SUMMER MEANS RESEARCH

URP student Chris Witzigman in the Tookany Creek investigating storm water runoff.
One morning this past July, Chris Witzigman was clad in chest-high waders, stringing a tape measure across the thigh-high Tookany Creek just south of Jenkintown, Pa. in order to accurately position a small mirror mounted atop a pole. Standing nearby on a low gravel bank, graduate student Emily Arnold was aiming a "total station," a laser-powered surveying tool, at that mirror to measure how much erosion had altered the streambed during the past month.

As summer jobs go, Witzigman—an avid fisherman and environmental sciences major—was in his element. Credit the College of Science and Technology’s innovative Undergraduate Research Program (URP), which gives undergraduates the opportunity to conduct real-world research under the guidance of CST and other Temple faculty members.

Meanwhile, about 30 yards downstream, computer science major Mark Dolan was wading through the creek with Laura Toran, the Albert W. and Alice M. Weeks Chair in Environmental Geology. She was explaining the urban stream research her group is conducting as part of a five-year, $1.2 million grant the William Penn Foundation awarded to Temple’s Center for Sustainable Communities. Toran and several other Temple professors are working with various watershed organizations to determine how to best manage storm water runoff, silt and contaminants in the Upstream Suburban Philadelphia Cluster—five degraded Delaware Valley creeks that need restoration.

The previous summer Dolan, an ex-Marine from Denver, had been troubleshooting balky computers for university faculty and staff members. Now he was spending most of his time working with both Toran and Justin Shi, associate professor of computer science. He was developing and refining ScienceTap, a hybrid program/mobile app that both researchers and watershed association volunteers can use streamside to upload data and photographs and access information.

Dolan had been meeting weekly with Toran’s research team, but this was the first time he visited them in the field.

“Do you measure the vegetation?” Dolan asked Toran.

“Yes,” she said. “If you are ready for that, we can create a form for you to add to the app.”

“The hardest part of programming is figuring out whether what you’re doing is easy and intuitive for people to use,” he told her. “That’s why it’s so great to be out here. I can see that if it’s too complicated, people aren’t going to be using it in the middle of the stream.”

Dolan and Witzigman are just two of 55 CST undergraduates who spent this past summer conducting research with faculty members as part of URP. CST launched the program in 2009 to enable undergraduates to obtain valuable hands-on research experience. Since then, 750 CST students have spent two sessions—typically one summer and one fall or spring semester—participating in the highly selective program. They get an up-close view of the research process by working with world-class researchers at either the Main Campus or the Health Sciences Center. They develop an independent research project and then present their findings within their department and at the URP Research Symposium. They may also attend and present their work at scientific conferences and sometimes even author peer-reviewed papers.

“I really like poster presentations,” says Toran, one of 145 Temple faculty members who have mentored undergraduates during the past six years. “It’s their own work and, because they have actually collected the data, they feel a lot more involved with it. Whether they go on to grad school or get a job, URP makes them better scientists and life-long learners.”

Unlike a lot of internships, they also get paid. During the summer, URP students can earn a stipend of up to $4,000. Funded by CST, URP covers half of those costs and the sponsoring faculty members cover the other half out of their own research budgets. That allowed Zack Hauseman (BS ’14, Biochem) who is now in a chemical biology doctoral program at Harvard, to quit a fast-food job and concentrate on research the summer between his sophomore and junior years.

“It allows students who need to earn money over the summer to develop skills in their field rather than just working in retail,” says Rose McGinnis, CST’s director of student professional development and URP.

Conducting independent research is critical for students interested in pursuing graduate education. Participants have parlayed URP experience into graduate programs at Harvard, Stanford and Yale universities and Johns Hopkins Medical School.

“To get into a top-tier research institution, it’s more and more important to conduct undergraduate research,” says Sean McWilliams (BS ’13, Chem), now in the third year of a chemistry PhD program at Yale where he is investigating nitrogen activation.
In URP, McWilliams researched catalysts for converting water into hydrogen, a potential fuel, with Michael Zdilla, Robert L. Smith Early Career Professor in Chemistry. Then, like many URP students, he continued working with his URP mentor even after his two-semester URP term ended. "Working with Dr. Zdilla was a major factor in my going to Yale," says McWilliams. "I wouldn't have started doing research without URP and I don't think I would have gotten into graduate school if I hadn't done research on bacterial biofilms," agrees Hauseman, the Harvard doctoral student who leveraged his URP experience into a subsequent internship with Teva, the generic drug giant.

"Most graduate school programs expect a significant amount of research from undergrads before they apply, so it is important to start early."

Such URP experiences, says McGinnis, are analogous to corporate internships that are essential for business majors to be competitive in their job markets. They learn valuable soft skills, such as interpersonal communications and working as a team, that are necessary for success.

"They have the opportunity to take what they learn in the classroom," she says, "and wrap it around a real project that could have impact."

URP also broadens students' awareness of multiple career pathways. "Sometimes students are told, 'You're good at science, you should be a doctor,'" says McGinnis. "No one has told them 'You're curious and have a scientific thought process. Have you thought about being a researcher?'"

For example, Mateusz Dobrowolski (BS'12, Biochem) was a part-time pharmacy technician on a pre-pharmacy track until his URP experience led to three years in the lab of Karen Palter, associate professor of biology, a biochemistry degree; and a current position as a neuroscience doctoral candidate at Johns Hopkins University.

"If it hadn't been for URP, I'd probably be finishing my pharmacy degree right now. It changed my life," says Dobrowolski, whose research involved studying the metabolism of fruit flies that exhibited early indications of diabetes. "Dr. Palter spent a lot of time talking with students about science and career goals."

Carrie Carson (BS'14, Biochem) worked with Professor of Chemistry William Wuest on compounds that inhibit oral plaque formation that Wuest's lab was synthesizing together with Yale researchers. Then she delved into related biological studies Wuest's lab was conducting in collaboration with Temple's School of Medicine.

"You experience a lot of failure in research," says Carson, who leveraged her URP research into a medicinal chemistry internship at GlaxoSmithKline and then into her current job as a research scientist with C3 Jian, a clinical-stage biotech company in Marina Del Ray, California that develops oral plaque solutions. "Research involves being persistent and working with other people because a lot of collaboration is involved."

WORKING INDEPENDENTLY AND IN TEAMS

URP student Garett Miller, a senior physics major and computer science minor from Lititz, Pennsylvania, was uncertain whether he wanted to go to graduate school and, if he did, was not sure if he wanted to go into astrophysics or biophysics—until he began working with Vincent Voelz, assistant professor of chemistry. He focused on protein folding, a process integral to such mental illnesses as Alzheimer's and mad-cow disease. In nature, such proteins fold in a microsecond, but to simulate that process it was taking Miller 240 hours' worth of time on the university's high-performance supercomputer network.

"There was always a question about continuing my education, but this summer was pretty successful so I feel secure about going to grad school for biophysics," he says. "When you're doing a lab assignment for class, you don't really have any attachment to it."
But in this lab what I am doing has direct implications for people who have those diseases, at least that’s the goal.”

Sam Nguyen, a junior biology major who recently declared a computer science minor, envisions a career for himself in bioinformatics, which involves crunching large amounts of biological data. For his URP project, Nguyen worked with Associate Professor Erik Cordes who was analyzing tracts of repeating DNA in deep-sea corals, and Assistant Professor Rob Kulathinal, gauging the usefulness of online tools to enhance the teaching of genomics.

“In my courses you have books, handouts and lectures with the professors presenting the information,” says Nguyen. “But in URP I need to go out, find it, and figure out things independently.”

Senior Hansen Pei, a native of Changsha, China, first came to Temple as an exchange student, but a year ago the math major transferred to Temple. He hopes to enter a doctoral program in the United States following his graduation next May. This past spring he worked with Yury Grabovsky, professor of mathematics. He is using mathematics to investigate the elastic properties of composite materials.

“What I am learning in my classes is all theoretical, like the structure of algebra and how to do computations,” says Pei. “But what I am doing in the lab is applying those concepts to a particular problem.” In the process, he says, his mathematical skills and speed have improved, as have his English and team skills.

After she graduates in December, chemistry/pre-pharmacy track major Taylor Lentz SUSpects her URP experience, although not drug related, will enhance her chances of being accepted into pharmacy school. Lentz, who next year will continue to work in Professor Zdilla’s lab, is researching the inorganic synthesis of alternative fuels by introducing carbon dioxide to ligand-bound cobalt metal complexes.

“It’s been great,” she says. “After a week of training I felt like I was able to revamp the research procedure on my own.”

PREPARING FOR SUCCESSFUL CAREERS

In addition to prestigious graduate schools, URP experience has led to good jobs as well. Kay Yi Li (BS ’14, Bio) began working in the clinical blood transfusion research laboratory of Yanhua Li, assistant professor of pathology and laboratory medicine at Temple’s School of Medicine.

Li went onto work at the Chinese Institute of Blood Transfusion in China. She was the English editor of the institute’s journal, collaborated with Chinese and international blood bank professionals on the translation of transfusion guidelines and wrote a paper on blood screening programs in China. Says Li, who recently entered the Cooper Medical School of Rowan University: “The knowledge and experience I gained from URP were essential for understanding blood transfusion practices in China.”

Andrea Watters (BS ’13, Neuro) tells a similar tale. Her URP experience and subsequent research with Servio Ramirez, a Temple associate professor of pathology and laboratory medicine, led first to a research internship with the U.S. Department of Agriculture and to her current position investigating targeted therapies for melanoma metastasis in the brain at Philadelphia’s renowned Wistar Institute.

It also led to the publication, this past June, of a cover article in the journal Stem Cells and Development regarding the role that tight-junction proteins play in the self-renewal of stem cells in the brain. The article’s authors included Ramirez, a dozen other Temple researchers and Watters—the lead author of her first published paper, which was based on research she started in URP.

Says the Glenside, Pennsylvania native who is contemplating pursuing either a PhD or MD degree, “URP was a complete career changer for me.”

—Bruce E. Beans