The Texas Institute for Discovery Education in Science (TIDES) in the College of Natural Sciences (CNS) aims to catalyze, support, and showcase innovative, evidence-based undergraduate science education. TIDES was proposed in the CNS 2013 Strategic Plan (as the Texas Center for Science Discovery) as a way to continue and enhance the college's leading role in Science, Technology, Engineering, and Mathematics (STEM) education.

**CULTURES:** How does the Texas Institute for Discovery Education in Science (TIDES) prepare young scientists for life after their studies in ways that traditional programs do not? Why is this important?

**DR. DOLAN:** TIDES has extraordinary potential to change what undergraduate STEM education looks like. One program housed under TIDES, the Freshman Research Initiative (FRI), is actually what attracted me to the position of director of TIDES. FRI is a program I have been watching for about a decade since it was launched.

The program is revolutionary because it engages freshmen, from their very first semester on campus, in doing research connected to a faculty member’s ongoing work, and they earn credit for courses that are required for their major. So, instead of, for example, doing your standard introductory biology course or your standard introductory chemistry course, you can do your research in chemistry or biology and earn that introductory laboratory credit. It is life
changing, because the students get to see what science really is, and how science is really done.

CULTURES: How do you create novel teaching methods and experimental programs like TIDES?

DR. DOLAN: We have to balance novelty with what we know is effective. As a new program, the most important thing for TIDES is figuring out what is already working. What assets are available? I spent a lot of my first six to nine months on campus answering these questions. But to make experimental programs and novel teaching methods more possible in the future, there must be a level of creativity and flexibility involved. Let me tell you, people are working really creatively, and they work with extraordinary energy and enthusiasm. Instead of saying, “No, that cannot count for introductory lab credit; introductory lab needs to address X, Y, and Z,” people said, “How can we make this count for credit? How can we integrate this into the curriculum?” Sometimes we have to use things that we already know work, and sometimes we have to innovate.

CULTURES: What impacts are you seeing from undergraduates taking an increased role in research at UT Austin, and how can this be applied to other universities and institutions?

DR. DOLAN: Data show that we are having a positive effect on graduation rate, that we are having a positive effect on the number of science majors, and that we are having a positive effect on the number of students that are graduating in general, for both science and nonscience majors.

But what is less easy to measure is the change in culture. The University of Texas is embracing an intertwining of research and teaching. As a result, students are empowered to contribute to what is happening at the university. They are not just the consumers; they are collaborators, as well. They are actively involved in the work that is happening at the university.

In broader terms, for example, we have engineering students, or students in the geosciences, which is actually a different organizational unit than where TIDES is housed, who are getting faculty to explore starting similar programs in their units. Students are feeling really empowered.

In more concrete terms, we have students who are authors of publications on a range of topics in high-profile journals. For example, alumni from our FRI program coauthored a major publication in genetics recently.
CULTURES: Your work at UT Austin focuses heavily on STEM education at the undergraduate level and beyond. To ensure that students are better prepared when they set foot on the UT campus, what are some lessons that you would like to share with educators working in K-12?

DR. DOLAN: I worked a lot in K-12 before transitioning to undergraduate science education, and I know that the kneejerk reaction is to think of K-12 and university relations as a one-way street, with K-12 learning from what higher education has to offer. We are really viewing this as a two-way conversation; we can learn just as much from our K-12 partners as they can learn from us. We already have some avenues through which we are engaging K-12 students and teachers. For example, the UTeach program in our College of Natural Sciences prepares STEM majors to be secondary STEM teachers, and supports them when they go into the field. We also reach out to high school students to engage them in research, because that is where I think our strength lies and something unique we can offer to K-12 schools. It is important to think of it as a collaborative relationship that enables us to build off each other's strengths.

CULTURES: Are there any specific techniques and teaching methods that you would like to see incorporated in all levels of education across the United States?

DR. DOLAN: I gave up looking for that silver bullet a few years ago. There are a range of approaches that need to be used because we have a range of learners; learners come from different backgrounds, capabilities, experience, and interests. And we have a range of people who teach. What might work for one instructor, might not work for another. Everyone brings their own unique experiences to the table, and that needs to be considered. One thing that we need to emphasize is Carol Dweck's "growth mindset," which says that everyone can get better with practice and feedback – and that includes students and instructors, whether it is students learning science or instructors changing their teaching.
CULTURES: In 2012 the Program for International Student Assessment (PISA) reported that several Asian countries dominate the top three and top six scores in science and mathematics testing. This has been known in the U.S. for a long time, and it is something that we have tried to compete with. What approaches do you think that these countries, specifically China, are taking that are placing them at the forefront of STEM education, and what can we learn from what they are doing?

DR. DOLAN: That is a tough question. To me, it is not about teaching approaches – it is about culture. The countries that are really at the top of the PISAs, or just STEM scores, place emphasis on academics and education. Culturally, education and teaching are highly valued by those communities. Being a principal, being a teacher, or being a professor is a highly valued position in those societies. It is also considered important that students spend time doing their schoolwork, and I think that that value is rare in the other parts of the world. I do not think there is an easy answer of how to replicate that elsewhere; I think it is a cultural issue that we are going to have to grapple with.

CULTURES: What advice would you give young students looking to pursue a career in science?

“THAT IS WHAT SCIENCE IS: BEING CURIOUS AND ASKING GOOD QUESTIONS. SO, I ALWAYS ENCOURAGE STUDENTS AT ALL LEVELS – PEOPLE AT ALL LEVELS – TO JUST BE CURIOUS AND ASK GOOD QUESTIONS.”

– ERIN DOLAN, PH.D.
DR. DOLAN: Again, there is no one silver bullet, but I recall a Nobel Laureate, Isidor Isaac Rabi, who discovered nuclear magnetic resonance, and he explains the reason he became a scientist was because his mother would not ask him when he got home from school, “What did you learn in school today?” She would ask him “Did you ask any good questions?” And I would say that that is what science is: being curious and asking good questions. So, I always encourage students at all levels – people at all levels – to just be curious and ask good questions. ■