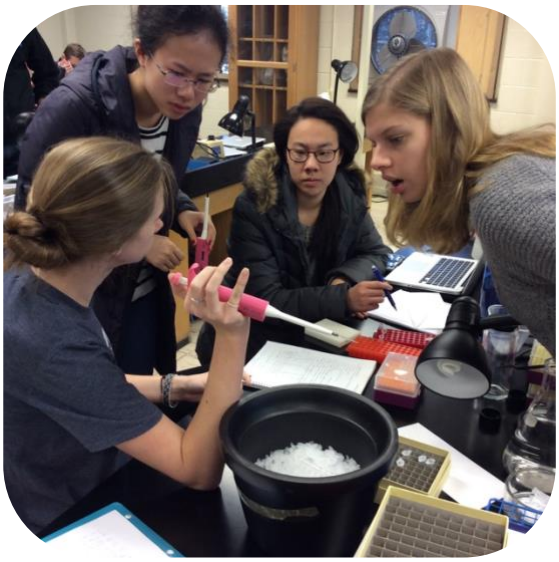
CURE: A game-changing approach to exposing students to hands-on research

Kelly A. Hogan

After a successful group presentation to our university accreditors, the chancellor asked me and several other STEM professors if we would share *when* we knew science was for us. I was surprised how easily each of us recalled a specific research project or experience. Many also spoke of a person who helped them find their science identity—a teacher or professor. The reflective question from the chancellor came at the perfect time. We were beginning a large five-year program called "Creating Scientists" and we were the program leaders. Our program would create more opportunities and pathways for students to find research experiences.

Being at an elite research institution, we offer our undergraduates cutting-edge, one-on-one research opportunities with professors. These research apprenticeships are enormous learning opportunities for students—a statement our alumni are quick to second.



Yet there are not enough research apprenticeships for all of our students. Who are the lucky students who graduate with one of these limited opportunities on their resumes?

Often unadvertised, these positions require students to have a certain amount of social capital to network with professors to learn about, apply, and interview for a coveted spot. Students who work many hours to support themselves may find themselves excluded, because these unpaid positions require extended hours in the lab. The students with the highest GPAs are often the ones selected by research professors, who have to balance their own research productivity with training undergraduates. Implicit biases creep into any selection process. Because of the soft skills needed, combined with the selection process, students often aren't pursuing research apprenticeships until their junior or senior year—even though the opportunities could have far greater impact on the student's major and career path if initiated earlier.

If our current system of bringing a few top self-selecting students into a research professor's lab limits the number and diversity of students who do research, can course-based undergraduate research experiences (CUREs) be a game-changer? By bringing research professors and their own research into classrooms, our institution is betting that we'll see the kinds of learning outcomes gained in research apprenticeships—for more students, earlier in their undergraduate careers.

A typical CURE design is one in which students spend a few weeks learning technical skills that they then use to answer novel research questions. Neither the student nor the professor know the answer to the questions. This is real science, not students following a "recipe" written in a lab manual as done by thousands of students before them. Besides answering novel questions, a CURE has four other characteristics: There are chances for students to fail and try again, students take ownership of their project, there is meaningful collaboration with peers, and the students communicate their findings outside the classroom.

Students simply enroll in a CURE course, networking not required. Because there are few to no prerequisites for many CUREs, there are likely to be many first- and second-year students in the class. Enrollment is typically about 20 students, so many more students have opportunities to participate in research with a professor through CUREs than through a traditional research lab setting. The research is part of their coursework, so students juggling jobs with classes may find this a more accessible opportunity. Because it's a course, this may be a better structured learning experience than an apprenticeship for some students: There will be a syllabus, assignments, feedback, and opportunities to work with and learn from peers.

Faculty are likely to be more passionate about teaching a CURE course than a more traditional lab course. They share in the excitement when students have their first taste of scientific discovery; they experience the rewards of teaching students to do science. Sometimes the results are fruitful enough to publish or jump-start a new project in their own lab. Thus, there can be efficiencies when the class research aligns with one's own research interests. As faculty do hands-on research with students, they learn who the "top" students are based on creativity, curiosity, and self-efficacy rather than GPA. The process creates a skilled and diverse pipeline of scientists who might continue in the faculty member's lab or who might get recommended for other high-impact opportunities.

When the chancellor asked us to reflect on when we knew science was for us, I had an "aha" moment myself. In college, I took a class in which I had a semester-long research project that allowed me to use advanced microscopy techniques and discover something my professor didn't know. This course was a turning point for me. As I was about to answer the chancellor, I immediately realized this course was when I first experienced discovery, collaboration, and even failure in science. I began my response to her with a simple statement, "I knew when I took a CURE class in college." At that moment, it confirmed for me that our program was indeed going to be a game-changer for how undergraduates access and experience research.

Kelly A. Hogan is the Assistant Dean of Instructional Innovation and QEP Director for the College of Arts & Sciences at UNC-Chapel Hill. She is also a Teaching Professor of Biology.