

## Fresh Starts in Science

STEM EDUCATION, ACADEMICS, RESEARCH, FEATURE, STUDENT STORIES

By Steve Franklin. Photos by Marsha Miller.



A student's hand hovers over a computer, skewing left, then right, then forward, constantly in motion. A few feet away a robotic flying machine called a quadcopter mimics the motions of his hand. A crowd of students stares in rapt attention as, with deft flicks of his wrist, sophomore Robert Lynch guides the craft through a hoop held by his partner-in-programming Matt Broussard.

The students are good at showing off programming skills they developed during their time in the Freshman Research Initiative (FRI), a unique approach to science education created at The University of Texas at Austin and now the nation's largest initiative of its kind. In FRI, students like Broussard, Lynch and thousands of others throughout the College of Natural Sciences emerge from their first year of college with captivating real-world experience.

"Research is where discovery begins, and it is also the basis of our educational mission," declared UT Austin President Greg Fenves in his inaugural State of the University address. He held up the Freshman Research Initiative as an example of the university's "major leaps in undergraduate education."

The evolution of the FRI has occurred against a backdrop of uncertainty for students in science, technology, engineering and mathematics (STEM) fields in the U.S. The President's Council of Advisors on Science and Technology released a report in 2012 that found 60 percent of undergraduates who begin college in a STEM field do not finish with a STEM degree. The loss increases to 80 percent for students in underrepresented minority groups, according to the Howard Hughes Medical Institute.

FRI participants are more likely to graduate with a STEM degree.

Students get their hands on developing apps, exploring biofuels, studying nanomaterials, and much more.

Most students lose interest in or become overwhelmed or alienated by science studies in their first two years of college, when taking introductory science courses. According to the President's Council report, students often switch majors because they find these early courses to be uninteresting, unwelcoming or indecipherable.

Enter the Freshman Research Initiative.

## A Decade of Results

The FRI began ten years ago with a pilot class of 43 students working on faculty-led research projects soon after the students arrived on campus. FRI has grown into the nation's largest research program for first-year students, immersing hundreds each year in cutting-edge scientific discovery. Today, roughly 900 first-year and transfer students participate in the program. Half are women and half come from economically disadvantaged backgrounds, are first in their families to go to college or have racial or ethnic backgrounds that are underrepresented in the sciences.

The program's results are impressive and have won it many fans. Over the last decade, the Howard Hughes Medical Institute alone has invested more than \$4 million to support FRI at UT Austin and given millions more to replicate the program at other universities because of its strong outcomes. Compared to their peers, FRI students are significantly more likely to graduate in four years and graduate with a degree in math or science. Their cumulative GPAs at graduation are higher, and they are much more likely to pursue an advanced degree.

The FRI accomplishes these results by making early-college science real and engaging. Students actually conduct research and experience the victories and failures common to scientific experimentation, but in a safe environment, all while earning course credit for participating in research.



FRI students have helped author more than 140 papers in peer-reviewed scientific publications.

"FRI allows students who really want to do research to do research from their very first days on campus, and it allows students who don't know if they want to do research to try it out," says Andy Ellington, a professor of molecular biosciences. Ellington helped start the program and is a faculty lead on three FRI research projects, which are called "streams."

Students begin the three-semester program in the fall learning what scientific inquiry is about. In a special course, they study how to design experiments, use scientific literature and carry out basic research techniques. They design and conduct their own experiments and build and evaluate scientific arguments about their results.

take in a brand new student who's never done anything is really rough, and the FRI is a way of getting them inoculated," says Nancy Moran, a professor of integrative biology who leads a new research stream, *Microorganisms in Bees and Other Insects*.

"It gets around this problem that in a research lab, to

The first semester is also when participating labs hold open houses where students can learn about the options for them to do research. Students apply to their top five choices among 28 different research streams, where they can not only learn to program robotics like the quadcopter or investigate big problems like bee health but they can search for new antibiotics, create nanomaterials, study white dwarf stars and more.

50% of FRI participants are women.

50% come from underrepresented groups or low-income households.

Students begin their research stream their second semester. At first they learn necessary techniques and lab protocols unique to their subject of research, while lectures, discussions and readings help them get up to speed on the background and importance of their research area.

### The Real Fun Begins

Next, students assist faculty with research and devise unique research projects to pursue, while being mentored by their faculty member and their research educator, often a postdoctoral researcher or graduate student within the lab. Just like the senior scientists, the new undergraduates conduct original research and seek answers to questions science has not yet answered.

In some cases, students even get published in peer-reviewed scientific journals. More than 140 papers authored in whole or part by FRI students have been published. This includes a high-profile paper in late 2014 that FRI students coauthored for a top journal, *Nature Genetics*. FRI alumna Lee Elam helped write that paper and now attends medical school at The University of Texas Medical Branch at Galveston.

"I ended up really liking research a lot more than I thought I would, so I wanted to do something where I could continue doing research," she says. "The work got me a lot more interested in genetics because I got hands-on experience with it."

In the final semester students continue their research, often with greater independence and responsibility. Many have gotten a head start during the summer, either as volunteers or on a fellowship.

Students bring a lot of creativity to the labs in which they work, often expanding the scope of research by pursuing avenues that lab leaders had not considered before.



"I'm looking forward to this year seeing what the students come up with," Moran says. "Having all these young minds coming up with new things or new ways of looking at things can be interesting."



### Life Beyond FRI

At the end of the program, students can continue in the world of research. They can join a lab as a student researcher, participate in summer research programs around the country or intern abroad or in the industry. Sometimes they continue with their original research stream as peer mentors, helping guide new first-year students.

Participation in early-college research has been linked to:

- increased analytical skills
- increased technical skills
- improved student confidence

"FRI granted me the opportunity to not only cultivate research skills, but to learn to be self-motivated and learn to mentor others," says Adriana Carillo, a former peer mentor who is now an analyst for the UT Southwestern Medical Center at Dallas. "FRI allowed me to develop analytical skills. Asking 'Why?' is a big part of being an analyst in the healthcare field. Had I not participated in the FRI, I would not have come to recognize one of my strongest skills and would have perhaps ended up on a different career path."

Simon Hiebert, another alumnus of the program, realized that, although doing bench science was not for him, the FRI could still be a source for inspiration. Hiebert created a company called CottonGen to license modified crop plants developed in the lab of Stanley Roux, a molecular biosciences professor. Heibert, who first conducted research in that lab as an FRI student, hopes that these transgenic plants will use resources more efficiently while producing higher yields.

"FRI is the cornerstone of this project and my current vocation," Hiebert says. "I'd say that's a pretty big impact."

The FRI reach goes beyond the more than 6,000 students who have participated the past ten years, extending also to faculty and the research mission of the College.

"This is a Texas-grown institution that has begun to have national impact, and I don't think people understand just how good it is," Ellington explains. "Texans should be proud of what they have and should continue to try and foster it wherever possible. I think that it's a gem at UT, both for education and for research."

To see FRI streams in action, [check out our FRI video series.](#)



PREVIOUS

**The Graduate Student: Brenden Herrera**

NEXT

**The Alumna: Hayley Gillespie, PhD, 2011**

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