

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### Blue Walls, Higher Scores?

Dolan's investigations are not about tweaking classroom or lab practices but are about uncovering the underlying phenomena that govern science learning, says Kennelly, "With Erin, it's not a case of 'If I paint the walls blue, do the scores go up?' Erin asks why, and not everyone does that. She has a real passion for getting at the heart of the process and not just chasing after short-term outcomes and treating the student as a black box."

Getting at first causes in how students learn is an uphill struggle, says Nancy Moreno of the Baylor College of Medicine. Moreno also came into science education research with a biology "bench" doctorate and now shares a major research interest with Dolan on the impact of science outreach programs. In Moreno's view, taking on the editorship of *CBE-LSE* shows that Dolan is "really stepping into a national leadership role" in convincing bench scientists that science education is no longer a worthy but distant concern. It is the future of American science, Moreno contends.

Dolan has shown that outreach partnerships between bench scientists and classroom science teachers can be highly effective, says Moreno. "One tends to discount outreach efforts as feel-good experiences, but there's a body of literature



Erin Dolan



on what works. There are rigorous ways to evaluate these programs, and Erin has really been a champion of examining these types of programs in a scholarly way.”

Running her education research group at Virginia Tech, Dolan is under no illusion that her bench colleagues will readily embrace the new scholarship. Part of the problem, Dolan says, is that academic papers on learning or education psychology are written in a highly specialized jargon every bit as obscure as anything Dolan ever read in neurobiology. Moreover, it’s unrealistic to expect bench scientists to follow the literature so far outside their fields. That’s why Dolan has been writing a regular column for *CBE-LSE* since 2008, “Recent Research in Science Teaching and Learning.” It puts the best of this research a clickable link away from ASCB members and other bench-bound readers.

“I see *CBE-LSE* as a crossover journal, publishing articles that are of interest to scientists and science education researchers,” says Dolan. But new teaching scholarship has to be research-driven, she contends, and high-quality papers that break new ground will continue to be at the heart of *CBE-LSE*.

### Sounds Irish

Erin Dolan was born in Princeton, NJ, where her dad was an electrical engineer with RCA. Only she wasn’t Erin Dolan then, she explains, but Erin Peckol. “Erin Dolan. Doesn’t that sound Irish? Sorry, but not a drop.” (It was her husband, Danny Dolan, who later supplied her with the name.) Her Peckol grandparents were Slovenian immigrants and her father one of their seven first-generation American children, all of whom went in for academic overachievement. “My dad’s family is full of over-degreed people,” she says with a laugh.

When Dolan was two, the family moved to Seattle where her father was a practicing engineer for 20 years before becoming an engineering instructor at the University of Washington. Her mother was an accountant, which Dolan points out, gave her a double dose of numeracy. Growing up in Seattle gave Dolan a great thirst for caffeine and fond memories of her secondary school, the independent Lakeside School. “It was just a great, great school and, more than anything, it probably shaped my views on education.”

For college, Dolan chose Wellesley College in Massachusetts, where she acquired an appreciation for small liberal arts colleges and for experimental neurobiology. Her introduction

to the research life came in the lab of Barbara Beltz, a developmental neuroscientist. When Dolan left for graduate school at the University of California, San Francisco (UCSF), she imagined a future balancing bench research and classroom teaching on a small college campus.

Cori Bargmann’s sensory and developmental neuroscience lab at UCSF certainly offered the bench training. Over six years, Dolan was co-author (still as Peckol) with Bargmann on a string of high-impact publications probing sensory activity in *Caenorhabditis elegans* neurons. “UCSF had the best dynamic for me,” she recalls. “It was a place where everyone assumed that you were smart rather than waiting for you to prove it.” UCSF also turned out to be a hotbed for science education outreach. Dolan was drawn into UCSF’s famed Science and Health Education Partnership with the San Francisco public schools as a volunteer in an after-school science club for middle school girls.

But when it came time to go on the job market in 1999, Dolan found the career prospects at small colleges daunting. “They wanted you to do everything with no resources,” she recalls. “Start a research lab with \$2,000 in start-up funds. I thought, I’ll get back to you on that.”

By a fluke, she applied for a science outreach position at the University of Arizona in Tucson. The work, touring a DNA experiment-in-a-box around schools, was a bit tedious, but highly useful, she remembers. “You teach a thing a million times—if you teach the same activity over and over—but you begin to see how students think and how they learn.” Dolan also began to wonder why students often didn’t learn. For one, they rapidly figured out that her “experiment” was not collecting real data. “Students aren’t dumb,” Dolan says. “They get it pretty quickly. They want to do something ‘real.’”

### Arabidopsis, Mon Amour

These observations led Dolan to create the Partnership for Research in Education in Plants (PREP). Working with high school science teacher Eric Brooks and plant physiologist Frans E. Tax, Dolan combined “real” research with relevance to 9th and 10th grade biology through the much-studied model plant *Arabidopsis thaliana*. For a former “worm runner” in the Bargmann lab, Dolan had not a moment’s hesitation in switching to plants for PREP. “Plants are cheap. Plants are hardy enough for student caretakers and, if you kill them, you just plant more seeds. Even bacteria and yeast require a lot of preparation and care, plus you

have to dispose of them properly and maintain a sterile environment for culturing.”

Equally important, the *Arabidopsis* genome had just been sequenced, Dolan explains. There were seeds readily available with specific genes already knocked out but with no apparent phenotype. *Arabidopsis* labs devoted their limited resources to more promising candidates, but the phenotypes of thousands of other mutants could be revealed when the plants are exposed to experimental stressors. *Arabidopsis* has about 25,000 genes and plants have to respond to thousands of environmental factors. The sheer number of experiments quickly becomes an impossibility for standard bench research. Yet, many high school students, with their own creative ideas, want opportunities to make a real contribution to the scientific community. It was also a perfect way to partner students with practicing scientists who could follow up on any student discoveries.

Originally supported by the National Science Foundation, PREP has become over the last eight years a two-way street for scientists and the more than 15,000 students who have participated, Dolan reports. “We’ve had publications where the scientist acknowledged student discoveries and grant applications where they [students] were acknowledged as the source of preliminary results.” Dolan has also documented gains in student reasoning skills and in students’ development of a scientific identity.

Dolan took PREP and her ongoing research into science partnerships with her when she left Tucson for Virginia Tech’s Fralin Life Sciences Institute, an interdisciplinary hothouse for bioscience initiatives. When Dolan arrived at the Fralin in 2002, she stood out for her outreach expertise, her research agenda, and her ability to pursue extramural funding. She moved from the Fralin to a formal “academic home” in the Biochemistry Department after winning a National Institutes of Health National Center for Research Resources Science Education Partnership Award (SEPA) in 2003. In 2009, Dolan won a second, five-year SEPA.

## Foodie in Seattle

Today Dolan, her husband, and their four-year-old daughter, Tara, live just outside Blacksburg, across the road from a cattle farm. Living outside Blacksburg is a relative term, she concedes, because it remains a very small town despite its enormous student population.

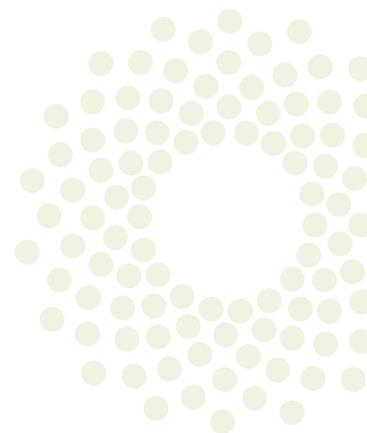
“When we want city, we leave,” she says. When they head for a city, Dolan usually has a short list of restaurants. “I’m a foodie,” she confesses. Seattle was a cradle of the foodie movement and her parents were early converts. For the upcoming ASCB Annual Meeting in Philadelphia, Dolan has a certain Cuban restaurant firmly in mind.

Back on campus in the Biochemistry Department, Dolan still stands out. Former postdoc Deborah Johnson recalls hearing Dolan speak as a vocational epiphany. Johnson was just finishing her doctoral thesis in biochemistry. “It was like, wow, I could do something else with my PhD than bench work,” Johnson recalls. “I wanted to do science education but I wanted to do

research. I didn’t even think it was possible until I heard Erin.” Then she realized that Dolan had a tenured faculty position and was looking for postdoctoral fellows to join her research group. “I didn’t know you could do that,” says Johnson. “We really hit it off. I told her, ‘I want to do what you’re doing.’”

Besides studying the PREP experience, Dolan and Johnson looked into the little understood nexus of undergraduate researchers, grad student “mentors,” and PIs. Many large institutions all but require grad students to take on undergrad mentees. Yet, in their interview study, Johnston says they discovered that no one sat down with grad students afterwards to assess the experience. When they did so, the researchers found a mixture of accomplishment, confusion, and blame. Some grad students said they had felt coerced into mentoring undergrads who were often seen as ham-handed threats to their data. (Undergrads, in turn, reported being used as all-purpose scapegoats by grad students.) For the most part, grad students reported positive outcomes of mentoring undergraduate researchers, yet Johnson reports, some came

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away disappointed, having learned little about what is a vital scientific skill: training your own trainees.

Mentoring is too important to science to be left in the dark, says Dolan. Until now, most studies of lab placements have focused on the undergraduate side. Rarely have the effects on the faculty member, the graduate, or the postdoctoral mentor been examined. Little had been known about how faculty attitudes affect the graduate trainee, leading Dolan to ask, “Does a positive mentoring environment guarantee a positive outcome for the grad student or postdoc who might resent being ‘stuck with the undergrads’? What is the impact of grad student coercion on the postdoc or the undergrad? We just don’t know.”

These fundamental questions—how students learn to reason, how trainees learn to train others—are more important to science education than how to

deliver more facts, Dolan believes. “Knowledge changes. Techniques change. Putting all this effort into cramming scientific knowledge into people before they get out of high school seems just silly. There’s way too much information out there in the world for anyone to make a decision based on it. Even in science, we don’t do that. Scientists make decisions based on the information they care about, for example, information from a trusted provider.”

Dolan is that trusted provider, says Johnson, who is taking a family leave break from research now. Her former boss understands the two disparate groups concerned with science education reform—the science researcher and the social science researcher. “Erin can talk with both and empathize with both. They are in different worlds and not many can do the crossover. No one does it quite as well as Erin,” says Johnson. ■

—John Fleischman

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