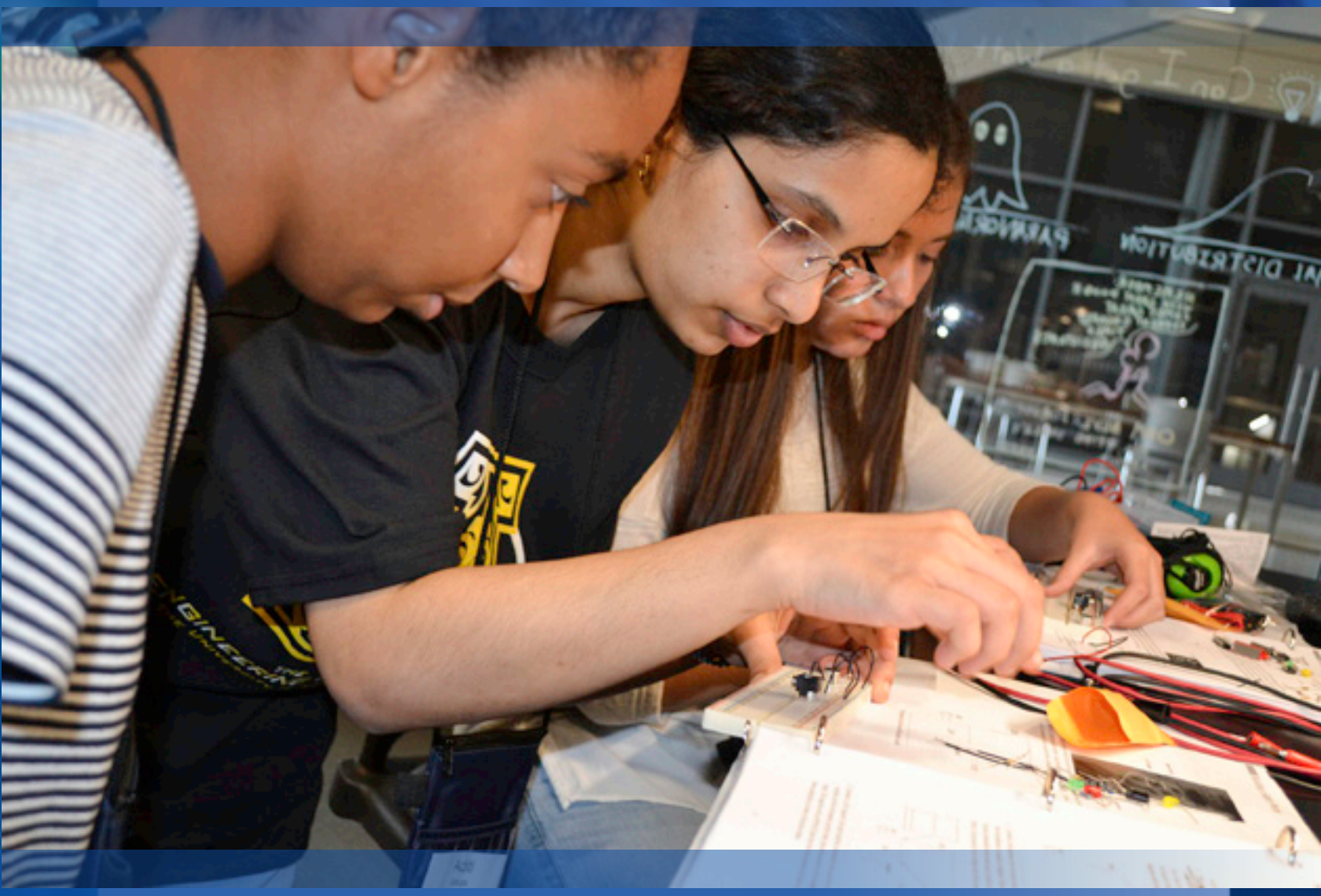
I-STEM EDUCATION INITIATIVE

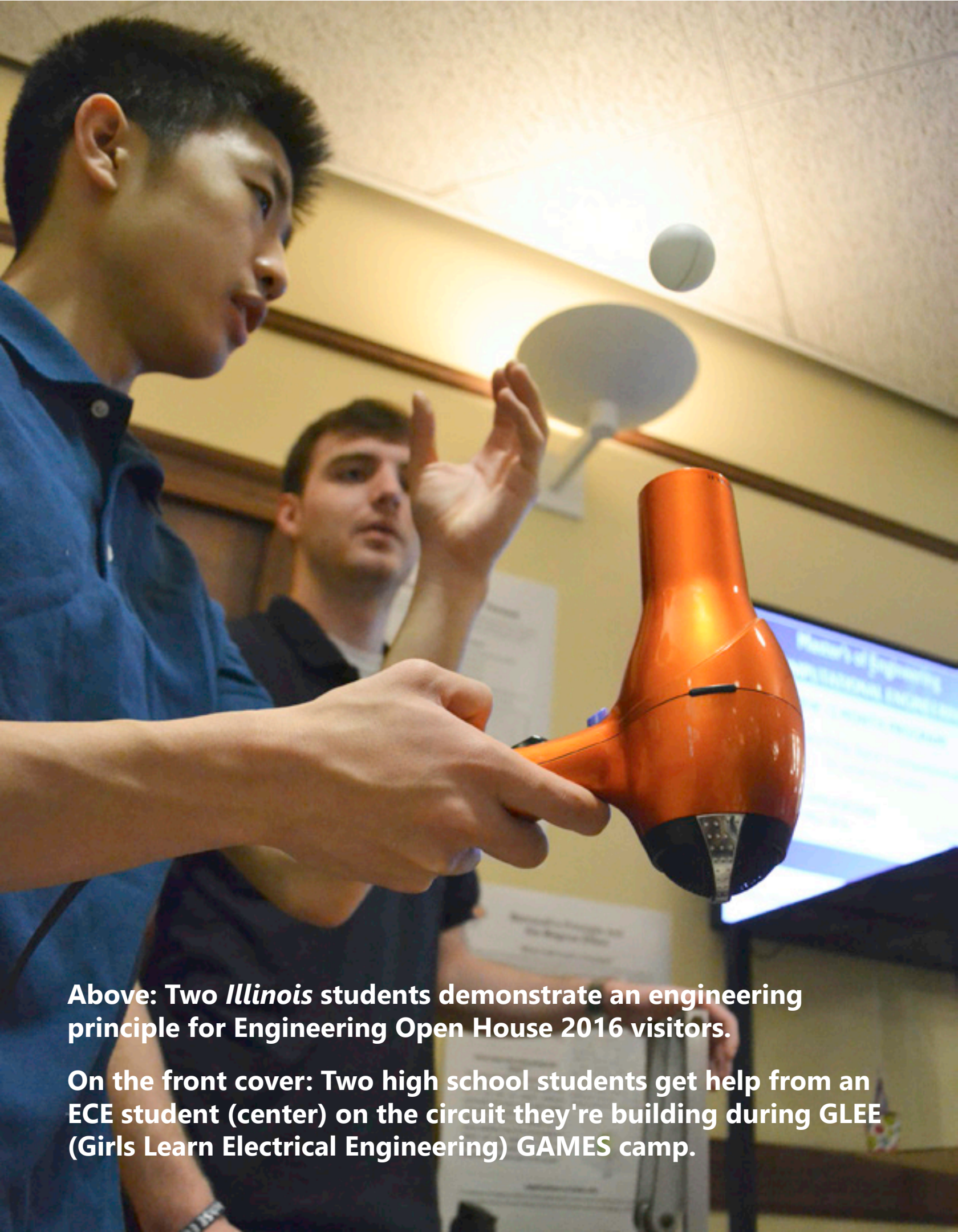
Science, Technology, Engineering, and Mathematics Education | University of Illinois at Urbana-Champaign

STEM EDUCATION AT ILLINOIS IN 2016



ILLINOIS

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Above: Two *Illinois* students demonstrate an engineering principle for Engineering Open House 2016 visitors.

On the front cover: Two high school students get help from an ECE student (center) on the circuit they're building during GLEE (Girls Learn Electrical Engineering) GAMES camp.

A SAMPLING OF ILLINOIS STEM EDUCATION OUTREACH PROGRAMS*

- Akono's Structural Mechanics Workshop: http://cee.illinois.edu/directory/profile/aakono
- ASME–American Society of Mechanical Engineers: http://asme.mechse.illinois.edu/
- AWM–Association of Women in Math: http://www.math.illinois.edu/awm/
- Bahl Research Group: http://bahl.mechse.illinois.edu/
- BMES–Biomedical Engineering Group: http://bmes.ec.illinois.edu/
- Blue Waters Graduate Fellowship Program: https://bluewaters.ncsa.illinois.edu/fellowships
- Blue Waters Internship Program: https://bluewaters.ncsa.illinois.edu/internships
- Brady STEM Academy: http://chbe.illinois.edu/outreach/brady-stem-academy
- Bruce Fouke Research Group: https://www.geology.illinois.edu/people/fouke/
- Bugscope: http://bugscope.beckman.uiuc.edu/
- CADENS: http://avl.ncsa.illinois.edu/category/cadens
- Cena & Ciencias (SACNAS): http://publish.illinois.edu/cenayciencias/
- Chic Tech: http://cs.illinois.edu/outreach-diversity/camps/chictech
- Engineering Open House (EOH): http://eoh.ec.illinois.edu/
- GAMES (Girls' Adventures in Mathematics, Engineering, & Science) Camps http://publish.illinois.edu/womeninengineering/?page_id=297
- Graduate College Educational Equity Programs: http://www.grad.illinois.edu/eep/diversity
  - SROP (Summer Research Opportunities Program); URAP (Undergraduate Research Apprenticeship Program); ASPIRE; SPI
- ICANEXSEL: Illinois-ChiS&E Alliance for Nurturing Excellence in STEM Education Leadership; email: info@chiprep.org
- Illinois Geometry Lab; email: igl@math.uiuc.edu
- iRobotics: robotics student group; email: irobotics.illinois@gmail.com
- Mechanical Science and Engineering Education Outreach (Joe Muskin: Education Coordinator: jmuskin@illinois.edu)
- NanoSTRuCT: http://nano.illinois.edu/education/index.html
- NutrImpact: http://publish.illinois.edu/nutrimpact/; email: nutrimpact@gmail.com
- Physics Van: physvan@physics.illinois.edu
- Pi Tau Sigma; url: http://pitausigma.mechse.illinois.edu/; email: ptsillinoisalpha@gmail.com
- RDLE Mentor-Matching Engine: http://www.istcoalition.org/mentor-matching-engine
- REACT: http://www.chemistry.illinois.edu/outreach/react/index.html; email: thereactprogram@gmail.com
- Research Experiences for Undergraduates (REU)
  - BioEngineering REU: http://nano.illinois.edu/REU-Bioimaging/
  - Chemistry REU: http://www.chemistry.illinois.edu/reu/
  - nano@Illinois REU: http://nano.illinois.edu/education/nanoreu.html
- Rheology Zoo: http://ewoldt.mechanical.illinois.edu/index.html
- SACNAS (Society for Advancement of Hispanics/Chicanos and Native Americans in Science); email: uiuc.sacnas@gmail.com
- SWE (Society of Women Engineers, Illinois chapter): http://societyofwomenengineers.illinois.edu/outreach/
- Urbana High School Project (ALEKS, Math)
- WYSE (World-wide Youth in Science and Engineering) camps: https://wyse.engineering.illinois.edu/
- XSEDE Scholars Program: https://www.xsede.org/xsede-scholars-program
- XSEDE Student Champions Program: https://www.xsede.org/web/guest/student-champions

*For a more complete listing of *Illinois* STEM Education outreach programs, see: http://www.istem.illinois.edu/resources/stem-ed-outreach.html

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*Stories and photographs in this magazine were by Elizabeth Innes, I-STEM's communication specialist, unless noted otherwise.

FOSTERING CITIZENSHIP THROUGH STEM EDUCATION INITIATIVES

In this second issue of the I-STEM Magazine, you will find more than fifty instances where cutting-edge research innovations in our campus successfully transferred to STEM Education initiatives. Each story highlights new learning perspectives and instructional contexts of what traditionally has been perceived as disengaged research. Each story exemplifies that STEM Education is not only about a particular discovery or technology, but also about the educative value and the social good of scientific innovations and research. Whether or not students pursue careers in science, technology, engineering, and/or mathematics they will be consumers of information on STEM issues that will directly affect their lives. An informed citizen should have the ability to apply critical-thinking skills needed to understand complex STEM-related issues, to develop his or her own views, and to act accordingly.

At *Illinois*, concentrating their efforts to improve STEM education, faculty and students do not only prepare for the future STEM workforce, but also endeavor to respond to the interests and values of all legitimate stakeholders, in particular those traditionally not heard in the STEM education context. The stories in the 2016 I-STEM Magazine illustrate how technology inventions, scientific discoveries, engineering applications, or mathematical models cannot happen in a homogenously expressed environment. To maintain the vitality of STEM creativity, it is essential that we be well-informed and active citizens, safeguarding the diversity of perspectives and thinking in classrooms, laboratories, and workspaces.

We are thankful to our faculty and students and recognize their diverse, campus-wide STEM communities and hope they will continue making an impact in 2017!

Luisa-Maria Rosu

Interim Director, I-STEM Education Initiative

Environmental Engineering and Sustainability GAMES camper (left) uses an instrument to make a measurement during an activity at Boneyard Creek.

INTERDISCIPLINARY STEM EDUCATION OUTREACH

A Uni High student (right) engages with a Clark-Lindsey resident as he tries out the device she designed.

DENOS' UNI HIGH ENGINEERING CLASS DESIGNS ASSISTIVE DEVICES FOR SENIOR CITIZENS

March 14, 2016

Engineering is about more than just designing things; it's about making a difference in people's lives. This is one key principle Uni High Engineering teacher Sharlene Denos tries to instill in her students. So she's always on the lookout for projects her class can do to give back to the community. Like the air maze they designed and built for the Orpheum in 2014. But they haven't forgotten the older folks. Denos and company spent time in 2015 designing some devices that provide accessibility for senior citizens. Then in January of 2016, they presented their designs to stakeholders at Clark-Lindsey Retirement Village in Urbana, who vetted the designs and contributed constructive input on how they might be improved.

The students at Uni High (University Laboratory High School) say they learned a great deal through the project. For instance, Lina Flores, a senior, who designed a step to assist seniors when getting into a car, reports: "I definitely learned teamwork and sort of understanding the needs of others. This taught me a lot about how to really appreciate what I have. It was fun. I learned a lot about CAD (computer-aided design) programming, so that was really fun. It was a great experience."

Uni High students demonstrate the device they designed to help seniors remove the caps of their prescription bottles.

Another student, Iulianna Taritsa, reports learning a lot about consumer-aided design—creating a product useful for a certain group of people.

"It's easy to get caught up in a design idea," she admits. "But returning back to the people you are designing for is so important. The Engineering Explorations class had us bring our prototypes to the Clark-Lindsey residents, show them to U of I engineering students, and even test them on our parents. So being able to test our design and optimize it for other people to use was something we really learned how to do in this class."

Taritsa indicates that when designing their project—an electronic pitcher that would give an audio cue after the user had poured out a predetermined measurement (i.e., 1/4 of a cup, 1/2 cup, etc.)—she and her partner encountered some challenges along the way, mostly technological.

For instance, they had hoped to provide cups that change colors with their pitcher, to give a better contrast line to see the liquid through the cup, but couldn't find a dye that changed fast enough. They had also wanted the pitcher to click and provide resistance depending on the angle being poured, but couldn't find a simple mechanism to do this.

They also ran into a few challenges related to the use of Arduino, an open-source, programmable microcontroller used for building electronics projects, to program their pitcher.

"It was the first time my partner and I were using Arduino; however, in each of these cases, our project either went through a design change to adapt to the obstacles, or we learned how to deal with the issue by spending time researching and learning about it."

Did Taritsa find the project rewarding? So much so that they even kept working once the semester ended."Not only did we work on this pitcher for all of the fall semester, but we also continued working after winter break and

into January to get our design ready to present at Clark-Lindsey. I know my goal for the engineering class was to have a working prototype by the end."

Even more rewarding? The first time their pitcher worked. "I distinctly remember the moment our design worked. We poured a glass of water with the pitcher, and it successfully measured the amount accurately and audibly. After that, my partner and I were full of high-fives and celebratory cheers. Seeing the project finally come together was a great experience; it made all the work to get there definitely worth it."

Another Uni student, Elizabeth Geistlinger, reported that coming up with a project was difficult. "We had to work to find something that would actually be useful to the residents," she explains, "but still be able accomplish in one semester, and by high school students."

A Uni High student (left) demonstrates to a Clark-Lindsey senior the electronic pitcher her team designed.

She describes some of the challenges her team, which had a common interest in hearing loss, encountered while coming up with a project. "There is so much research out there, and so many products to assist with hearing loss, that we had to talk to some of the residents that had hearing problems to understand what they wanted to change. It ended up not being us helping with a hearing loss issue, but an issue that arose from their hearing aids."

Like Taritsa's group, hers also encountered technology issues: "We also were trying to 3D print a model of our product, but the way it was designed, the printer had issues printing it."

Geistlinger learned a bit about leadership too. "I also learned even more how to be the team leader. I was the only girl in my group, and 99% of the time, I was the one in charge. I learned that telling people to actually work isn't being mean."

She also learned that age doesn't really matter in regards to helping someone. "I learned that a bunch of high school kids who want to help people, can do so much more than I thought. Some of the things we made were actually useful, and the residents liked the ideas."

Like Taritsa, Geistlinger also found their project to be very rewarding. "It was cool to be able to work directly with the Clark-Lindsey residents and figure out what they needed, and how we can help. At the end of my presentation, I got to talk with a resident who was curious about our project and show him how it works. I think that direct contact with the residents is really what made this project worth it."

Not only the students found this cross-generational collaboration to be rewarding. According to Laura Beyer, the Public Relations Coordinator at Clark-Lindsey, her clientele were delighted to help out, for a number of reasons:"Our residents love interacting with students—any young people," she admits. "That brightens their day. They love helping others learn. Over 60% of our residents have

Two Uni High students present the step they designed to assist seniors entering an automobile.

their Masters or PhD, so they are very passionate about education and helping the youth strive to that level as well."

The fact that the projects might be of some benefit to them personally added to her patrons' incentive:

"Seeing what innovative ideas that these students come up with not only inspires our residents that there's hope for the future in whatever area that they're looking at; it does benefit the aging services as a whole."

Beyer also indicates that her clientele were excited to have a part in possibly shaping some future engineers: "Whatever these students may go on to do in their futures, whether they become inventors or engineers and are creating these things for real, not just the prototype or the idea but putting it into fruition and making changes in the world."

The Uni High-Clark-Linsey partnership began in spring of 2015, when Denos' class competed in CU Make-a-Thon. During this 28-hour community event, teams worked together to build physical prototypes and mock-ups centered on the theme, accessibility for older adults. Participants had been tasked with designing and building an assistive device or improving an existing one that could help senior citizens perform normal, everyday activities by making it more accessible for older adults to use. Clark Lindsey, which had sponsored the event, brought residents to be advisors and judges.

Beyer reports that she and Denos met at the Make-a-Thon and realized that a collaboration could be a win-win for both age groups.

"She is teaching an engineering event where they look at a specific population and think about how they can improve their lives to talk about the humanistic side of engineering," says Beyer. "Since her students, who had come to the Make-a-Thon (which was focusing on older adults), had an interest in this population, we thought we could do a project at Clark Lindsey for her engineering class."

While the prototypes they designed for the Make-a-Thon had to be finished and presented for the event, the prototypes students revealed at the January 8th presentation at Clark-Lindsey were brand new projects that they had come up with, based on discussions with the Clark-Lindsey seniors, then worked on for the entire fall 2015 semester.

(Foreground): Two Clark-Lindsey residents appreciate Uni High students' presentation of the device they designed.

An NGS student presents his research project to a local expert.

2016 NGS SCIENCE & ENGINEERING FAIR FOSTERS RESEARCH/PRESENTING TO EXPERTS

March 24, 2016

February 19th, 2016 was probably circled in red on the calendars of many Next Generation School students (and most likely their parents' calendars, too). After weeks spent choosing a project, learning about their subject in depth, designing and conducting a research project, then making a poster, the day of the school's Science and Engineering Fair had finally arrived. Projects completed, students were excited to finally get to present their research—first, to a local expert, who gave them positive (and possibly negative) feedback—then to mom and dad during the evening session for the public.

As in past years, no one student or team was declared the winner—all the students were winners. They'd learned about the scientific method, gained in-depth knowledge about the subject matter of their project, plus acquired some useful skills about how to do and present research. The students also gained some other real-life skills that will be useful no matter what field they go into. For one, as in past years, the school invited community experts, many from *Illinois*, to help judge the projects, so students got an expert's assessment of their project. So they were put into a situation where they learned to think on their feet as they explained their work to someone they don't know.

Both Next Generation School staff, as well as the community experts, consider the benefits the students reap well worth everyone's time and effort. For instance, Head of the School Chris Bronowski says seeing her students' excitement and watching them grow through the process was well worth the work involved.

"Watching what the students do and watching them push themselves," acknowledges Bronowski, "it makes all of the preparation, all of the work that goes into it, every minute of it, worth it."

Bronowski, whose daughter is in kindergarten this year, got to personally experience first-hand the excitement the Fair generates in students.

"This morning, she was beside herself because they were going to have an expert coming to their room, and they were going to get to talk about their project," She says. "Seeing that inspiration in her and that excitement, that's why we do it."

On the flipside of that, in addition to engendering excitement, she and her staff also hope to stir up some more negative feelings—like trepidation—so the students learn to overcome those.

"There were a lot of nervous kiddos coming in this morning, and that's good," she admits. "That's good to put them in situations where they are nervous, and then they come together with these people who are wonderful, and they do it, and they see 'Okay, well that wasn't so bad!' and then the next time they do it, they're not as nervous as the time before."

An NGS student presents her research project to an *Illinois* researcher.

In fact, the idea is that students should present to a total stranger. In the past, they have discouraged the recruitment of parents whose kids attend NGS to serve as judges, "because we really do want it to be someone whom the children are not familiar with," says Bronowski. However, some last-minute cancellations this year forced them to call on parents who were STEM experts to serve as judges. However, parents were cautioned during the orientation to not judge the project of their child, or children they know.

"Because we do want it to be a somewhat uncomfortable situation where they're talking with someone that they don't know," says Bronowski.

Illinois Division of Nutritional Sciences graduate student Lauren Killian interacts with an NGS student about her project.

students experiencing? The disappointment of failure. "They need to blow it sometimes," adds Bronowski, "so that they see, 'Okay, I can pick up the pieces and move on, and life doesn't end.' You do have to have those times where you do fail to see, 'It's all okay.'"

According to Bronowski, she and her staff had thought about introducing a theme to this year's fair to give it more of a focus, but decided not to.

"I'm really glad that we didn't," she says, "because the variety in what the students have done this year and really watching them go with their passions and their interest is I think…I don't know that we will ever consider that again after watching how they pick projects or ideas that are really suited for them. That's what it's all about: you follow your passion…We had two of our basketball players who designed a shoe. I think that ultimately we all kind of sat back and thought, "This is what it's about."

She says this year they did reintroduce middle schoolers working in partnerships, which she indicated worked well for them.

Like Bronowski, the community experts, most of whom are *Illinois* researchers or graduate students in STEM fields, take time from their work to serve as judges, many of them year after year, because they, too, enjoy the students' excitement.

Back serving as a judge for his second year in a row was *Illinois* Assistant Professor Erik Nelson. He enjoyed himself so much last year, that he signed up again.

"I was so impressed by the quality and the caliber of the science presented, and just the overall enthusiasm of the students was very contagious, so I really wanted to come back this year and learn about all the new great projects that are going on."

Nelson believes participating in the Fair benefits the students in a couple of ways. For one, they learn about science:

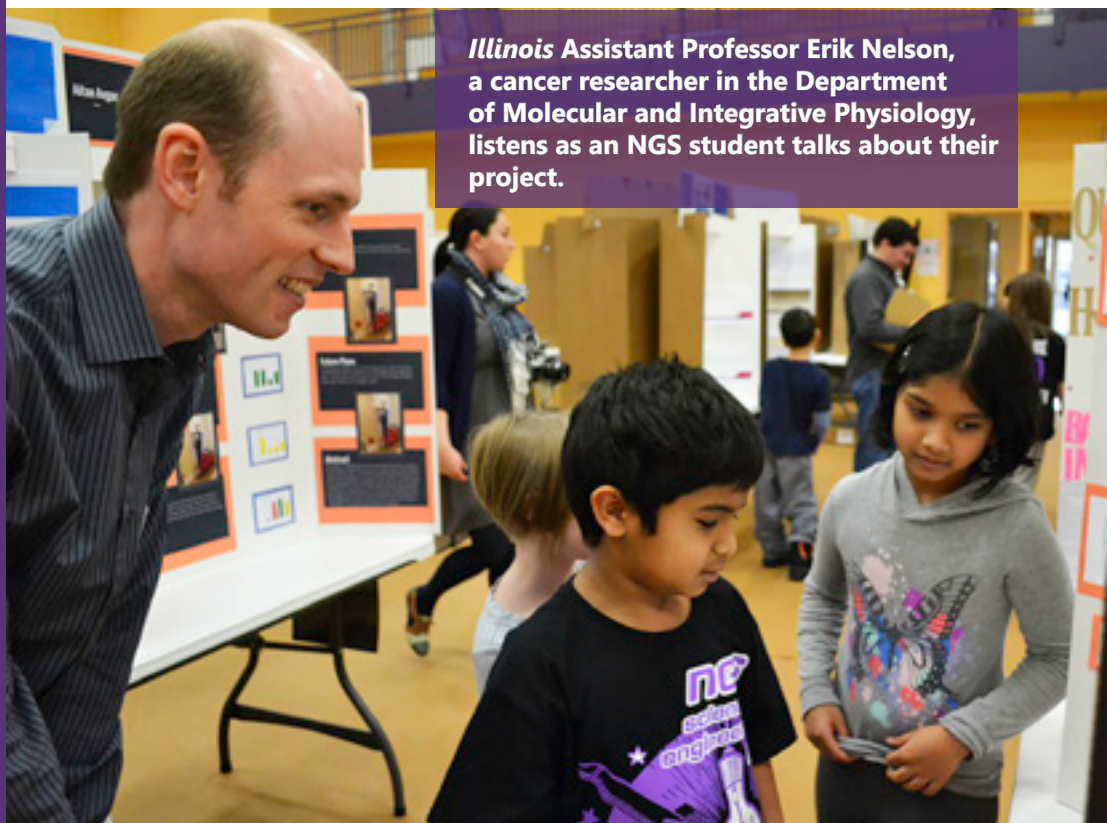
"This is a great way for the students to learn about the scientific method and learn about all the basic practices that real scientists do. They need to come up with a problem; they present a hypothesis; they come up with a mechanism to test that hypothesis; and then they go ahead and test it, and find their results."

Like Bronowski, he also feels having students present their research is another key benefit:

"Today they have the opportunity to present the entire story from how they designed their projects to what their conclusions are, which in science is just as important as doing the work itself."

Did Nelson see any future scientists or engineers? "Absolutely," he reports. "I think every one of these students, at least all of the presentations that I've seen today, any one of those can be a potential scientist."

Another community expert who served as a judge, Henna Muzaffar, an *Illinois* researcher in Food Science and Human Nutrition, also believed many of the students could be future scientists. She cited one project about battery lives; the student had examined



***Illinois* Assistant Professor Erik Nelson, a cancer researcher in the Department of Molecular and Integrative Physiology, listens as an NGS student talks about their project.**

Community expert Mary Tucker listens as an NGS student presents his research project.

three different kind of batteries used in hearing aids, and how air interacts with the content of the batteries when they're not in use.

"You can see that the depth of knowledge that the student has gained from this project is tremendous," says Muzaffar, "and if she feels excited about learning this information, you can definitely see a scientist in her right there."

Muzaffar has attended the NGS' Science Fair for the last five years. "Every year it's very exciting to come to the Science Fair and see all these kids come up with innovative ideas and great presentations. It's a great learning experience for people of all ages."

This year Muzaffar actually got the opportunity to evaluate students' presentations: "I'm very impressed with the oral, the written, and the scientific skills that the students of Next Generation possess. I'm very, very impressed with all these kids. They are wonderful; they've done a tremendous amount of work in their projects, and it shows! They're excited about the topic they explored, and they've put hours of work in preparing their presentations and doing the actual experiments, and then thinking about what future directions they can go from what they've learned from this present experiment."

It was also Maxwell Baymiller's first year serving as a judge, and the *Illinois* biochemist was also quite impressed: "I've been really pleasantly surprised. Some high-quality projects, especially in the young kids. I really like how they've encouraged them to create a clear question, address it with an experiment, and then get feedback rather than a win or loss.

Baymiller says he, too, saw some future scientists: "There's a couple of interesting biology projects. There was one kid who was very, very motivated about growing his funky organism. I'm actually about to recommend him to some different organization."

Baymiller also appreciated the students' creativity when choosing their projects: "One thing that was really interesting to me was that there were students who applied their science project to nontraditional areas. A great project just about baseball; the kid is into baseball, and it might have made him better at baseball by testing something about throwing. A girl who's into Greek literature, who did a great social psychology experiment with it. You wouldn't think that you could apply science to these things, but these kids managed."

So, how did Head of School Chris Bronowski think the kids did? "They did so well," she asserts. "It's not an easy process, and there were lots of "What do I do?" emails to Mr. Fritz on Saturday, especially at the middle school level. But ultimately, I feel like every one of our groups has come up with a really dynamic, interesting project that they should be proud of. We're very proud of them for their effort and the thought that went behind it."

A local student appreciates the joys of ooblek during EOH 2016.

STUDENTS/ALUMNI PROMOTE ENGINEERING AT ILLINOIS DURING EOH 2016

Engineering students Nicole Vail and Jennifer Luebbers (left to right in the second row) and their pen pals from Campus Middle School for Girls.

April 15, 2016

Thousands of guests of all ages flocked to campus on March 11–12, 2016, to attend "The STEM of Innovation," the College of Engineering's 96th annual Engineering Open House (EOH). Among them were students from local schools on field trips, including some who showed up as guests of campus student groups, like WIE (Women in Engineering) and EOS (Engineering Outreach Society). *Illinois* engineering students had done projects with them earlier in the semester, then brought them to EOH as a culminating event. Even some former students showed up representing their current companies, like Ford, to try to lure youngsters into engineering…or to entice current engineering students into their company. And of course, lots of *Illinois* engineering students showed up just to strut their stuff.

A wide range of visitors attended EOH, for a lot of different reasons. Parents brought their children from infants on up to pique their interest in engineering. High school students specifically came to explore their options regarding engineering as a career, while engineering-bound students sought to choose which engineering discipline is right for them, and whether *Illinois* is the school to prepare for it. Teachers from numerous schools brought their classes on field trips so their students could experience a day of engineering activities. And some of those classes visited campus as the culmination of projects done earlier with campus groups.

Kavita Desai and William Fazio of the EOS prepare to test one of the middle school student's structures by rolling it down the ramp to see if the egg remains intact when it hits the wall of bricks.

For example, WIE (Women in Engineering), did a Pen Pals project with girls from Campus Middle School for Girls. Female engineering students had exchanged letters with the middle school girls earlier in the semester, then the two groups finally met face to face when the

girls and their parents attended EOH as their guests. The engineering students with whom the middle schoolers had been corresponding spent the day escorting their young pen pals around to different EOH exhibits, and even treated them (and their parents) to a pizza lunch.

Some of the highlights the girls particularly enjoyed were SWE's Girls' Club, where girls (and some guys too), could do fun, hands-on engineering activities. They built lava lamps, made their own lip gloss, used a chemical reaction to create their own mirror. And, of course, they played some games: Avengers-themed pinball and air hockey. While most EOH exhibits were hands-on, one was feet-on: the girls got to operate an ecologically friendly water pump, for which the girls supplied the power by riding a stationary bicycle.

Another campus group that did outreach with local students was the Engineering Outreach Society (EOS), which is comprised of all engineering students. For several weeks prior to EOH, EOS volunteers visited classrooms in two local elementary schools, Leal and Prairie, to do projects with the kids to get them excited about engineering and STEM fields.

Engineering student Kavita Desai, the outreach chair of EOS, was the one who organized the whole thing. She came up with the project, designed the ramp over winter break, got all the materials together, then she and her cohorts went to the schools to supervise while the kids made the protective devices.

Then, for the pièce de résistance of the project, the youngsters visited campus for EOH. The project, which the kids had been working on for several weeks at the school, was a kind of glorified egg-drop engineering contest. They had the middle schoolers build carts they put eggs in. Then as a test to see who had built the sturdiest, most well-designed cart, the engineering students would roll them down a ramp, causing the cart to ram into a wall of bricks to see whose design would protect the eggs the best.

Students from Campus Middle School for Girls are in awe of the experiment they're performing.

Why would a busy engineering student do all this extra work? "I just love working with kids," says Desai, "and I think it's really important just to promote STEM for the younger age because, honestly, to become an engineer, you have to start thinking like an engineer from when you're younger. So by just exposing everyone, we're giving them the ability to think earlier. Not everyone gets it. It's also fun just to do science."

As always, EOH offered visitors lots of hands-on activities. Several exhibits offered the ever-popular ooblek. Made famous in Dr. Seuss's Bartholomew and the Oobleck, it was a slimy green substance that fell from the sky and stuck on everything. Nowadays, ooblek is made from cornstarch, water, and colored food dye, and its not necessarily green. A Non-Newtonian fluid, it's a liquid which acts like a solid when force is applied.

Students from Dr. Williams Elementary School in Urbana on a field trip to EOH 12 to participate in an egg-drop engineering challenge.

Materials Science and Engineering senior Sarah Fraser, who knows all about materials, was on hand to give students the opportunity to get their hands on some oobleck, which she appeared to have fun doing herself. Fraser has participated in EOH all four years of her career at *Illinois*, because she hopes her love of engineering might rub off on some kids who attend.

"I really love EOH because I went to these types of events as a kid and loved them. I wanted to share my passion and show kids that science can be fun. I hope EOH inspires kids to pursue an education in the sciences and keep asking questions."

Ashley May (left) and SWE member Quyen Nguyen, interact with EOH visitors while running the Avengers Pinball Machine.

Also helping with a Girls' Club exhibit was Lara Flasch, a junior in Industrial Engineering and one of SWE's outreach coordinators. Flasch helped visitors make mirrors, and particularly appreciated the range of ages among the EOH visitors:

A middle school student with the lava lamp she made at SWE's Girls' Club during EOH 2016.

"This year was the 96th annual EOH—it feels very special to be a part of such a big tradition in the College of Engineering! I think EOH was an awesome opportunity to represent SWE to such a huge audience of people. It is amazing to me the variety of people that we were able to meet and interact with. Some kids came with their parents, some came on field trips, and some adults came without kids, so SWE was able to reach all types of people!"

Like Fraser, Flasch also hopes that their efforts might persuade some young people to choose careers in engineering: "I hope that a lot of the kids (and adults!) felt inspired by seeing all of the EOH exhibits, and felt confident that they could make an impact on the world as engineers too!"

Ashley May, who is a junior in Chemical Engineering, and also a SWE Outreach Coordinator, helped out at the Avengers Pinball Machine in SWE's Girls' Club. May enjoyed the interdisciplinary aspect of working with SWE members on many of the Girls' Club exhibits.

"EOH gives our SWE members a great opportunity to work together on several interdisciplinary, hands-on engineering projects. Then, when we interact with attendees at EOH, we're able to share the engineering principles that we learned about and spark people's interest in the things engineers can accomplish."

May also appreciated interacting with inquisitive young visitors and fostering their creativity.

WIE guests from Campus Middle School for Girls chat with an engineering student about the principles that make the air hockey table work.

"During EOH weekend, it was neat to see so many kids approaching our exhibits with excitement and curiosity, and I think our main goal was to encourage them to look at the world with the mindset of 'How does it work?' and 'How can I make that?'"

Also attending EOH were representatives of a number of companies comprised of lots of engineers, like Boeing, John Deere, Caterpillar, and Ford. In fact, a lot of the folks from these companies who show up for EOH are *Illinois* alumni, who enjoy being back on campus for the event. Most came to brag about what their companies are doing and to underscore to visitors how important engineering is for their company, for instance.

One Ford Company representative was alum Sean Dietrich, who had studied engineering mechanics with a focus on automotive engineering/automotive design and graduated from *Illinois* in 2014.

According to Dietrich, Ford sends representatives to EOH so they can expose folks to groundbreaking new technology they've developed, from the aluminum truck, to turbo direct inject engines, to environmentally friendly seating, and regenerative braking (which other companies use too). In keeping with EOH's Innovation theme, he says these, "can be really interesting to a lot of students."

Is his goal to maybe get some visitors to end up in mechanical engineering? "That's always the goal—if you can get someone interested in something that's valuable."

Dietrich believes from personal experience that cool products can be the Pied Piper that lures youngsters into engineering. Following is an anecdote he shared about what got him interested in automotive engineering: "The first time I remember being interested in cars was back when I was 11 or 12 driving down the street, and had a Mustang drive me, and I'm like, 'That's a cool car. I would want to design those someday.' That led me to go on and get an engineering degree and working on cars. That's the kind of stuff...if we can get people excited about what we do, then we might put them on the right track."

A middle school student riding a stationary bike provides the energy to power an eco-friendly water pump during EOH 2016.

A kindergartener pours polymer into his mold.

NGS STUDENTS ON THE BALL TEACHING BTW KINDERGARTENERS ABOUT POLYMERS

April 26, 2016

Two kindergarteners work on their polymer mixture.

Garbed in rubber gloves and protective goggles, Next Generation School (NGS) eighth graders on a February 23rd field trip to Booker T Washington STEM Academy (BTW), shared with BTW kindergarteners the art of making bouncy balls. According to NGS Science Teacher Bryant Fritz, it was a win-win for both groups of students. His eighth graders experienced working with young children and how to take the principles they have learned down to a level younger students can understand. BTW youngsters were exposed to some lab principles, learned how to use scientific equipment, and, of course, ended up with a ball that they had made all by themselves (with a bit of help from their older mentors.) And they all had fun.

Organizing and leading the event was Mechanical Science and Engineering's Educational Coordinator, Joe Muskin, who has previously drafted NGS students to serve as teaching assistants at BTW. NGS has been partnering with Muskin and BTW for several years now. "I brought them back again this year," explains Fritz, "because I see what an incredible and positive experience it is for our students at Next Generation.

For one, they experienced what it's like to work with young children. And they started to learn, at and engineers have to learn how to do themselves: communicate principles at a level someone younger or less well informed can understand.

They also learned to do something else adults must to learn to do: overcome nerves when thrown into a new situation.

"When I was describing what we were going to do," admits Fritz, "they were all really nervous about working with kindergarten students, because they've never done this before. But once they got here and they realized how eager and excited the young students were, I think everybody got pretty comfortable, and it was overall just a great day."

A BTW kindergartener watches as his mentor pours the polymer mixture he made into his ping-pong-ball mold.

Fritz' eighth graders would agree that it was a positive experience. For example, several commented on how polite the youngsters were. According to Jonathan Dullerud, "It was actually really fun, because we got to help the kids, and they were just really happy. Actually, most of the kids that my partner Albert and I got were really polite. So it was really cool."

The eighth graders had all done the activity themselves when they were younger, so they didn't learn anything new on that score. However, they did learn some new things about teaching. For instance, Camille Moulin learned, "it's difficult when people don't really listen sometimes. Once they do its really easy."

Sean Ries take on teaching was very similar to Camille's: "Time sometimes flies, but only when they're actually paying attention."

Eighth grader Sylvia Byron admitted that working with young children was a challenge, "They're a handful. A lot to handle!" However, she still enjoyed it.

"It was really fun. The kids were—most of them were very polite, and I liked watching them learn. They were really interested, and it was really fun seeing their faces light up."

Did the kindergarteners learn some science?

Jonathan Dullerud thought so. "I think they did because I explained to them how the air reader works over there, and how the pressure makes it so that the lid doesn't come off, and it was just really cool. They were really happy."

Fritz thought his students did a good job teaching.

"I think they taught as much as they possibly could. We talked about trying to communicate those ideas to younger students and tried to tell them about some of the basic ideas that are involved in the lab. We wanted them to have fun with the little kids but we also wanted them to learn something with it too."

A kindergartener pours food coloring into the polymer she's using to make her ball.

AN NGS student helps a kindergartener with her polymer mixture.

A BTW kindergartener pours the polymer mixture she just made.

A Jefferson Middle School student learns the intricacies of TinkerCAD.

ECE'S KITT PETERSON EXPOSES LOCAL MIDDLE SCHOOLERS TO RAPID PROTOTYPING

May 6, 2016

While it will be several years before Champaign-Urbana's current crop of middle school students get the keys to their own cars, at least a number of them now have a key chain to put them on. And it's one that they designed themselves, thanks to ECE graduate student Kitt Peterson and MechSE's Education Coordinator, Joe Muskin, who developed a curriculum that introduces rapid prototyping to sixth graders. So during the 2015–2016 school year, around 90 middle school students at Jefferson, Franklin, and Edison Middle Schools learned how to use TinkerCAD, a free, online software, then designed key chains, which were then 3D printed.

Kitt Peterson works with a student who's having issues with her design.

While first-year ECE grad student Christopher (Kitt) Peterson works in Dr. Gaurav Bahl's lab doing research in electromagnetic nonreciprocity ("If a current is traveling in one direction," he explains, "and it comes back the same way, it doesn't do the same thing"), he uses computer-aided design software (CAD) a lot in the 3D circuits he designs, and also dabbled in 3D printing as an intern at Coca-Cola as an undergrad.

Plus, having visited Uni High's engineering class with his lab mates to teach them about opto-mechanics, he discovered that he enjoys exposing younger students to the joys of engineering. So, when a number of the local middle school teachers who had just gotten 3D printers in their classrooms but weren't sure how to use them approached Joe Muskin, Peterson agreed to help him develop a curriculum.

Peterson says their goal was to introduce rapid prototyping: "It's not so much about the 3D printing, it's about the rapid prototyping—designing something and then having it built quickly so you don't have to wait a long time to test it. And I think that's more what we wanted to focus on."

Jefferson's STEM Specialist, Tina Lehr, was also excited about exposing her students to rapid prototyping. "This partnership allows students to work with new technologies and develop skills in the field of engineering." She was also excited about giving them

Tina Lehr works with a student during the TinkerCAD lesson.

"the opportunity to collaborate with local individuals who specialize in engineering."

Having the students make something useful was also key, according to Peterson: "A lot of 3D printing is focused on having fun with it and making toys," he adds. "We wanted to try to do something that was more focused on how it would actually be used, not just as a novelty." So, they decided the first item students would design was a 4 x 2 cm key chain. (They didn't want it to be too big, because it would take too long to print.)

The lessons they designed were for a class that's about half an hour long, and since that's not a lot of time per day, the lesson

would extend over a period of several days. The lesson the first day was an overview of what 3D printing is, and about the TinkerCAD software, which has numerous different shapes which can be dropped, rearranged, reshaped. So the first day's lesson emphasized the different tools the students would need to use to make their key chain, including how to put a hole into an object, how to make an object of a certain size and dimension, and, how to use the letters included in the software. (Several students put their initials on their keychains.) While the software is quite simple, Peterson acknowledges that "You can actually make a lot of complicated stuff with this if you really go for it."

On the second day, once they understood the basics of TinkerCAD, instead of just starting to design in the program itself, students then drew their designs with paper and pencil.

"Because when you're actually designing something as an engineer, you usually start with sketches of what you're going to do. You don't start immediately in the simulation; you're making a prototype."

So they decided the next step would be for students to make a drawing of their design. "We thought that would be a good place to start so they could get a rough idea of what they wanted to make. I think it's easier to make changes on paper than it is in the program. It's easier to visualize the changes. And then they went into the program and tried to replicate this design."

Another plus with using online software is that the students didn't have to be in the classroom to work on their projects. A student with access to an online computer could log into the school's central account, access their saved project, and work on it anywhere, including at home.

"I think a lot of the students did that," says Peterson, "because it gets them really excited about it."

Based on what worked well and what didn't the first time they did it in a classroom, Peterson and Muskin have changed the lesson plans accordingly.

A middle school student working on his design in TinkerCAD.

"We had them design the thing first, and then go into CAD," says Peterson. "But we found that because they hadn't actually seen the software—there are some limitations to this, obviously; you can't make very complicated shapes really easily—they were designing stuff that was a little too complicated. So we decided to change it up and give them some experience with this first, to see what its capabilities are, and then start designing it. And that actually helped a lot making the process faster, because they didn't have to change their design."

There's another engineering aspect Peterson wants to include: having students go back and make improvements on their design once it's been printed:

"What I want to do in the future is maybe, after they make the first prototype, go back and redo anything they feel they want to change about it. Because once you get to actually hold it, that's what a prototype is for. You get to see if there's any changes you want to make. So I think that would be a good next step, if we could do another round. I think it's maybe

Some of the unique key chains students designed on TinkerCAD (photo courtesy of Tina Lehr).

have students revisit their designs. I'd like to have them do it immediately after this; they go back. It's part of the original design. It might be too expensive to print them twice, but I think it's good to at least have the students revisit their designs and maybe not print them out again."

Indicating that her students, "did a fantastic job!" Lehr also appreciated that her students had a chance to not only create a design, but problem solve and revisit their design to improve it:

"Each student worked hard to create his or her own original design. To do this, they had to practice using the CAD program, and their design had to meet certain specifications. It required them to problem solve and complete the process of designing, testing, and redesigning."

Once Peterson and Muskin get all the kinks worked out of their curriculum, they'd like to see it become sustainable in the schools:

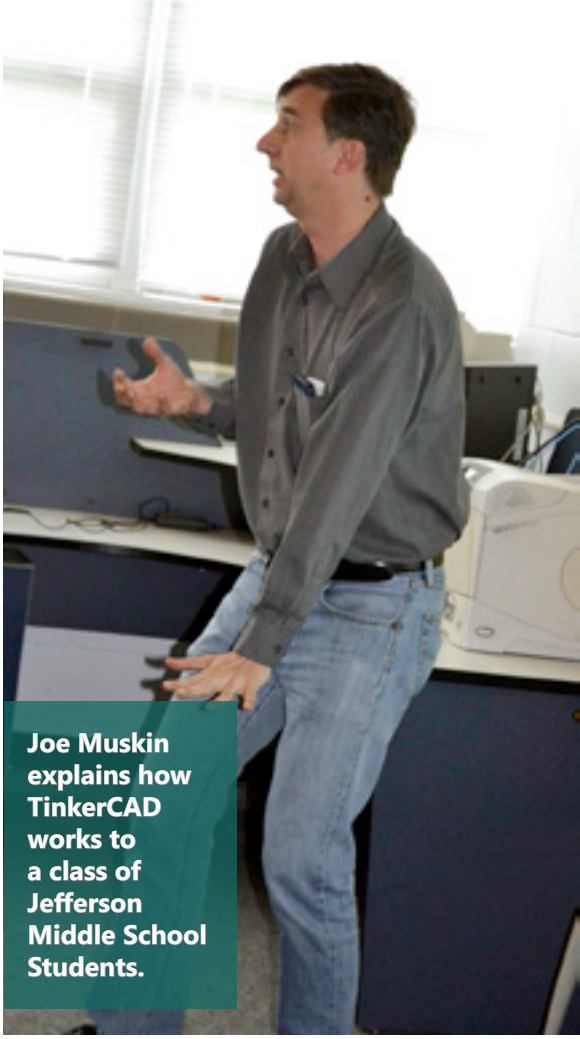
"We're moving toward the teachers being able to teach this by themselves," says Peterson. However, they're not working themselves out of a job completely. They also envision scaling up the project down the road:

"We've talked about expanding it," admits Peterson. "We're doing it this year with sixth graders; we were talking about, in the next year, maybe doing one for seventh graders, especially if there are students who did this in sixth grade, it would be nice to do something more in depth, maybe in 8th grade too."

Plus, because the students would be older and already have had previous experience in CAD design, he figures they would be able to try something a bit more difficult. "Because, I think with sixth grade, you have to really worry about getting the focus on it and get it done. You have to explain it more in detail. But if they're older, you can go more in depth."

Peterson's career goal for the future is a faculty position; because while he wants to keep doing research, "I like teaching," he admits.

It's clear that he does, because he keeps coming up with new ideas for projects he wants to try out in the classroom:

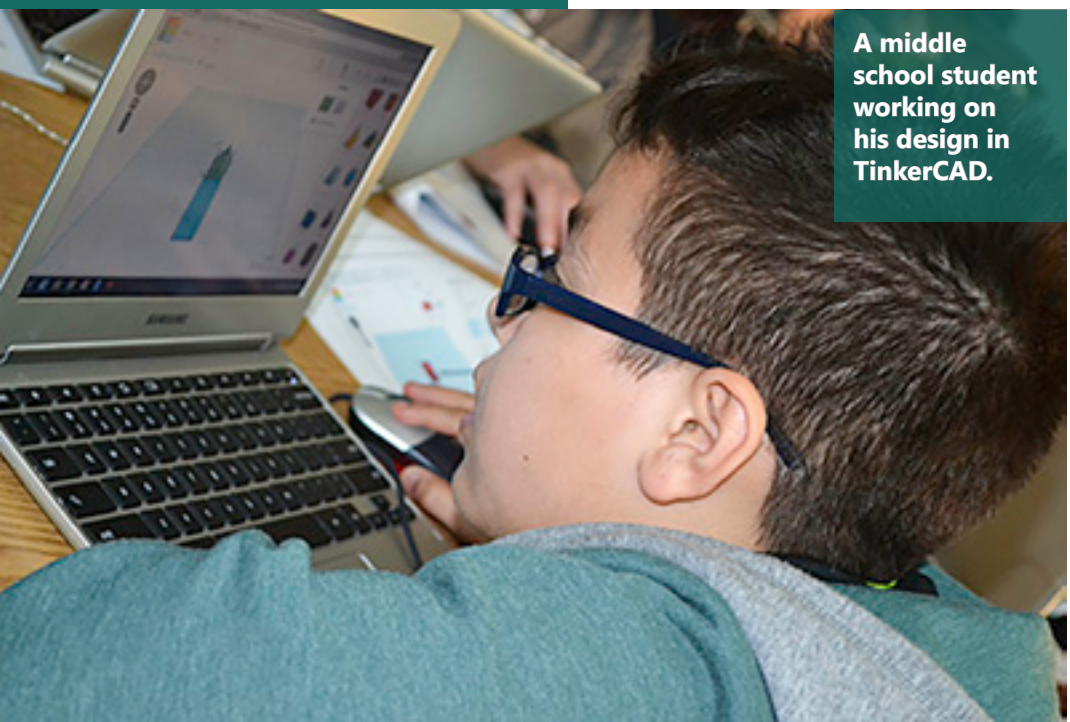


Joe Muskin explains how TinkerCAD works to a class of Jefferson Middle School Students.

"I was thinking that it would be nice if there would be some way to do a project where you actually do some kind of simulation. Most of the engineering is done first in simulation, and then you make a prototype. But you always do a simulation first. So I was thinking something like that would be nice to bring into the classroom."

He's also got another project in the works that he thinks younger students would enjoy: "I'm working on another one. I worked on it a lot last semester and now I'm working with an undergrad student on it. "We call it a laser telephone. Instead of listening, you can talk into it, and there's a circuit that picks it up across the room; you can actually hear the person talk into it in the other side of the room. So we're hoping to go with that into another classroom too."

So how'd the students do? "It only took them a day or two to learn how to be pretty good with this,"



A middle school student working on his design in TinkerCAD.

Kitt Peterson works with a middle school student who's having issues with her design.

excited about it in some ways," Peterson admits. "When you first start, they are not very into it. And then the next day they're more excited about it."

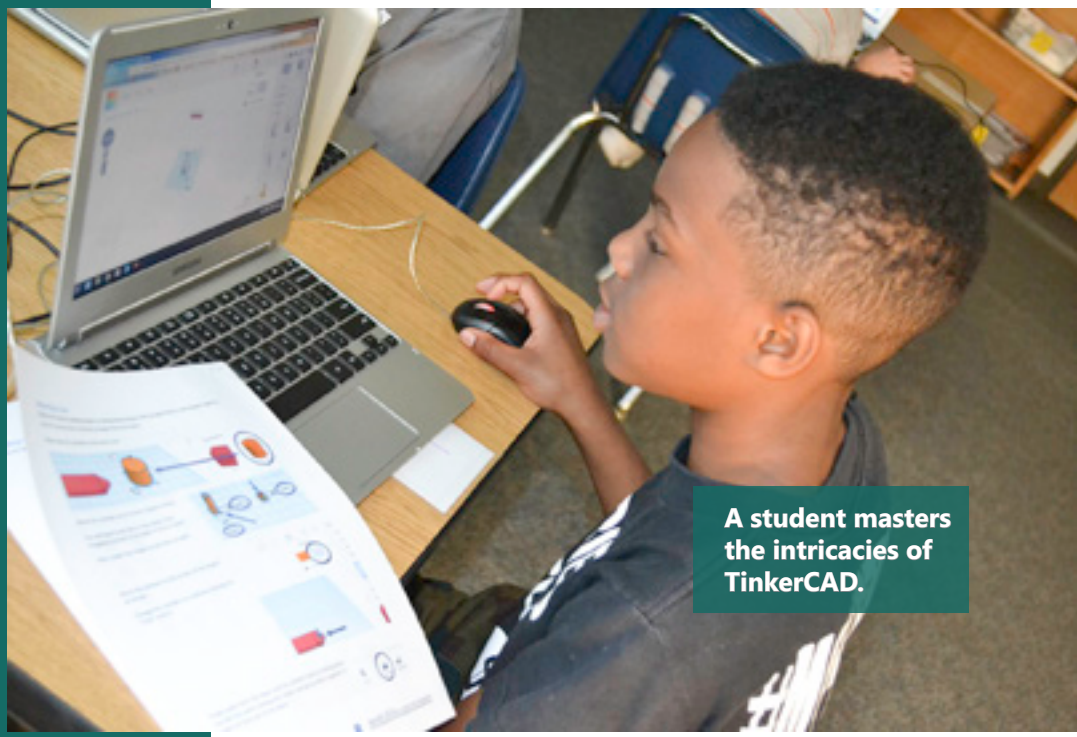
And he also believes he recognized a few future engineers in the group: "There were a couple students who were really into making good designs," he says. "Obviously, there's a lot of students who are more art focused, like making it fancy."

Why would a grad student busy with his own studies and research take the time to develop a curriculum and take it into local classrooms? Peterson believes the hands-on aspect of the lesson and being exposed to the kinds of things engineers do has the potential to make science exciting for the students:

"I would hope that it helps them get excited about doing science type things. Because if you just teach science with equations and numbers and stuff, it's hard for a lot of people to get excited about it. But when they actually can see it—because with the 3D printing you can actually see what you made in your hands and hold it. Because it goes from just a drawing to something to hold. That's another thing with the lasers and the telephone. You can actually see it working. It works similarly to how a real telephone works, the same basic concepts. But if you can actually see it working...so I think that helps them gain interest in it."

Like Peterson, Lehr also hopes the project gets her students excited:

"I hope this project inspires students to explore the field of engineering, CAD, and 3D prototyping even further, either either as a hobby or as a possible career choice. These are exciting new technologies that are making an impact in our lives today, and I am glad we had the opportunity to collaborate with Joe and Kitt to bring these opportunities to students at Jefferson."



A student masters the intricacies of TinkerCAD.

CS @ ILLINOIS SAIL EXPOSES VISITORS TO COMPUTER SCIENCE AT ILLINOIS

May 12, 2016

What it's like to be a computer science (CS) student at Illinois? On Saturday, April 9, 2016, around 250 high school students (and even some eighth graders), including 115 girls, from around the state and the nation participated in CS @ ILLINOIS Sail to find out. Sponsored by *Illinois'* Computer Science Department, the free, day-long event was filled with workshops about computer science and math theory, how to create websites, the ever-popular mobile and gaming apps, career opportunities in CS, and how to not just survive but thrive during one's freshman year. Also featured—a bunch of just plain fun workshops showed visitors that CS students know how to have fun too.

According to Corly Leung, a Computer Science junior in charge of Sail, the purpose of the event was to allow student visitors to "get a taste of what CS at *Illinois* is like, versus the traditional, 'We walk you around campus; we talk to you; but you don't really get to know us,'" kind of campus visit. "When the students take the different classes in Sail," she continues, "they really get to know the teachers, because it's a class size of around 20 to 30; and then during lunch time, there are college students just talking to them as friends. We hopefully give them what CS at *Illinois* or the people or the environment is like."

While CS @ ILLINOIS Sail was called SPLASH last year, the name was changed this year to prevent confusion. SPLASH, an event held at universities nation-wide, including *Illinois*, does university-level outreach events for many majors, including CS. So CS rebranded its premier outreach event as Sail so everyone would know that it's different from SPLASH.

When visiting students and their parents arrived on campus, they had a tour of the engineering quad, including the Siebel Center for Computer Science, and breakfast. Participants then participated in two workshops to round out the morning, had lunch where they were able to interact with *Illinois* CS students, then four more workshops in the afternoon. Students attended around six different classes chosen from about 75 different computer-related and non-computer-related classes offered by *Illinois*' CS students. Most were CS related: CS and/or math theory); websites (HTML,CSS,JavaScript); media (music, electronics); and mobile apps (iOS/Android).

An *Illinois* CS student, Milan Dasgupta (right) works with a visiting high school student during Sail's "Python & Raspberry Pi" workshop

For instance, there were plenty of heavy-duty math courses, such as: "Burnside's Lemma—An Introduction to Higher Mathematics," "Algorithms and Objects: Breaking Down a Problem," and "What I Wish I Knew About Calculus."

There were also lots of CS/programming courses, such as "Introduction to Linux," "Data Structures: How Programmers Store Stuff," plus numerous workshops related to specific software: "Recursion and Python," "How to Revit," and "Making a Simple Twitter Bot with Python."

The popularity of apps and gaming was apparent, and in many workshops, learning was couched in game playing: "Intro to Android Reverse Engineering," "Twitter Bots with Raspberry Pi," "Make an HTML 5 Game with Phaser," "Crafty Logic: Learning Digital Logic through MineCraft," "Game-Playing AI," and "Video Game Mechanic Design," where students could learn the basics of video game design through Super Smash Bros Melee. Another popular class was "Virtual Reality: What Makes an Immersive Experience."

Participants in the “Python & Raspberry Pi” workshop have some questions.

Students also had access to courses about website development, html, and CSS: “Intro to HTML/ CSS—Build Your Own Portfolio!” “The Art and Science of Building Websites,” and “You, Online: Personal Sites 101.”

For music lovers, there was: “Programmatically Creating Music on the Web,” “Hamilton—The Man Behind the Musical,” and “Songwriting Featured!” for which students were encouraged to bring their own instruments.

A couple of courses even tackled a weighty subject not so much about computer science, but because of it—individual privacy. The “Braving a Brave New World: Technology and the Fourth Amendment” course explored “American attitudes, laws, and policy action with regards to privacy due to widespread communication technologies.” While the class touched on technical details of tools used to protect and/or dissolve privacy, the emphasis was on the ramifications of technology, rather than the creation of it.

Corly Leung (left) and a couple of other WCS members on hand to help Sail run smoothly.

Another course, “4th Amendment: Internet Privacy,” tackled the 4th Amendment in light of the recent FBI interaction with Apple. Still another, “Security and Cryptography,” addressed the nuts and bolts about how data are protected.

A number of “how-to” courses specifically designed to help students adjust to college life, especially during their freshman year included: “How to Breeze through College Math (A Mathematica Lesson),” “How 2 College,” ”Common Freshman Fears,” and “You’re in College! Learn How to Food!” Others dealt specifically with CS: “How to Get a Job in the CS Industry,” “Surviving the CS Culture.”

While Leung describes Sail as “more CS focused,” she adds, “but on the other hand, we have our interests and likes outside of computer science, and we would like to show that. We have a very popular SMASH class.”

So, Sail also featured quite a few totally-non-computer-related courses just for fun.

As the name implies, students in “Making Ice Cream” did just that. “Parachuting (Kindergarten Style),” also included some good old-fashioned Frisbee; for Harry Potter fans, there was “Quizditch (Harry Potter Trivia),” and students revisited an old pasttime, but with a new international flavor, during “Chinese Yo-Yo.”

Students could dance the hour away in courses like: “Dance—Intermediate Hip Hop” and “Finding Hop in a Hipless Place” (hip-hop).” And for students who were bored of plain socks, there was a ‘Tie Dye Workshop,” which,

Sail participants interact during one of the workshops.

according to Sail's website, enabled visitors to "make wicked cool, psychedelic socks!"

A few workshops gave students a good time while tackling some bedrock principles addressed in other engineering disciplines. For example, the "Eggciting Eggsplosive Eggdrop Competition," dabbled in Mechanical Engineering, and challenged students to build a contraption that would protect an egg as it plummets to the ground. A couple of other courses wrestled with lift and thrust and aerodynamics: in "Introduction to Aerospace" students built and launched paper airplanes; "Plane Sheets of Paper" was a paper airplane competition.

Sail participants listen as a CS student explains some principles of website design.

Sail even included courses for pet lovers. For folks partial to dogs, there was a "Therapy Dog Session," during which students could pet trained therapy dogs to relax. For cat lovers, there was: "Machine Learning with Cats," which allowed visitors to "learn a bit more about machine learning with," according to the instructor, "nature's perfect animal: the cat!"

Parents were able to talk to advisors, student groups, and representatives from financial aid and study-abroad programs. During their meal times, they were able to interact with undergrad students from the CS department.

In addition to learning more about computers, Sail participants came just for the experience itself. For instance, eighth grader Annemarie Graham, who says she likes computers and is interested in being a computer scientist, admits she came because she "thought it would be fun to get to see what college is like." Her impression of college? "Yeah, it seems fun."

Graham's friend, Haylie Conger, Another eighth grader, admits she came to SAIL "Because it's a good opportunity to learn."

Both were part of a large group of eighth grade girls who had traveled from out of state for the day. Some of their parents had gotten together and decided to get an early start by exposing the girls to college.

Why do the CS students dedicate part of their weekend to participate in such an event? Leung says that for her, it's not only to give the students a true picture of CS at *Illinois*, but also to correct negative impressions they might have about computer science in general.

"These students are high school students who get a taste of what CS at *Illinois* is like, and have a chance to know what CS is like without just making the assumption that all we do is code in front of a computer. It is nice if they do decide to come here because of SAIL, but I think it's more important for them to really understand what computer science is, to get a feeling of what we're like, and see if we are a good fit for them."

Corly Leung, the director of Sail, is in her third year in a 5-year combined Master's and Bachelor's degree program. While she was the outreach director chair for Women in Computer Science (WCS) last year, she calls her involvement this year more like 'Oh, they are doing an outreach; I guess I can help" kind of thing.

Leung explains that it was because of a similar outreach that she ended up coming to *Illinois*. She attended a Society of Women Engineers Little Sister's Weekend, in conjunction with a WCS admitted student's day. "So when I came, I really liked the environment; the people were friendly and cooperative. It gave me a sense of community that I really enjoyed, so that's why I came to *Illinois*."

That's actually the reason why she started to get involved in outreach, to provide that for younger students:

"When I came to *Illinois*," she explains, "I didn't know anyone. This place is freezing. I'm from California. I didn't know anyone. I came here with like a feeling of I was either going to make it and be happy, or I was going to be really depressed. When I came here, the people here were very supportive. They gave me some sense of community, so that's why I want to help when students come in."

CGS'S SUMMER CAMPS TEACH STEM WITH A GLOBAL FLAVOR; ACT AS A BRIDGE TO COLLEGE

June 7, 2016

While one might not think of *Illinois'* Center for Global Studies (CGS) as a STEM unit, two of its three summer 2016 camps address STEM topics…from a global perspective. Sustainable Futures, from June 5–10, addressed a number of topics regarding sustainability. Global Health, in its first year, will address communicable diseases and epidemics. (The third, non-STEM camp is Intensive Arabic.) CGS Outreach Coordinator, Jeremie Smith, admits that while their camps are a lot of work, they're valuable in a number of ways. Students benefit academically, such as experiencing a broad overview of sustainability issues, while going more in-depth on several. Students benefit socially: Smith sees his camps as a sort of bridge program that not only prepare high school students for the academic rigor, but life-style changes of college. And finally, students experience personal growth: many get a big dose of self-confidence, or get exposed to diverse students.

Sustainable Futures camper Jack Easley examines the flora and fauna during a visit to Allerton Park. (Photo courtesy of Jeremie Smith, CGS Outreach Coordinator.)

A student prepares to taste an organic strawberrry during a tour of the Student Sustainability plots.

While CGS's camps are for rising sophomores through rising college freshmen (4 or 5 students of this year's students are attending *Illinois* in the fall), Smith says the majority of participants tend to be rising seniors. "Which actually makes a lot of sense," he explains, "because I think when students finish their junior year, they start taking seriously the search for colleges and thinking about college in a new way."

Because Sustainable Futures is in its third year, the faculty who teach the various workshops "know what they like, what works well, and what builds continuity and students' understanding," Smith explains. Participants learned about groundwater treatment, filtering, and natural aquifers, including a lab on wide-damaging aquifers. In one session, students did a climate change computer simulation on a program developed by Professor Jonathan Tomkin, Associate Director of the School of Earth, Society, and Environment.

During a tour of the Sustainable Student Farm, grad student Erik Stanek explained that the Woody Perennial Polyculture Project is exploring an alternative to growing just corn and soybeans, and

suggest that farmers at least dedicate some farmland, such as around a field's perimeter, to polyculture. According to Stanek, their plantings—row after row of chestnut trees, hazelnut, or apple trees, under-planted with not only red, but gold "Anne" raspberries, and currants, with swaths of pasture between the rows on which animals could peacefully graze—were designed to emulate an oak savannah.

During a field trip to Allerton Park, students heard about the environmentally-friendly policies being put in place regarding rainwater usage and solar panels, and even got to examine the solar panels see how they're connected to the grid.

***Illinois* grad student Erik Stanek shows students some almost-ripe currants during a tour of the Woody Perennial Polyculture Project.**

Also, students visited the new ECE Building on campus, which is aspiring to a Net Zero Energy rating and targeting a LEED Platinum certification from the U.S. Green Building Council. A structural engineer for the building led students on a tour and showed them what makes the building different than your average building, why certain things were done, how much money it's supposed to save the university, and how much less energy it uses.

New for this year, CGS's Global Health camp ran from June 12th–17th. According to Smith, nine of the eleven participants were girls with a strong interest in health professions (some hoped to become doctors) or medical science. He reports that "They also have a humanistic bent—they're interested in learning about other cultures and languages and like the idea about learning healthcare systems in different parts of the world. Will all of them end up working in a global health field? No, of course not. But a couple of them might have their passion confirmed and maybe a couple of them realize, 'I'm not interested in it as much as I thought!'"

One activity the Global Health students did was a field trip to Peoria's Communicable Disease Center, an experimental and simulation center where they run simulations on epidemics. Students got a chance to do both computer simulations and hands-on activities with dummy patients.

While Smith says half of the lessons learned in his program are academic (students learned about sustainability, global medicine, or Arabic), he suggests that the other half are "social lessons about being a student at a university, about interacting in a very diverse community, sharing a dorm room with another student you just met."

A former high school teacher, Smith discovered first-hand the need for summer programs like those CGS has developed. He used to find that a lot of his students, even the successful ones, had difficulty adjusting to college. "There's a big jump from high school to college, even if you go to quite a good high school. More and more, I saw students that I was working with…being involved with summer academic programs and that this gave them both some experience doing college-level work and also the social lessons of being away from home and being in a residence hall." Then when he came to CGS, his experiences running their fledgling summer program reiterated how beneficial a summer experience on campus could be for high school students.

"It's the kind of thing that gives them confidence that they can be successful at a university. They can get a taste of college life for a week or two, and I've just been impressed with how those students who have participated in past years' programs have gone on to be successful college and university students—some of them here.

In addition to being a bridge program, Smith sees his summer camps as a catalyst to get students thinking about college: "It's a bridge that allows high school students that are successful and hardworking high school students to have an experience at college life in a structured environment for a short period of time. I would hope that gives them a shot in the arm to finish high school strong and to take seriously the search for a good college program that suits them well. So I think that's the main thing; I look at the programs as being a really good bridge opportunity."

Smith also believes the diversity among the camps' participants is another plus. "Again, this wasn't one

of our intentions," he admits, "but it's turned out to be that we draw a really diverse collection of students: geographically from all over the country, and ethnically from people's backgrounds. And it's been really fun to see those students interact with each other—a lot of them for the first time.

Smith shares an anecdote about the diversity among last year's participants, which he calls "a real boon."

"We had two students from the Navajo reservation participate in Sustainable Futures. Both of these students had limited experience outside of their community and certainly had never been to a giant university like this. But also the students they interacted with here, maybe half of which are from the Midwest, had never really interacted with a peer from a living Native American community."

Another activity, classified as neither academic nor social, blatantly prepares students for college: dinner with some academic advisors from across campus. On their applications, CGS staff had students indicate which majors or fields they might be interested in, then arranged to have advisors from many of these majors attend. Smith says 10–12 advisors typically attend the dinner from all over campus, such as from engineering, liberal arts and sciences, biology, education.

Smith says students not only benefit academically and socially, but personally—they experience an increase in self-confidence. He reports that students who have completed the program have a whole new attitude about starting college: "Oh, I can do this work. I can do this. I'm excited for it."

Smith shared another feel-good story about the two kids from the Navajo reservation. Smith was the reason they had attended last year's camp in the first place. When he visited a high school in the middle of a desert in Arizona, one of the teachers told him, "Our students aren't prepared for it, academically or socially." Continues Smith: "But he told me that they just lack confidence, so that's the biggest problem."

Thinking of CGS' summer program, Smith suggested having a couple of the school's students attend the camp, then got them scholarships.

According to Smith these two students "had an incredible experience, did really well, and thrived." During his closing presentation, one boy, Ezekiel, was talking about what he had learned about environmental sustainability. He added that from a Navajo cultural perspective, 'This is how we've always kind of looked at the earth; something that should be preserved.' And he had this confidence in his voice and willingness to share his perspective, and appeared comfortable, feeling like his perspective would be valued, and it was a transformative experience for him."

But the story gets even better. Smith visited the school again this past winter. Those two kids, who happened to be home after their first semester of college, had heard from their friends, "Oh, Mr. Smith's back at the school." So they came to the school to visit him.

What one student told Smith confirmed what he believed was one of the major benefits of his camp: "Zeke was telling me that he had been really worried about starting college, and had gotten a scholarship to go to Utah State, but he didn't know if he could handle a big university, being away from home and his community," explains Smith. "Coming to the University of Illinois gave him the confidence, and it really changed the way he looked at college."

Smith thinks a lot of the students who participate in the program are in a similar position for different reasons. "They're a little worried about college; there's a lot of pressure on high school students to get into college, and to find money for college." Smith adds that they're also being told: "You're 17 years old; you should know what your majors gonna' be!"

In addition to improving students' self-confidence, Smith believes his camps have the potential of being a journey of self-discovery for participants. And he tells them this during his opening talk: "If you open yourself to it, the most you will learn during the week you're here is about yourself—like who you are, what you're interested in, and what do you bring that's valuable to a group that's working together and collaborating together?"

Campers experience a compostable toilet during their Allerton Park tour. (Photo courtesy of Jeremie Smith, CGS Outreach Coordinator.)

He says they'll also learn: "What do you like about a large university? What don't you like about it? Because there's pluses and minuses to all of those things."

While the camps only last for one week, the students form a network and stay in contact long after the camp is over. Smith, who's a member of the Facebook page CGS sets up for each camp, admits, "There are still conversations that go on," He reports seeing communications between students who did the camp two years ago, something like: "'Hey, Lauren, what are you up to? I'm in my second year at Kansas. What are you doing?' and the response, 'Oh, I decided to go to U of I. I'm staying in the same dorm we stayed in two years ago.' Smith believes they're "learning how to make adult relationships, which doesn't mean you live in the same town necessarily….kind of extending your world view in a lot of different ways."

In addition to Facebook, many students send follow-up emails, "'Cause I tell them, 'Let me know what you're up to.'" And they do. In fact he's written letters of recommendation for a couple of them for college admittance or scholarships. He reports that quite a few past campers were in the process of applying, had already applied, or even a couple that had already been accepted where they come in the program. He says probably 4 or 5 students in this year's camps have already been admitted to *Illinois* for the Fall.

One of the things Smith is proudest of, is their scholarships: "We've been fortunate in that our budget model has allowed us to offer scholarships to students who ordinarily would never be able to participate in these kinds of programs," he admits. "So students from the Navajo reservation, but also students from our community who are good, hard-working students whose parents are working class or immigrants, and this University of Illinois program is outside of their price range in a lot of ways. But we've been able to provide scholarships," says Smith. "That's something that I'll remember and be proud of long after I'm not here."

He's also proud of the impact the camps have had: "I think, for the most part, we've been successful. I give a lot of credit to the faculty members that lead an engaging and really interesting course. The program is only 5 ½ days, but students seem to get so much out of it."

But it's not just the students who reap benefits. While CGS didn't intentionally design the program as such, it's turned out to be an excellent recruiting tool for the university.

"A lot of the students are really excited about the campus, and they work with top-notch U of I faculty members that teach the courses, getting the experience of building rapport with a professor. So I think that quite a few of the students in the past years have ended up matriculating to the University of Illinois."

He adds, "If you run a great program, and students have a really great experience, then inherently, a lot of them are gonna want to come here for their full college experience."

At the Student Sustainability Farm, students experience a greenhouse full of tomatoes that were planted in early March and will be ready for harvesting shortly.

Left to right: Sruti Ekkirala and Nghi Nguyeni enjoy organic strawberries during a tour of the Student Sustainability Plot.

SUSTAINABLE FUTURES CAMPERS EXPERIENCE SUSTAINABILITY IN AND OUT OF THE CLASSROOM

A student prepares to taste an organic strawberry during a tour of the Student Sudtainability plots.

June 23, 2016

In its third year, the six-day 2016 Sustainable Futures camp from June 5th–10th, exposed ten high school students to sustainability, both in the classroom and in the real world via tours of local sustainability efforts. One key activity was students' final group projects, 21st Century Scenarios, which they presented on Friday to camp leaders and parents. What drew the students to the camp? In addition to learning more about it, several acknowledged that they hoped to discover if a career related to sustainability might be right for them.

Sponsored by the Center for Global Studies and organized by CGS' Outreach Coordinator, Jeremie Smith, the camp is designed for high school students on the cusp of deciding about college and careers: seven of this year's campers were rising seniors; the other three were juniors. While a number of the participants hailed from Champaign-Urbana, others came from Illinois and beyond—California, New York, Arizona, and Texas.

The camp's two main instructors were Jonathan Tomkin, Associate Director of the School of Earth, Society, and Environment (ESE) and ESE lecturer Rob Kanter, who both found the camp extremely rewarding.

Tomkin, who taught most of the classroom instruction, says, "It's a great opportunity to talk about some really interesting ideas with some really interested high school students." Some of the big trends he addressed? Population, food, water, energy, and climate change.

Kanter's role was to teach the students while on field trips to local places implementing sustainability. For example, at the Student Sustainability Farm and the Woody Perennial Polyculture Project, students heard about sustainable farming, including an alternative to growing just corn and soybeans: a polyculture comprised of chestnut, hazelnut, or apple trees, under-planted with raspberries and currants, and with swaths of pasture between the rows where animals could graze. During a trip to Allerton Park, students heard about environmentally-friendly policies regarding rainwater usage and solar panels being put in place. Back on campus, students toured the new ECE Building, which is aspiring to a Net Zero Energy rating, and learned about water run-off during a visit to Boneyard Creek:

Sustainable Futures campers experience a compostable toliet during their Allerton Park tour.*

"Jonathan and I complement each other very well," Kanter explains. "Because I enjoy taking students into the field to see people doing things that have to do with sustainability—hands on, you know, in practice. So that's what I enjoy doing."

In fact, Kanter enjoys the camp so much, that he says he would probably do it even if he weren't paid for it (for which he inserts a caveat not to tell those responsible for his paycheck.)

"This is a fantastic opportunity for me. This is doing something that I enjoy, (don't tell 'em) that I would do for free. I mean, to be around young people,

high high school students who are as interested and as engaged as the students here are, is just a really great opportunity for me."

Students also learned about the campus, such as university resources, like the library; an evening scavenger hunt, a fun way to expose students to the campus; and a dinner meeting with advisors from a number of units. The camp wasn't all work and no play; fun evening activities included a movie night, bowing at the Illini Union, and a movie on the Quad the last night of the camp.

How'd the students do? "They did fantastic," Tomkin reports. "Very engaged. Very clever. I'm very much looking forward to seeing their final projects."

Does Tomkin see any of the students going into a sustainability field? "I think it's very possible," he says. However, Tomkin sees sustainability as an area that may be addressed via a broad range of disciplines:

"I think my field is very broad," he explains, "so I'm interested in things pertaining to sustainability and that touches on everything from engineering to business to social science to natural science, and I think I consider it important not just that someone becomes a professional in the field, but also that they use sustainability thinking in other parts of their practice. I'm in the School of Earth, Society, and Environment, and my specialty is actually in glaciers."

Does Kanter see any of the students going into a sustainability field? "We have to wait a little bit to see," he says. "What I hope that they learned is that sustainability isn't something that's going to happen in the future, but sustainability is something that people are putting into practice now. And that creative, engaged people can change the world now—not sometime in the future."

Like Tomkin, Kanter also sees sustainability as broader than any one particular field, and hopes that no matter what field the students go into, they try to keep it in mind: "What I really like about this program is that I want all of them to think about what they do in terms of sustainability," he says. "So they may or may not do work that is called sustainability, but whether they are facilities managers or engineers or urban planners, sustainability can be a part of what they do."

Sustainable Futures participants Giulia Barbieri, Jack Easley, Mihir Thakar, and James Brady appreciate their tour of the Woody Perennial Polyculture Project.

During a tour of the ECE's new building, the campers learn of all the steps taken during construction to give the building a Net Zero Energy rating.*

Most of the students participated in the camp in order to discover if a career in sustainability might be in their future. For example, Anna Balla, a rising senior this fall at Mundelein High in Mundelein, Illinois, explains, "I came to camp because I don't know what I want to study in college, but I am really interested in sustainability and the environment. And so I'm thinking that's a possible route for me. So I came here to learn more about it and see if that's what I want to pursue."

And according to Balla, she believes she does want to pursue it. "I've learned a different way to approach it you know than what I thought I was going to do."

Balla's favorite thing about the program? The people: "The professors that are so passionate about what they're doing…you can just see it while we're out and looking at animals. They just light up, that's like they're favorite thing. So that's what I thought was really unique and cool about the program.

Like Balla, Stacey Chui, a senior this fall at Stony Brooks School in New York, also hoped to discover if she might like a career in sustainability. "I came to camp

Left to right: Stacey Chui and Jack Easley present their 21st Century Scenario final project during the camp's final event.

because I want to know what I want to do or study in college," she admits, "and this has always been an interesting topic to me, and I really want to get to know it more. So think it's a really good opportunity. It's not too long. Six days, yeah.

While Chui is still not sure about what career she's going for, she believes she learned a lot during the camp. "I think it is good. I've learned a lot more. Like I've learned things that I didn't really put much thought into it before. And, yea, these are like real-life problems and stuff…It definitely gets me to think more about it. I still don't really know what I want to do in life, but it gives me some thoughts. Definitely."

Jack Easley, a rising junior this fall at Uni High in Urbana, attended the camp not only to determine if a career in sustainability is for him, but also to live more responsibly himself: "I came here because I knew some surface-level stuff about sustainability, but not much," he admits, "and I think it was something I was definitely interested in finding more about and sort of whether I want to go that direction for a career or college. And just learn more about it, and how I can live more sustainably."

Easley says he learned a lot, and he thinks participating in the camp is going to change how he lives from day to day, as well as his attitudes about sustainability: "Like just learning about how stuff works…I think it will sort of change more than what I do—sort of how I think about stuff. I think that's a pretty important thing to do."

Easley believes he'll end up in a career in sustainability, something to do with sustainable agriculture. "Systems that can still be efficient," he explains, and then, also biodiversity, sort of looking at animal species and how we can maintain the biodiversity in areas."

Another local student, Sruti Ekkirala, who also attends Uni High and will be a senior this fall, was excited about the global aspect of the camp: "I was really interested in the environment and sustainability, and I thought this was a really good opportunity to get the local and global context for that. So that's why I'm here."

Ekkirala says she learned a lot more about the big picture: "Joel said something on the lines of how you don't realize how much energy goes into meat production. I always thought it helps to do your part to turn off the tap and lights when you're not using them, but in the grand scheme of things, those don't really matter as much. And so getting that kind of context and realizing that, yea, that's important, but there are a lot of other things that cause it and are more unsustainable."

Ekkirala also hopes for a career in sustainability: "Yea I'm interested in it, so I hope so. Not exactly sure how it will play out."

Participants in the 2016 Global Studies summer camp: Sustainable Futures (photo courtesy of Jeremie Smith, CGS Outreach Coordinator).

During a tour of the Student Sustainability plots, students do a little bird watching.

Students listening to their "patient's" heartbeat.

HIGH SCHOOLERS LEARN ABOUT GLOBAL HEALTH AT CGS' FIRST-EVER GLOBAL HEALTH CAMP

July 5, 2016

The week of June 12–17th, twelve high school students, mostly young women, visited campus to participate in the Center for Global Studies' (CGS) first-ever Global Health summer camp, which focused on some health-related global issues like nutrition/diet and the spread, treatment, and prevention of disease. The camp also addressed global health solutions and organizations, and for students seeking ways they could be involved, careers in global health.

When CGS approached Bioengineering Associate Professor Jenny Amos about doing a new Global Health Camp for summer 2016, her response was, "I've been doing camps for years, and I said, 'Sure. What's one more camp?'"

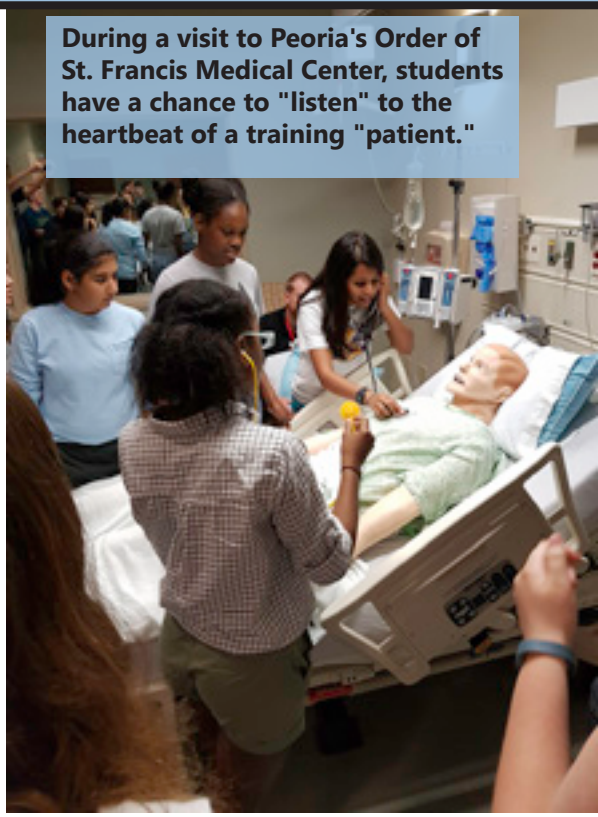
Amos, who has been running the Bioengineering GAMES camp for the last five years, adds, "I have experience running camps; I do curricula for a living; this is no problem. So it's been a lot of fun."

Helping with the camp was grad student Kenny Long, with whom Amos has been collaborating on an IGERT, plus developing a Global Health Certificate for undergraduate students, which includes a course, currently under development, where *Illinois* undergraduate students will collaborate with students from Sierra Leone to come up with solutions to solve some real-world global health problems.

The first cohort of twelve kids at the camp was mostly girls, which Amos says is pretty typical. "When you're talking about education-related projects that have a high social focus, or health focus, you tend to get more women…Women are more engaged when they can see the social connection, or the impact."

While the camp is focused is on health, Amos explains, "But we've taken a very broad definition to health."

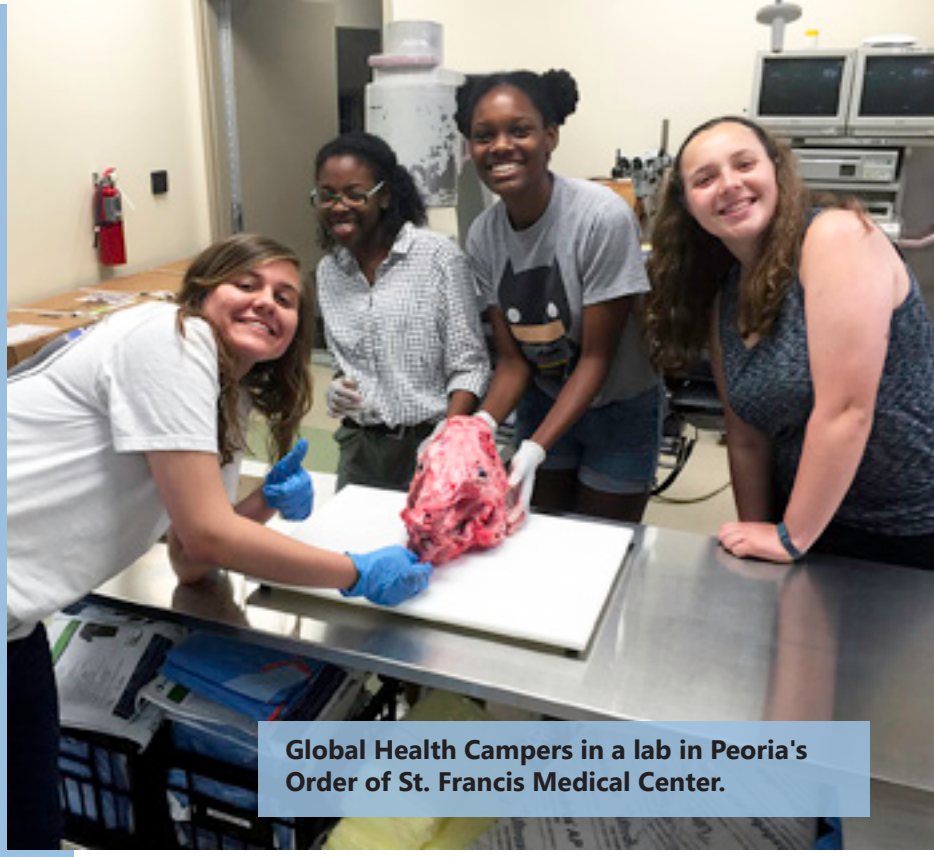
For instance, one activity related to nutrition about which Amos was very excited helped students understand how health can be impacted by economics. According to Amos, this activity is done by Bioengineering sophomores. On the very first evening, after their kick-off welcome activity, Amos and Long had students dive right into an exploratory study where they tried to come up with the most nutritious meal plan they could using items from a grocery store on $1 a day, $5 a day. "Its kind of just a fun, energetic way to start off. 'Ok, you guys are settled; let's go to the grocery store!'"



During a visit to Peoria's Order of St. Francis Medical Center, students have a chance to "listen" to the heartbeat of a training "patient."

Following an introductory activity during which they explained to students the concepts of how the human body gets energy from food, calories, and fat, they took the students on a field trip to County Market and turned them loose in the grocery store, where they did some research. Students were encouraged to find the most nutritious things they could. For example, they'd go find meat, and write down all the nutrition information, including the price of the meat. Then, the next morning, they had to put together meal plans for $1 a day, $5 a day, and then an unlimited amount of money for a maximum healthy diet (which Amos says usually involves foods like salmon, kale, and flax seeds).

A Global Health camp participant administer's CPR to a dummy "patient" during their visit to the Order of St. Francis Medical Center in Peoria.



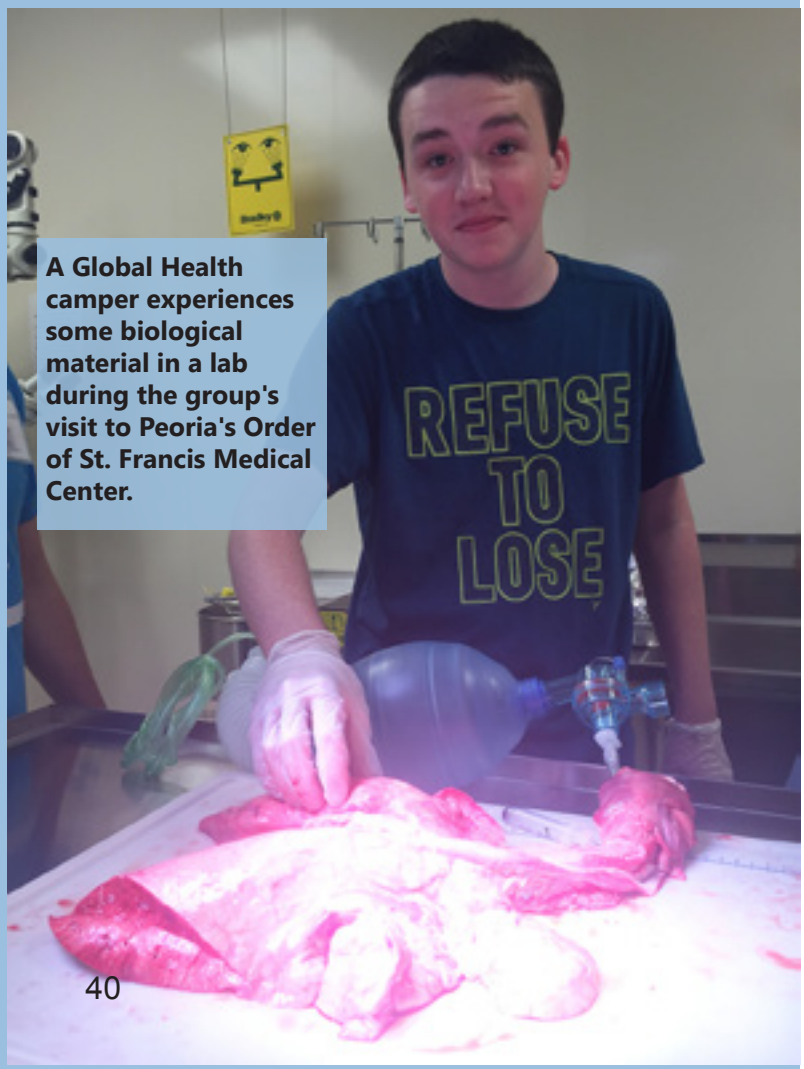
Global Health Campers in a lab in Peoria's Order of St. Francis Medical Center.

"And for the dollar a day," explains Amos, "you eat like Kraft mac and cheese, or an apple, and whatever, right? So they get to see that people aren't choosing to eat badly; they're victims of circumstance. People don't want to go eat at McDonald's every day, but sometimes that's what they can afford, and it's a lot of calories, and they need calories, but calories are not health. So it's a really nice kickoff to nutrition, and what it means to be nutritious at low resource settings."

For their main, week-long project, teams of three students researched a specific disease and the burden of that disease, such as its prevalence. Students were to look at different solutions in place right now, then come up with proposed solutions to this disease, or the healthcare system, or whatever they chose to focus on.

According to Amos, "Their project is pretty much all research." Students picked a disease from the different lectures given by guest speakers throughout the week. Amos says students had "a lot of exposure to different diseases to choose from."

To help students with their research, they learned about *Illinois'* many resources, including its library system, and toured one of *Illinois'* many libraries, while learning about library research and online searches from librarian Erin Kerby.



A Global Health camper experiences some biological material in a lab during the group's visit to Peoria's Order of St. Francis Medical Center.

Then, students had from Tuesday until Friday to work on their projects. Then, on Friday afternoon at the camp's final event, students gave ten-minute oral presentations about the disease they had researched. Some of the things they were to discuss included the history of the disease, the prevalence within a specific country/area, how people are dealing with this disease today, and what they thought could be done in the future to prevent/mitigate the disease.

Many of the camp's participants, who were considering careers in health care most likely found Wednesday morning's field trip to Peoria, Illinois, particularly enlightening. They visited the Order of St. Francis Medical Center, an academic medical center that trains health care professionals of tomorrow. There students got some hands-on experiences that gave them a taste of what a career in health care might be like.

Another fun and educational activity which wasn't directly related to health education, but to understanding the resource setting was a poverty simulation which involved role-playing. This activity was headed up by Business professor Madhu Vishwanathan and some of his staff from the Subsistence Marketplaces Initiative.

For the activity, via role play, students got to experience what it's like to live in poverty situations. The simulation involved a number of different

contexts, such as a social interaction where poverty is involved, a health-related situation, something in the market. Visiting the eight or so different stations, students got to experience what many of the world's poor experience every day.

Another unique learning activity involved playing cards—not with hearts and spades, aces and kings—but with diseases. Students played Pandemic, a popular card game about the prevalence and spread of disease.

Amos says the activity was "Kind of keeping in the simulation spirit. So we have our nutrition simulation and poverty simulation, we're going to teach them about epidemiology. We'll have them play Pandemic and actually try to apply real principles, not just naïve game play, and see if they can beat the game by knowing more about epidemiology. So that should be really fun too. Really interactive."

According to Amos, through the game, students would learn about things like "mortality, morbidity…tracking malaria."

The participants of the 2016 Global Health camp, including camp coordinator Jenny Amos (center, front row) and her grad student assistant Kenny Long (right, front row).

While the week's main emphasis was learning about global health, the campers also took time out from their work to learn about their college options during a dinner with a number of academic advisors from across campus. They got to play too; they went bowling and had a movie night, followed by a trip to a local favorite: Custard Cup.

Campers enjoy some ice cream at Custard Cup.

The purpose of the camp was "to get students aware of global issues, especially pertaining to health," says Amos. For students who are interested in that, they hoped "to have them understand their options, career wise. So we have people coming in to talk about NGO's they can get involved in, or degrees that they can pursue."

Amos goes on to explain that Global Health is a complex issue; there's not just one unit or degree for global health. But however they want to get involved, she wants them to know that they can learn about it at *Illinois.*

"Any of us can work in global health and input on that," she says. "So we want them to understand that it's a complex issue and that there are many paths, that there are many ways you can work in global health, from an academic research perspective, from an NGO perspective, from many different perspectives. And we want them to understand that they can do it here in I*llinois*, and hopefully we can recruit some of them here."

Two high school campers build a prosthetic device during one of MechSE's Exploring Your Options WYSE camps.

MECHSE'S WYSE CAMP HELPS HIGH SCHOOL STUDENTS EXPLORE MECHANICAL ENGINEERING

July 19, 2016

Many of the 24 high school students who participated in the 2016 Exploring Mechanical Engineering camp held June 26–July 2, are pretty much set on careers in engineering…They're just trying to figure out in which discipline. And MechSE's (Mechanical Science and Engineering's) WYSE camp appears to have the potential to assist them in their decision-making process. For one, unlike *Illinois'* other WYSE (Worldwide Youth in Science & Engineering) camps, most of which offer a brief introduction to a variety of engineering disciplines, MechSE's spends the entire week exposing campers to some of the fun stuff in mechanical engineering—from building their own 3D printer to designing a prosthetic device, and to learning how a career in engineering would allow them to make a difference in other people's lives.

Exploring Mechanical Engineering was run by MechSE faculty Matt West, Elif Ertekin, and Education Coordinator Joe Muskin, with help from a number of graduate and undergraduate students from MechSE and other engineering departments.

Two WYSE campers race toward the finish line during a wheel chair relay at Intelliwheels.

WYSE camper Connor Kirk works on his team's prosthetic device.

Many of the activities were new this year, including the main project: students designed then built their own 3D printer—pretty amazing for high school students to do, considering how new the technology is. That's not all they designed and built. They made a key chain they designed with CAD (computer-aided design). They were given a patient scenario, a young woman who had her left arm amputated three inches above her wrist, and asked to custom design a prosthetic device. They also designed and built a robot that responds to light. In addition they were also exposed to a cleanroom and learned about copper tape and programming arduinos, material testing, and microfluidics.

Students also got a taste of how engineers can impact industry and make a difference in people's lives. They visited Caterpiller and a new startup, Intelliwheels. While getting BS and MS degrees at *Illinois,* IntelliWheels co-founder and CEO Scott Daigle designed a wheelchair with gear-shifting technology similar to a bicycle. Now, at IntelliWheels, he designs wheels to improve the efficiency and usability of manual wheelchairs. His engineering philosophy which he tried to instill in the visiting students: Listen to the people one is designing for in order to create products that help solve their specific problems.

One "hands-on" activity in which campers participated during the Intelliwheels tour was a wheel chair relay.

Each camper got a chance to try out two different wheelchairs—one was a low-tech, less expensive wheel chair; the other a more expensive chair with high-tech wheels, to experience for themselves the differences in the useability of the two chairs. They also experienced the types of challenges persons in wheelchairs regularly experience regarding uneven or slanting pavement, etc.

One student who especially enjoyed these field trips was Connor Kirk, a rising junior from New Jersey: "I like how we're able to go to places, such as the Caterpillar office and Intelliwheels," he says. "I thought that was pretty cool."

Like many of the student participants, Kirk really enjoyed camp and says it helped him with his decision-making regarding what field/discipline to go into.

"It's a lot that we're doing, and I think all the experiences are helping me decide if I want to go into mechanical engineering or not. And I'm having a blast," he adds.

Like Kirk, Lizzie Wakelin, a rising senior from Springfield, Illinois, says she's thinking about being an engineer, and that MechSE's WYSE camp is helping her to zero in on which field:

"Yea, so this is to help me decide which discipline I should go into, because I'm not really sure what kind of engineer, and this will help me decide if mechanical is for me or if I should be in a different discipline."

Wakelin wants to be an engineer in order to make a difference in people's lives:

Two teammates work on the 3D printer they're designing.

"I enjoy math and science," Wakelin admits, "and it gives me a lot of happiness whenever I solve some complicated problem and build something that helps other people. I want to be able to build things in the future that can benefit people in some way."

Also thinking about being an engineer is Camille Broderick, a rising junior at Chicago's St. Ignatius College Prep. She joined a robotics club at her school last year, and that really got her interested. "I've been stronger in science and math, so that really got me thinking, 'Maybe an engineer could be a possibility.'"

Another student who's definitely thinking about being an engineer is Chloe Torm, a rising junior at Barrington High School in Barrington, Illinois. And it's clear that she's been thinking about it for a while…she's been a regular participant in the GAMES camp circuit for several years.

"I've done multiple engineering camps," Torm admits. "I've done GAMES camp three years now, and this is my first WYSE camp. So I've done robotics, aerospace, electrical, and then this camp is mechanical." Torm, who had actually attended the Electrical Engineering (GLEE) GAMES Camp the week before WYSE camp is "definitely leaning towards aero and mechanical."

She too believes WYSE camp is helping her to make a decision.

"Yea, I think so," she admits, "since I didn't do a mechanical camp, so it's helping me see possibilities of what I could be doing if I choose this track."

Is she going to apply to *Illinois*? "Yea, definitely!" says Torm.


A camper tries to navigate around a cone during a wheel chair relay.

Two campers use on of the Mechanical Engineering Lab's machines to drill a hole while creating their prosthetic device.

Pretty set on being an engineer, Rabin says the camp is: “helping me make up my mind on what discipline I want to go into. Right now I’m looking at a pretty broad spectrum as far as aerospace, electrical, mechanical, computer… I really enjoy a lot of aspects of these different things. I enjoy circuit boards; I really enjoy programming; I really enjoy building things...it’s helping me decide.”

Several of the staff members were also motivated by the desire to help the young people choose engineering as a career. For instance, MechSE grad student Lydia Bakalova wanted to help out with WYSE Camp to get them interested in engineering when they’re younger.

“I wanted to kind of see how we can improve building engineering skills into students with WYSE Camp to get them interested in engineering when they’re younger. I wanted to kind of see how we can improve building engineering skills into students from an early age. And I think it’s a good idea to start them from high school, then convince them that engineering is a super diverse field and they can do many different things. I’m really excited to see what they can come up with.”

Two high school students from Highland Park, a suburb about 45 minutes north of Chicago, also say that the WYSE camp is helping them decide. Both were unsuccessful in getting into the camp last summer, and would also say it was well worth the wait. For example, Dylan Treschel, a rising senior, admits, “I applied last year, but I did not get in. I got lucky this year though.”

Thinking about a career in engineering, Treschel says he’s trying to decide which discipline.

“I’ve been kind of focusing on either electrical, computer, or mechanical engineering. I’m kind of here to see whether I like electrical or mechanical engineering more.”

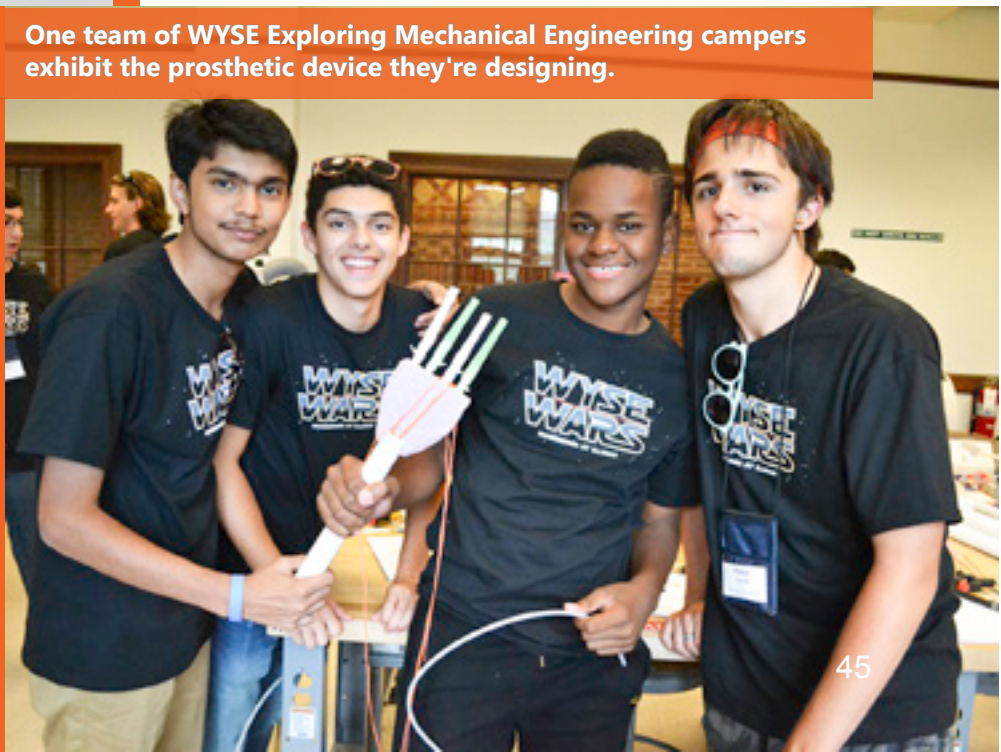
Another rising senior at Highland Park, Kyle Rabin, also applied last year, but applied too late and didn’t get in.

“This year I was fifth on the waitlist, I believe, and I got in. So that was good.”

His favorite part of the camp? Not having to worry about a grade!

“I’m really enjoying it so far,” says Rabin. “I really enjoyed building a 3D printer, and I enjoy working with small groups, especially with these projects. Usually, when we do projects like this, it’s in school, and you have to be stressed about the grade you’re getting, but this is purely for fun, and you’re just hanging out and doing cool things. It’s fun!”

One team of WYSE Exploring Mechanical Engineering campers exhibit the prosthetic device they're designing.



And Bakalova believes some of them might end up becoming engineers: “I think a lot of them have potential interest in doing that,” she says, “and they seem to be very interested in what they can do in the future, after graduating.”

Also helping out with WYSE was Baigalmaa Batmunkh, a Master’s student from Industrial Systems Engineering. Because her research is somewhat related, she was recruited to help teach the CAD computer design class. “So I got very fascinated about the idea of teaching what I know so well to future engineers.” She was also excited to “interact with students and help them learn about engineering skills.”

How’d the students do? “They work very hard, and they are very motivated and creative,” she explains. “So I am very fortunate to get involved with this summer camp.”

Batmunkh, who is from Mongolia, might also have a hidden agenda—to learn all about running STEM camps. She says that back in her country, they don’t have these kinds of science camps for high school students. And she hopes to someday host a similar camp for students in her own country.

“I want students in developing countries to have the same opportunity to learn and improve, and get a good education so that they can change their lives and change society as a whole,” she admits. “I really want that! One day I hope to come back to my country and work with students in underprivileged communities and then teach them science education.”

***Illinois* grad students Lydia Bakalova (left) and Baigalmaa Batmunkh, who instructed WYSE campers.**

She especially hopes to encourage girls to pursue a science education: “because in my country, Mongolia, we don’t have many female engineers. Even in leadership positions, there aren’t many females. So I really want to use my education to encourage other girls to pursue an education in science, and make changes in lives.”

Another MechSE grad student, Matt Milner, says he did the camp because he gets a kick out of watching the students problem solve.

“I think it’s a lot of fun to get out there and let them kind of create, and let them design something. Give them some ground rules, give them a problem to solve, and kind of see how their mind works and how

MechSE Ph.D. student Matt Milner works with a high school student during WYSE camp.

they solve the problem. It's really interesting to see."

Milner also finds working with the camp rewarding in a couple of ways: "I think it's good to give back," he admits. He also finds it rewarding to help the students grapple with whether they want to go into engineering as a career, and, if so, which discipline.

"Hearing the things they're talking about: 'Do I want to be an engineer? Do I want to do this? Do I want to do mechanical? Do I want to do aerospace? Do I want to do electrical?' These are all the same types of things I thought about. So having gone through it a couple years ago, I can talk to them about what I've been through and show them how I got through figuring out those tough decisions. And maybe something I went through could impact them. They can say, 'He did that, and that's kind of how he figured it out; that's maybe what I'll do.'"

Did Milner see any engineers among the group? Oh, yes, definitely," he says. "I think absolutely every one of them could be an engineer."

A WYSE camper works on his team's prosthetic device.

WYSE camp staff members Abby Pakeltis, a MechSE undergrad, and Elif Ertekin, WYSE camp co-coordinator, enjoy the wheelchair relay at Intelliwheels

Milner also admits that he and his cohorts were promoting Illinois.

"Oh yea, absolutely. Absolutely. You know anywhere they end up going, I think they'll be perfectly successful, and we really hope to have them here."

Milner, who "absolutely" intends to do the camp again next year, is already thinking about how to improve it. He says that every time he wears the cool WYSE WARS t-shirt (it had kind of a Star Wars theme) that participants wore on the final day of camp, it will remind him to plan how to make next year's camp better.

"I think it will bring back good memories and kind of solidify…I think it's a good way to be thinking, 'How can we get this better? How can we expand this? How can we bring in more students? What else can we critique and make this more interesting for students?'"

MechSE undergrad Abby Pakeltis, who helped with the WYSE camp, also found it to be rewarding, and believes she actually saw some students discover their future careers:

"Each week, I watched as the students with a variety of experience in engineering participated in the activities. Whether the campers were familiar with certain topics or were learning them for the first time, they all spent the week realizing their passion for learning and creating. During the camps, I would ask the students if they knew what they wanted to design or develop as engineers. One camper talked to me about creating prosthetics, and I was then able to see him build an incredible prosthetic hand at camp. Many of them had a chance to build or experience these possible future careers."

An Aerospace GAMES camper prepares to launch the glider she designed and built.

ROSADO CONTINUES TO IMPROVE ENGINEERING CAMPS, GROW THE STEM PIPELINE TO ILLINOIS

July 27, 2016

Sahid Rosado is a STEM outreach force to be reckoned with on the University of Illinois campus. After starting out as just an instructor for an Environmental Engineering G.A.M.E.S. camp session a few years ago, she is now the Outreach Coordinator for the College of Engineering and is in the process of not just improving but revolutionizing *Illinois'* Engineering camps via the addition of middle school students as she seeks to grow the STEM pipeline to the University.

This summer, 342 students attended Engineering's 13 week-long camps: 8 G.A.M.E.S (Girl's Adventures in Mathematics, Engineering, and Science) and 5 WYSE (Worldwide Youth in Science and Engineering) camps. Rosado was in charge of them all, which means she helped departments create fun and informative curriculum, made sure campers had suitable places in the dorms to live and to eat, arranged exciting evening activities, and ensured that students were exposed to the University of Illinois campus as a prospective college via a number of activities.

Never content to rest on her laurels, Rosado is always looking for ways to improve the camps, which she says were already great and informative when she inherited them a few years ago. For example, the G.A.M.E.S. Mechanical Engineering camp, G-BAM (Girls Building Awesome Machines) and the Material Science and Engineering camp, GLAM (Girls Learning About Materials), both revamped their curriculum for the 2016 summer. The G.A.M.E.S. computer science camp also experienced a change this summer. Rosado claims, "The computer science was different this year than it was last year because now we have them on a rotation, so last year was robotics, and this year it's very general computer science track." This change allowed the campers to spend more time coding and programming.

The G.A.M.E.S. camps weren't the only ones to experience change. Similar to G-BAM GAMES camp, the Exploring Mechanical Engineering WYSE camp, also revamped its curriculum. Also, the WYSE Discover BioE camp had a change in the team running it, and a field trip to JUMP Simulation Education Center in Peoria was added, (as well as to their BIOE G.A.M.E.S. camp counterpart).

And in a huge push to get campers to consider *Illinois* as their future university, another big change occurred during camp this year: All the campers got to hear from a University of Illinois Admissions representative. Rosado exclaims that "This year we actually had a rep from admissions come every single week. Last year we weren't able to make that happen, so this year admissions really worked with us."

Sahid Rosado, College of Engineering Outreach Coordinator

Curriculum wasn't the only part of these camps to get an update; the evening activities all campers participate in were also improved. For GAMES campers, Rosado upped the number of MakerGirl sessions. She said "The campers loved MakerGirl based on the surveys they provided us last year…and they're now doing two sessions instead of one just because we have so many girls." Fridays were typically "relaxation day" for the campers, but "some of the counselors last year suggested that the girls wanted to go to Green Street and go shopping," Rosado explains, "so now we made that an activity. On Friday evening, we give them the option of eating at

Hendrick House or eating out on Green Street, to just kind of experience a campus type of thing. We call it Green Street Shopping Day." Also, the usual kickball event has been replaced with the option of yoga or Zumba, run by two enthusiastic counselors. Not everything was changed though; due to popular demand, the scavenger hunt and movie night were kept.

A Chemical Engineering GAMES camper extracts DNA from strawberries.

While the Engineering camps are doing extraordinarily well and the campers are having a blast, Rosado isn't content to leave things as they are. She has some great plans for the future to make camps like these, and similar activities, available for more age ranges. So the next big hurdle for Rosado to conquer is the middle school age range.

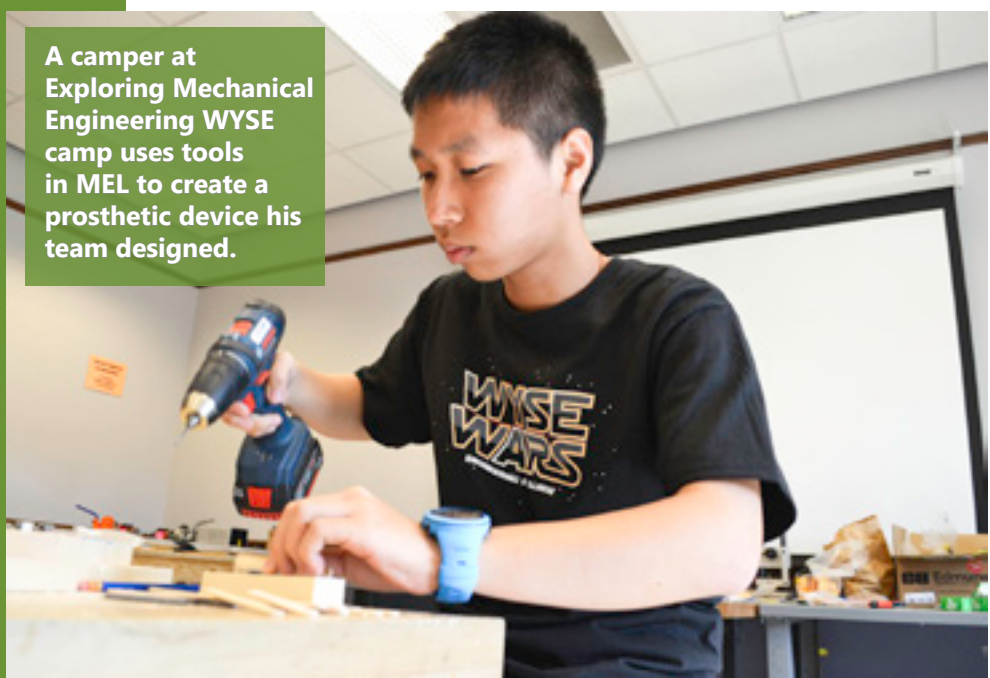
"Middle school is a very crucial age, especially for girls," she explains. "There is a lot of research and articles saying how important that age is. They show that girls, or in general students, they show very keen interest in STEM. When they track the students in high school, they've lost that interest. So there's a lot of research that shows that middle school is such a crucial age for students because that's when we can really grab their attention."

With support from this research, Rosado plans to add a middle school track to the G.A.M.E.S material science camp and call it Mid-GLAM. For the first year, it's only going to be a day camp for local girls. However, depending on the success of and thoughts about the camp, it may be made into an overnight camp, which would make it more accessible for girls who aren't local.

While Rosado acknowledges the importance of reaching out to middle school students, this doesn't mean Rosado is over G.A.M.E.S., which she says is important. "Even last year," she admits, "among incoming seniors who attended G.A.M.E.S., 74% applied to Engineering at *Illinois*," so Rosado and team are obviously doing something right.

Adding the middle school track isn't the only thing on Rosado's list of goals. To further entrench the STEM pipeline to *Illinois* Engineering, she also wants to expand the ChiS&E (Chicago Pre-College Science and Engineering) program, which exposes Chicago Public Schools students to STEM and the University of Illinois, from just 6th and 7th graders to 6th, 7th, and 8th graders. In addition to this, she created the ICANEXSEL (Illinois-ChiS&E Alliance for Nurturing Excellence in STEM Education Leadership) program, which involves a course for *Illinois* undergraduates to help raise their social awareness and generate more undergrad volunteers to mentor in ChiS&E.

While all these goals and achievements would be satisfying and fulfilling to most people, Rosado has yet to quench her thirst for fulfillment. She actually believes she "will never feel fulfilled." This is not necessarily a negative feeling though. When talking about her projects, Rosado states "I'm definitely moving towards the direction that I want to move in, but as I start thinking of things to do then I'm like 'Oh, we can do this too' so I feel like I will never be fulfilled, but it's good. I'm happy with what we're doing." Rosado is much more into the journey and creation of STEM awareness and empowerment than the destination of it.



A camper at Exploring Mechanical Engineering WYSE camp uses tools in MEL to create a prosthetic device his team designed.

Environmental Engineering GAMES campers analyze results during a water quality activity at Boneyard Creek.

A RailTEC grad student, Zhipeng Zhang, (right) supervizes as STEAMCATION students learn about different sizes and types of railroad cars.

STEAMCATION PROVIDES SUMMER STEAM...WITH A LITTLE HELP FROM ILLINOIS FRIENDS

August 16, 2016

The 48 local youngsters who spent the summer at STEAMcation doing activities which incorporated art into a variety of STEM-related activities not only had a lot of fun. They learned some STEM principles too. And helping teach the youngsters about some of these topics were a number of outreach-minded University of Illinois folk, such as the MCBees, a graduate student group from MCB (Molecular and Cellular Biology), and RailTEC, the Rail Transportation and Engineering Center.

STEAMcation is the 9-week summer program of STEAM Studio, Next Generation School's after-school and summer program that emphasizes STEAM (Science, Technology, Engineering, ART, and Mathematics). And according to Angela Nelson, STEAM Studio Director, contributions by *Illinois* staff and students who helped teach lessons and conduct activities about their areas of expertise were invaluable. In fact, she can't overstate the importance of exposing her students to these role models. Says Nelson: "It's huge; it's huge!"

To ensure that the STEAMcation activities were age appropriate, the students were broken down into two groups (with appropriate, STEM-related names, of course): the group for younger students (1st and 2nd graders) was dubbed "Nano"; the group for older students (3rd–5th graders), was named "Tera."

For each week of STEAMcation's nine-week summer session, students addressed a different STEAM-related topic.

Angela Nelson (center), STEAMcation students coat pennies with a zinc/copper alloy.

A STEMcation student makes his own musical instrument during STEAMtune week.

1. STEAMology (who are you as a fine arts specialist?).
2. Sustainable Farming (students visited *Illinois*' sustainable farm).
3. Lights, Camera, Action! (more Hollywood and fine arts than STEM, students looked at how to make a colored shadow. They also wrote scripts that they got to perform at the end of the week.)
4. Tinkering with Toys (students took toys apart, then learned how to make their own toys that could do different things).
5. Oceanography (students made submarines that went down and came up via the use of syringes).
6. Geocaching (students learned how to geocache).
7. STEAMtune (students learned the science of how instruments work, then got to make their own).
8. Castles and Courts (about science in medieval times; for this activity, the MCBees led a number of activities, including covering pennies with a zinc/copper alloy to turn them silver/gold).
9. STEAMvention (trains and how they work, which included a visit to RailTEC).

In addition to exploring the nine weekly topics, each week, STEAMcation offered Makers Lab and Fine Arts Studio.

"In the afternoon," Nelson explains, "they got to have the fun, the running around, or testing their experiments ....They've been doing a lot of fun experiments where they get to really learn and have

fun with the topics." For instance, one activity involved making cardboard boats which they got to race in a pool.

Another of the summer's highlights? Interacting with *Illinois* faculty and students who shared their time and expertise with the youngsters.

For instance, for Castles and Courts week, on July 25th, several outreach-minded Ph.D. students who are members of the MCBees graduate student group from MCB (Molecular and Cellular Biology) took the morning away from their labs to visit STEAMcation to share about science in the medieval times with the youngsters.

And on August 3, in an exciting end-of-the-summer field trip, STEAMcation's Tera group of 24 3rd–5th graders made a visit to *Illinois'* RailTEC (Rail Transportation and Engineering Center) to learn all about trains as part of STEAMvention week.

According to Nelson, one benefit of activities like the MCBees and RailTEC visits was so students could experience STEAM in the real world.

"A big component of what we try to do at STEAM Studio is give them real-world experiences, so they realize that math and science is happening all over the place. And the key thing is that it's not in isolation. So them going and seeing what these scientists are doing and seeing how they work together and how these experiments are done are helping to get them into a different frame of mind about what science is and the different facets of science so they can start to realize how they interconnect."

She also hopes her students discover all the different ways that one can be a scientist. "So you don't have to be a doctor or an engineer building a building. There's lots of different ways that you can be a scientist," says Nelson.

Nelson actually considers the lunch with the engineers during the RailTEC visit to be one of the highlights of the day: "Because they get to sit down with these people and ask them questions about how they got into what they do,

An MCB Ph.D student (center) works with some STEAMcation students to coat their pennies with a zinc/copper alloy.

and see how excited they are about their field and the cutting-edge research that's happening, and get to ask those questions that are on their minds."

Nelson also says that, as her program has grown over the last three years, she's noticed that the types of questions her students are asking are a lot more deep.

"They're actually starting to ask about the research when they talk to these people, and go, 'Well, why did you do this?' or 'What did this mean?' So it's starting to break down the boundaries between scientists and the public in many ways. They're thinking like a scientist. They're asking the questions. They're curious. And they're starting to make connections between different fields."

STEAM Studio Director Angela Nelson watches as a student puts the finishing touches on her muscial instrument during STEAMcation's STEAMtune week.

Nelson goes on to share the benefit to her students of being exposed to a varity of scientists and engineers in different fields.

"There's a stereotype out there," she adds, "that every scientist is sitting in a lab coat and just doing this type of experiment. But when they actually see that these people are doing lots of different types of experiments, and it's impacting their own lives, then all of a sudden it has a lot more meaning to them. You don't just have to be sitting at your desk the whole time to be a scientist."

Nelson's philosophy? Make everything a learning experience, even something that her young charges consider a mistake or failure.

"We really try to celebrate the unexpected. When things don't work the way they are expected to, let's not be upset with it or mad. But let's start to question and understand what it means. The kids are doing that. They are spending more time trying to understand. So we're opening their eyes and showing them that there's no one right way. There's multiple different ways."

A participant in STEAMcation is putting the finishing touches on her percussion instrument built during STEAMtune week.

Something else they push at STEAM Studio is discovery, inquiry-based learning. "We want them to discover, rather than be told," admits Nelson. "And I've noticed that means so much more to them. And it's amazing what a child can figure out on their own. So they make those connections on their own, and we just kind of give them the stepping blocks to get there."

According to Nelson, it is the emphasis on hands-on activities that makes it so easy for the kids to learn.

"They love it!" she exclaims. "Sometimes they're scared to start, but they're excited about these topics and it's possible to make it enriching for them. The key thing is that it's hands on. We get scientists or community members to come in and do something with the kids. So it had some purpose to it other than just a presentation."

Nelson particularly wants to express a thank-you to the University groups and personnel, like the MCBees and the RailTEC staff and students.

"I think the biggest thing is that we are so thankful for the amount of time that they are putting in to making this possible," she says. "The number of students that they have coming in as well as professors and community members to support these kids and get them excited about this is huge... I know how much time it takes to come up with these activities and then to take the whole day and dedicate it to them. These types of collaborations make a big difference for the kids.

A STEMcation student shows off the musical instrument she built during STEAMtune week.

Nelson appreciates having the University nearby: It's fortunate that we have UIUC so close. I've never run into a problem where I can't find someone who doesn't want to come and share and do something. It means so much to these kids."

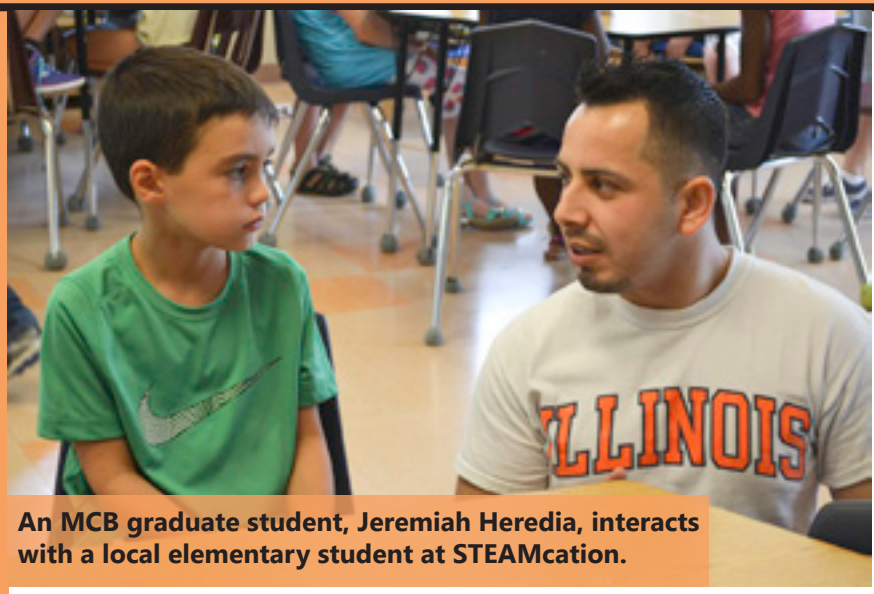
MCB Ph. D. student Mara Liveszey (center) shines a black light on a student's hands, revealing the "germs."

ILLINOIS' MCBEES EXPOSE STEAM STUDIO'S STEAMCATION STUDENTS TO MEDIEVAL SCIENCE

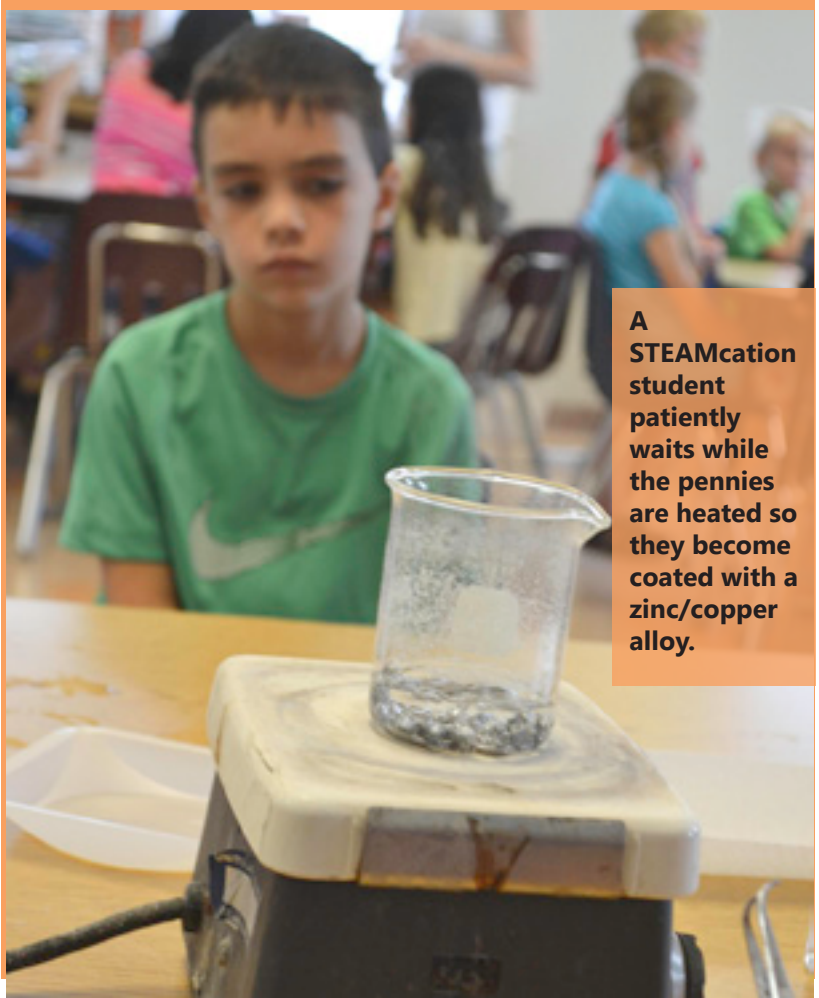
August 16, 2016

On July 25th, 24 local youngsters spent the morning doing some hands-on activities learning about science—in medieval times and today—as part of STEAMcation, the 9-week summer program of STEAM Studio, Next Generation School's after-school and summer program. And taking the morning away from their labs to sharing their scientific expertise and passion about their field with the youngsters were a number of outreach-minded Ph.D. students who are members of the MCBees, a graduate student group from MCB (Molecular and Cellular Biology).

What makes STEAM Studio different from your run-of-the-mill STEM (Science, Technology, Engineering, and Mathematics) programs is that it incorporates an ART component, (thus changing the familiar STEM acronym to STEAM). The Studio's 9-week summer program, STEAMcation, emphasized a variety of activities using art to learn about STEM.



An MCB graduate student, Jeremiah Heredia, interacts with a local elementary student at STEAMcation.



A STEAMcation student patiently waits while the pennies are heated so they become coated with a zinc/copper alloy.

For instance, the week of July 25th–29th, the topic, Castles and Courts, was about science in medieval times (and today). For their outreach, the MCBees first taught the students a series of brief lessons, each followed by a fun, hands-on activity related to it. The lessons/actvities ranged from covering pennies with a zinc/copper alloy to turn them silver/gold); the spread of the Black Plague, including how disease is spread today; and medieval medicine, which included a hands-on activity during which the students mixed up their own "cure" for disease.

According to the MCBee's Outreach Coordinator, Mara Livezey, the group's goal was to help the younger students think like scientists.

> **"One of the most important aims of any outreach group," explains Livezey, "is to seed in young children's minds their identities as scientists."**

So, with this goal in mind, the MCBees had the students participate in a number of hands-on, active learning exercises intended to reinforce the lessons taught that day. These chemistry, microbiology, and medicine-based experiments taught STEAMcation participants about the scientific process and scientific thought in medieval times.

For instance, one lesson was about alchemy. Students found out that creating gold out of other elements is not possible, then learned about present-day uses of galvanization and alloys. Supervized by the MCBees grad students, for the lesson's

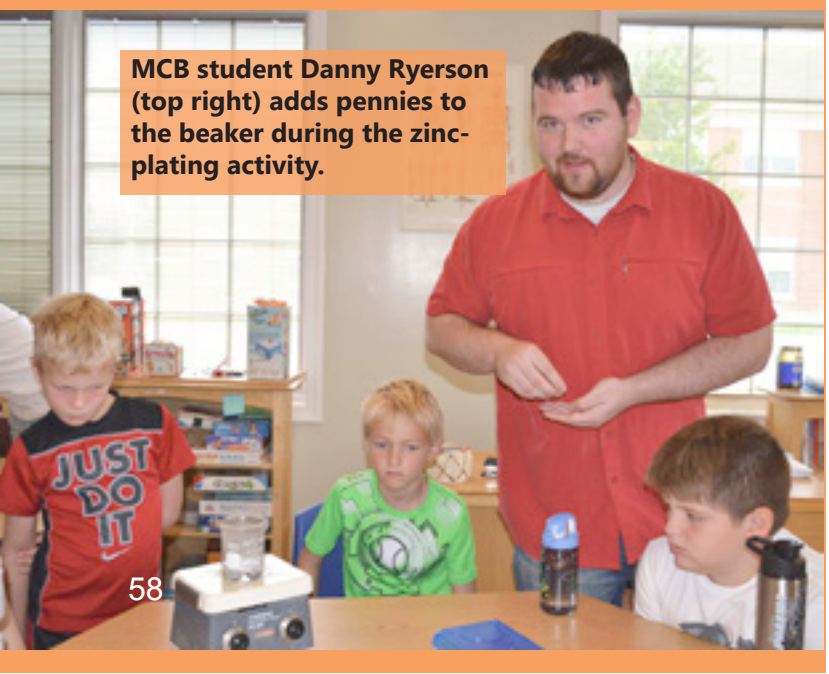
corresponding hands-on activity, students plated zinc onto pennies, creating a zinc-copper alloy by heating the pennies, to turn them gold in color.

In the second lesson, the students learned about the spread of the black plague which decimated the population across Europe during medieval times. Then the MCBees did a fun activity to illustrate how easily germs can still be spread today. Without the students' knowledge, the MCBees had previously coated some objects used in the first lesson with glow powder to simulate how easily a disease can be spread by touch. Livesey then used a black light to show the youngsters the "germs" on their hands.

Finally, to learn a little bit about medicine in medieval times, students made an herbal remedy consisting of grapeseed oil and dandelions to "cure the infection," just the way it would have been done in medieval times. The students first crushed dandelions, then added them to a vial of grapeseed oil, which they proceeded to shake vigorously.

"We hope that through our activities," adds Livezey, "the students learned about science (or the lack thereof) in medieval times and left with a greater excitement for and curiosity about science and the scientific process."

According to STEAM Studio Director Angela Nelson, one benefit of activities like the MCBees' visit was so students could experience STEAM in the real world. And in addition to sharing their expertise with the youngsters, the *Illinois* grad students also serve as role models. In fact, Nelson can't overstate how important students' exposure to these role models is. "It's huge," she exclaims. "It's huge!"



MCB student Danny Ryerson (top right) adds pennies to the beaker during the zinc-plating activity.

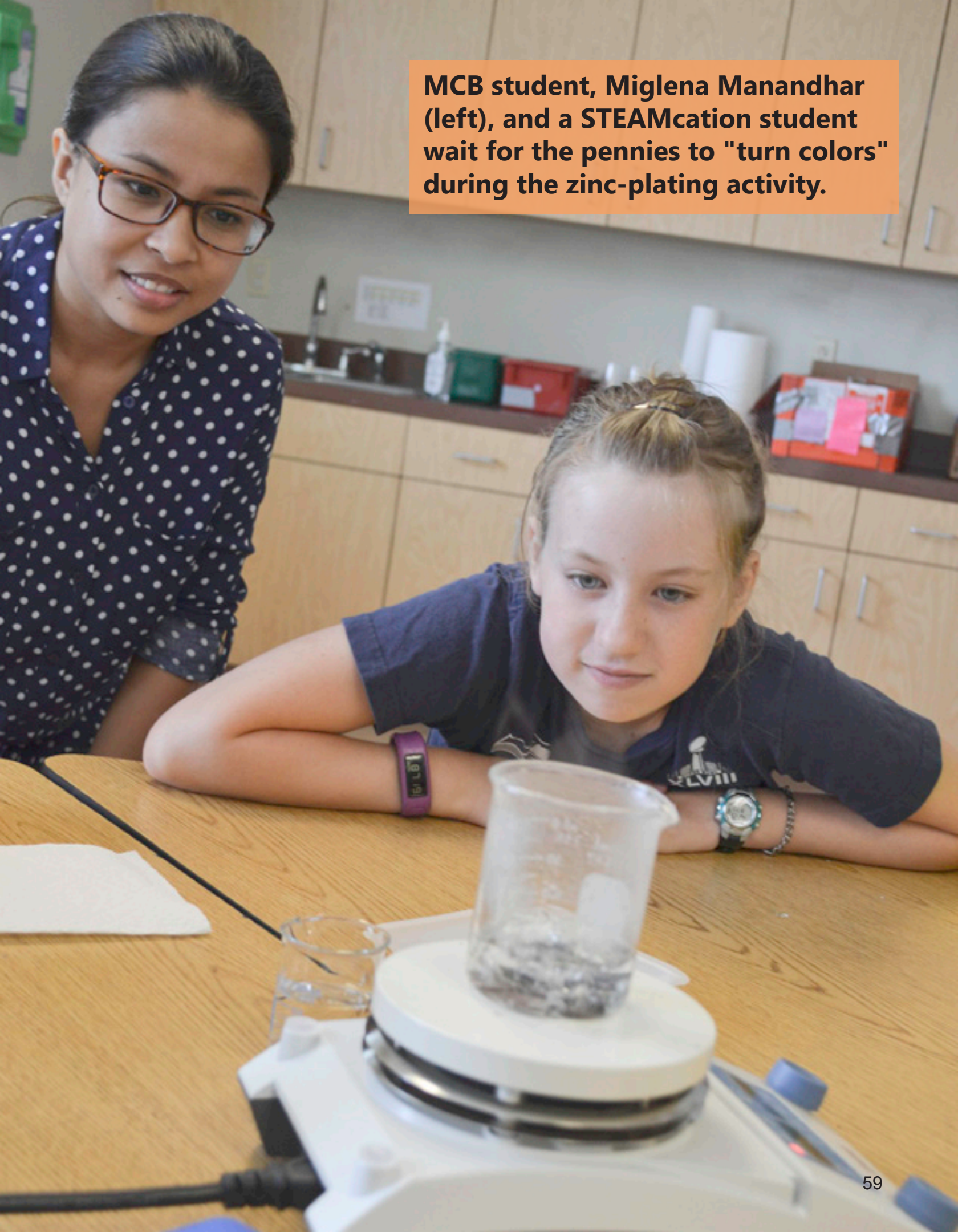
A STEAMcation student shakes her grapeseed oil and dandelion ointment to mix it up.

Nelson particularly wants to express a thank-you to the University groups and personnel, like the MCBees, who sacrifice their time to come and pour into the lives of the youngsters in STEAM Studio.

"I think the biggest thing is that we are so thankful for the amount of time that they are putting in to making this possible," she says. "I know how much time it takes to come up with these activities...These types of collaborations make a big difference for the kids."

Nelson is grateful to have a resource like the University nearby, which helps make her job of planning meaningful STEM programming a tiny bit easier:

"It's fortunate that we have UIUC so close. I've never run into a problem where I can't find someone who doesn't want to come and share and do something. It means so much to these kids."



MCB student, Miglena Manandhar (left), and a STEAMcation student wait for the pennies to "turn colors" during the zinc-plating activity.

STEAM STUDIO'S STEAMCATION STUDENTS VISIT RAILTEC...LEARN ALL ABOUT TRAINS

August 17 2016

Knowing that trains still engender excitement in youngsters, at RailTEC, *Illinois*' Rail Transportation and Engineering Center, staff and students tap into youngsters' love of trains to teach them some STEM principles. And on August 3, 2016, a group of 24 local 3rd through 5th graders from STEAMcation, STEAM Studio's 9-week summer program, visited RailTEC and experienced it firsthand. They spent the day learning about railroads; did a variety of fun, yet educational, hands-on activities related to railroads; plus had the chance to interact with some great role models—real, live engineers, who shared their passion for railroads and engineering with the youngsters.

The trip to RailTEC was the pièce de résistance of STEAMvention week, the final week of STEAMcation, the 9-week summer STEAM (Science, Techology, Engineering, ARTS, & Mathematics) program of Next Generation School's after-school and summer program for elementary students, STEAM Studio.

For the outreach, RailTEC faculty and students, in collaboration with the STEAM Studio Director, Angela Nelson, came up with numerous creative, hands-on activities related to trains that students found both fun and educational.

For instance, during the Intermodal Game, students learned an object lesson in economies of scale.

Arthur De Olivera Lima exibits an actual railroad spike; for his activity, students used push pins as miniature rairoad spikes.

RailTEC grad student Alejandro Reyes (right) teaches two students about roller resistance.

A wooden train with several cars loaded with materials can transport them more quickly, more safely, and with less expenditure of energy than individual trucks making individual trips to transport the same amount of material.

A RailTEC graduate student Nao Nishio, who helped out with the Intermodal Game, explains why she got involved with the outreach.

"I love railroads, studying railroads," she admits. "and I'm also a grad student for Rail Tech, and I definitely wish I had the experience they had when I was younger. I got into it in college, where I met Dr. Barkan teaching the class and all that. I'm hoping they get inspired and go into the STEM field or the STEAM field."

During the "Railway Track Design and Construction" activity, students used various components to build a replica of train track from scratch. Railroad ties were topped by rails (which were securely held in place using colored push pins), placed atop a bed of sand then topped with a layer of gravel. The students used spring scales to measure the resistance of track to movement. Besides learning the basic structural design of the track system, they learned to use measurement tools, record

data, and to analyze the results to help them understand how the track system actually works.

Arthur De Lima, a graduate student conducting research on improved track designs, helped with the railway track-building activity.

He called the event "a fun opportunity to teach kids what we do here—share the knowledge. When you look at a track, not many people know what's going on beneath the surface, how you build it, and how you operate over it. It's to show the kids how it actually functions, and seeing their excitement is always fun."

The activity, which was completely hands-on and involved building a track from start to finish, appeared to be extremely effective in teaching the children about tracks.

"I think the hands-on aspect helps them understand," says DeLima, "because if you're showing pictures and things, they might not be paying too much attention; but if they're working and building their own track, it gets them to understand what's going on."

RailTEC Ph.D. student Brandon Wang (right) watches a student "build" a railroad track.

A RailTEC grad student assists two students to weigh the different products being "shipped."

The Rolling Resistance activity involved comparing the resistance of two large model railcars that were otherwise identical, except one was equipped with metal railroad wheels and ran on track, and the other had rubber tires and ran on a flat surface that simulated pavement. The students used spring scales to measure each car's resistance to movement as weight was added to the railcar. They conducted replicates for each condition, recorded the data, and then calculated averages. They used their data to draw graphs that illustrated how the cars' difference in resistance increased as more weight was added, and that the car with metal railroad wheels required less force to move because of its lower resistance.

At the Wheel-Rail Dynamics activity, students first taped together plastic cups (orange, of course, emblazoned with a railroad's logo, no less), then tested them on a railroad track to see which of two designs would follow the track better without derailing. Then they tested smaller, metal rollers of different shapes and thicknesses on a metal track to see which worked best.

Students learned about "Electromagnetism,

Grad student Nao Nishio (center) explains to a student how trains with many cars can carry products more efficiently and economically.

Railway Signals, and Railway Traction," and actually built electromagnets using a nail, wire, and batteries. These illustrated how electric relays work and helped them understand how railway signals are controlled. At the locomotive simulator, students got to "steer" a locomotive, and even learned what the different train whistles mean (something this reporter didn't know).

During "Freight Car Size and Weight," the young visitors learned the best designs for freight cars used to carry products of different density. Helping out with the activity was RailTEC grad student Lijun Zhang, who says she got involved, "Because I really love kids, and I want to introduce them to some knowledge about the railway."

In addition, Operation Lifesaver, the national organization that promotes railroad crossing safety, sent an instructor to teach about railroad safety. Students watched several live and simulated demonstrations illustrating mass and momentum and explaining why trains can't stop quickly. They also experienced a video whose mantra was "Tracks are for trains, not for kids!""

Chris Barkan, Executive Director of RailTEC, says he and his team do outreach events such as STEAMcation's visit, first, "Because it's the right thing to do." Secondly, because of "the importance of STEM," and the need to get more kids interested:

"I think most people involved in science and engineering are excited about their field and are eager to share their passion with students."

Barkan believes his subject matter is the perfect vehicle to do so.

"We can take advantage of the special appeal railways have with many kids (of all ages) They are large, fast, powerful moving objects that easily capture one's interest. Students can "play" with these model train activities and at the same time learn STEM concepts."

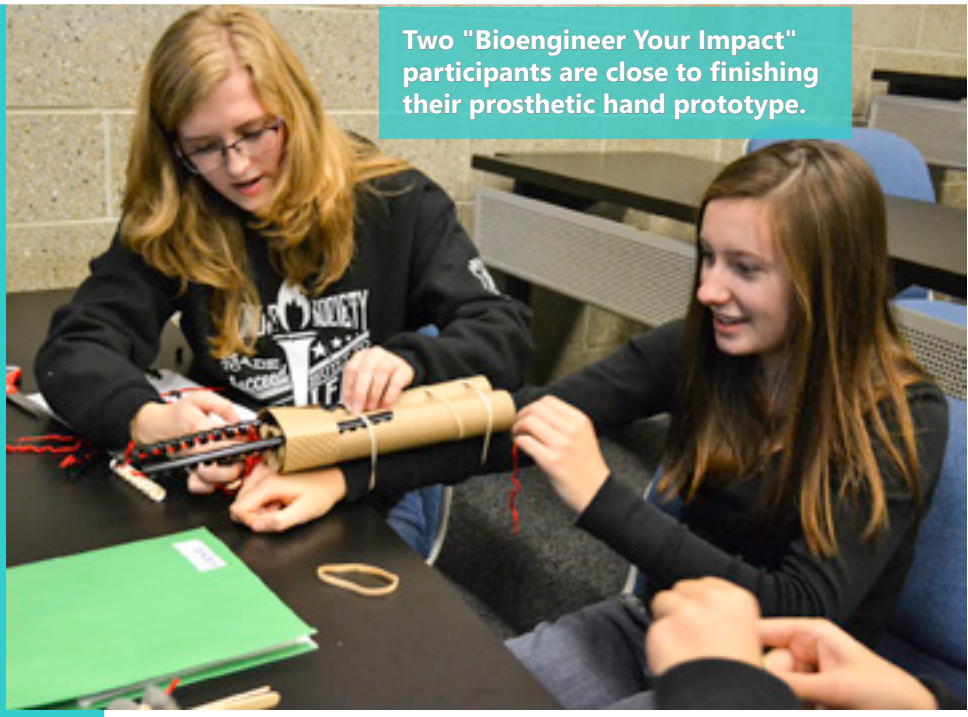
Left to right: Two STEAMcation students learn about the types of rail cars used to carry various products from RailTEC graduate students Zhipeng Zhang and Lijun Zhang.

BIOE junior Jackie Chen shares with the high school students during the student panel on internships in industry.

BMES OUTREACH EXPOSES HIGH SCHOOL STUDENTS TO CAREER POSSIBILITIES IN BIOENGINEERING

October 25, 2016

What is a bioengineer? What do bioengineers do? This is what 20 high school students from around the state hoped to find out at “Bioengineer Your Impact" on Saturday, October 22, 2016. Hosted by BMES, the (Biomedical Engineering Society), a student organization for Bioengineering (BIOE) undergrads, it was the organization’s first large outreach for high school students and was designed to pique the young visitors' interest in Bioengineering. During the day, highschoolers interacted with current BIOE students as student panels shared with the younger students about their experiences in research and as interns in industry. Plus, a variety of presentations and activities helped visitors discover the breadth of bioengineering career opportunities available to them in academia, industry, and the medical fields.



Two "Bioengineer Your Impact" participants are close to finishing their prosthetic hand prototype.

A high schooler discusses the materials she and her teammates should use to create a prosthetic hand during the afternoon design challenge.

During the event, visitors got lots of chances to interact with Illinois BIOE students. For instance, they heard from a couple of student panels; one comprised of both grad students and undergrads discussed some BIOE research applications. Another panel of BIOE undergrads shared about their experiences as interns in industry. Plus, to further help students understand research opportunities at Illinois, visitors toured several labs in the Institute for Genomic Biology.

BMES’ Outreach Director, Katherine Kiang, a junior in Bioengineering specializing in Cell and Tissue, reports that the interactions with Illinois students helped expose highschoolers to the many career options in BIOE: “They’re going to also meet a ton of different students who are either volunteers or speaking on the panels, and they all have such great experiences. So just by seeing that there are people that have done this vs. this, I think is going to be the biggest thing to show them just how diverse the field is.”

Speakers for the event included Assistant Professor Jenny Amos, who shared about Illinois’ new engineering-based College of Medicine at the intersection of engineering and medicine. Also speaking was MD/Ph.D. student Aadeel Aktar, who shared about his experiences in prosthetics, including his new startup company, Psyonic,

which builds low-cost prosthetics. Aktar's prosthetic hand is ground-breaking, in that sensors allow an amputee to control the prosthetic's movement using the same muscles in his/her arm that controlled their hand; plus, the sensors transmit back to the brain the sensations of what the "fingers" are touching,

During the afternoon Design Challenge, participants teamed up to design prosthetic devices, then create prototypes using string, tape, cardboard tubes, plastic coils, etc.

Why would busy university students dedicate a Saturday to outreach targeting high schoolers? Kiang hopes to show them that BIOE is a great career option:

A high school student works on his team's prosthetic device during the design challenge.

"They're at the age when they're really thinking about their career paths, so they're able to grasp these things we're telling them. This is king of a higher level than just trying to get people excited about math and science or teaching them what engineering is. It's a little more specific."

According to the event co-chair, Jennifer Zupancic, a BIOE junior specializing in therapeutics, one goal of the outreach was to inform visitors about the breadth of careers available in Bioengineering.

"A lot of people have a design idea when they hear bioengineering, but it doesn't usually encompass all the different fields. So they might think, 'Oh, it's just prosthetics,' or 'It's just medical devices.' But there can be a wide range."

Since participants who signed up for the event were specifically considering careers in the Bioengineering field, she added that it's important that they more fully understand what they're signing up for:

"When you're deciding what you want to major in college, it's good to have a full understanding when you go in, because sometimes you might get there and go, 'Oh, I wanted to do computational. But BIOE with a CS focus was better than just CS.'"

Like Zupancic, Kiang's goal for the event was to show students how diverse of a career path each could have as a Bioengineering student.

"A lot of times, people just think, 'Oh, bioengineering. You're going to go to med school,' or 'Bioengineering. You're going to make prosthetics.' There's just so much you can do, because it's such a diverse field, and it's so new. So showing them that, and decreasing any misconceptions they might have as to what this bioengineering field, which is a pretty new field, can let them do."

A high school participant makes the fingers of Aktar's prosthetic hand move.

Another BIOE student who took part in the event was Jackie Chen, a junior specializing in Computation and

A panel of Bioengineering students share about their experiences as interns in industry.

Systems Biology. During the student panel about internships in industry, Chen shared that he served as an Advanced Imaging and Modeling Intern at Jump Simulation in what he claims was a very programming-and-communication-heavy internship. “Because I was developing an Android application from scratch,” he explains, “I had to communicate with various doctors to understand the best approach to implement my product.”

Chen, always interested in mentorship and outreach with K-12, is also involved in Engineering Outreach Society and Engineering Ambassadors, which work with local schools to inspire students to pursue STEM. And he got involved in "Bioengineer Your Impact" in particular to “give these highschoolers insight on what it means to be an engineer and to work with medicine. These were insights from an engineering student that I wish I had when I was in high school.”

Like Chen, other BIOE students wish they had had a similar opportunity in high school. For example, this is why Zupancic does outreach:

"In the past, I have helped with several large outreach events to educate high school students as well as younger students about engineering in general through SWE. The events provided students with an opportunity to learn more about the various engineering majors from students currently studying them, and I wish I had a similar opportunity in high school. Due to my interest specifically in bioengineering, I think it is important for high school students to be able to learn more about the field when deciding on a major."

Katie Douglas, co-chair of the event, feels the same way: “I wanted to help with this event because a lot of high schoolers don't know what bioengineering is. It would have been helpful to have an event like this when I was trying to decide on a major for college.”

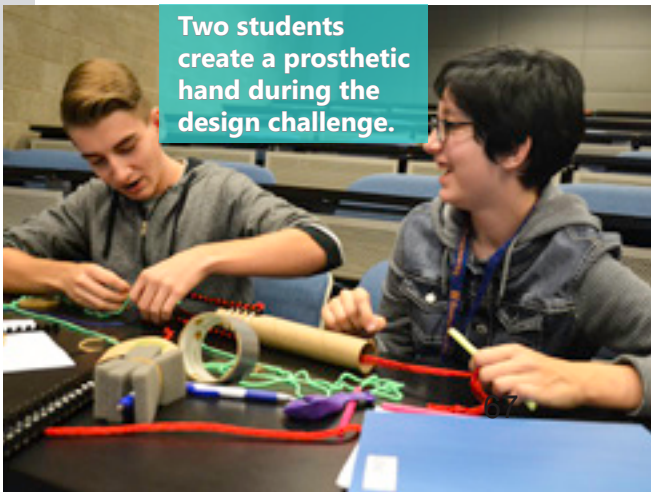
And this was exactly why Shannon Tripp, a sophomore at Carl Sandburg High School in Orland Park, a Chicago suburb, participated in “Bioengineering Your Impact.” She is specifically exploring careers in Bioengineering and wanted to find out more about it.

“Last year in biology, we learned about bioengineering, and I thought it was supercool!” she acknowledges.

Tripp also particularly enjoyed Aktar's prosthetic hand presentation: "Yea, I thought that was phenomenal. It was amazing."

Tripp says she found the event helpful in finding out more about a career in bioengineering. "It gave me a lot of insight into what you can do with a bioengineering degree, and how you can use it in different ways.”

Another participant, Bianca Rubel, an eighth grader at University Laboratory High School in Urbana, came to the event because enjoys events about engineering and science. "I love going to all of these engineering events. I've gone to a ton and I always have a lot of fun." Does she intend to go into engineering? "I don't know, honestly," she reports. "I have no idea what I'm going to do, but engineering's definitely a possibility."



Two students create a prosthetic hand during the design challenge.

ILLINOIS STUDENTS HELP YOUNGSTERS LEARN SCIENCE, HAVE FUN AT ORPHEUM'S SPOOKTACULAR

November 3, 2016

Decked out in their Halloween costumes, a number of local youngsters and their folks showed up for some pre-Halloween fun at Spooktacular, an event held at the Orpheum Children's Science Museum on Saturday, October 29th. While the youngsters appreciated getting to wear their costumes and, of course, access to the ubiquitous Halloween candy which was liberally sprinkled around throughout the museum, they also had fun learning about science and interacting with *Illinois* students who were present to make the day special.

REACT members Kevin Stehlik and Dhruvi Shah do a chemistry experiment for a local youngster at the Orpheum's Spooktacular.

Adding to the fun were a number of REACT (Reaching and Educating America's Chemists of Tomorrow) students who were on hand to share some ooky, spooky hands-on chemistry activities.

For instance, Dhruvi Shah, a civil engineering freshman and REACT member, helped with the dry ice bubbling acid activity. "I think the kids had a lot of fun. I think (hope) at least a few were inspired by how cool science can be and start thinking about going into STEM when they grow up."

Performing the Dry Ice Crystal Ball experiment for visitors was biology freshman Ankita Datta, who says she got involved with REACT because she loved what the organization had to offer.

"I love children and am always looking for to the opportunity to spread my knowledge on to others because I know it can make a difference in their lives," Datta explains regarding her participation in Spooktacular. "I think this event influenced children to be more interested about science by triggering their curiosity and to want to know more about how the universe works."

Chemical Engineering freshman Jacob Leicht did the experiment called "Frankenstein's Hand," which mixed baking soda and vinegar to produce carbon dioxide, thus making the glove expand.

Leicht shares why he got involved with REACT: "Because I love teaching chemistry to kids." Another bonus of joining the program, according to Leicht, was, "I can use it to count a chemistry course for honors credit."

While he says some of the children were probably too young to fully understand what was going on, believes others actually got something out of it.

"I was surprised at how much enthusiasm and knowledge they had about the chemistry, so they enjoyed seeing it in action," Leicht admits. "Who knows, maybe even a few actually learned something new about chemistry."

Leicht's partner at the Frankenstein's Hand experiment was Shuyue Zhang, a freshman in chemical engineering. Zhang participated in the event because she loves outreach. "I have been

always engaged in all kinds of volunteering activities in high school, so I just wanted to complete the REACT program as a way to volunteer."

Zhang believes the event helped pique some youngster's interest in chemistry:

"I personally really enjoyed seeing how surprised and happy the kids were when they saw the gas filling the glove. So I think doing the experiment, particularly on a Halloween weekend, will make them to be more interested in chemistry and to start to notice science can be simple and can be everywhere in our daily lives."

Also helping with the day's festivities were a number of Illinois students from Human Development and Family Studies who exhibited their artistic skills at the very popular "Face-Painting" station.

While Kaitlyn Sebastian, a freshman in Human Development and Family Studies, indicates that she participated in Spooktacular because it was a volunteer opportunity provided by her major, but she also thought it would be fun. "I specifically chose the Orpheum event because I knew it would include a ton of fun interaction with children in all kinds of cute costumes."

Part of the face-painting team, Sebastian appreciated that the event was not only fun for families, but educational too.

A local youngster prepares to drop dish detergent into a plate of milk to watch the diffusion of the food coloring.

Left to right: REACT members Shuyue Zhang and Jacob Leicht show visitors "Frankenstein's Hand."

"I think the Halloween Event at the Orpheum Museum was a great opportunity for families to dress up and do fun, Halloween-themed activities together. The chemistry presentation was a very cool and, most importantly, educational twist to the event for the kids to enjoy!"

A local grandmother explains why she brought her four grandchildren to the event.

"The Spooktacular was a win-win," she explains. "It was both fun and educational. They got to wear costumes, get their faces painted, and eat candy, all while learning about science. It's my goal to expose them to and get them excited about STEM as much as possible while they're young. Plus, I intend to continue doing so as they grow. I want them to be comfortable with it and feel it's something they can do when they get older. I'd like it to be a viable option for them later on when they're thinking about careers."

A young "Princess Leia," accompanied by her mom and dad, gets some early exposure to STEM at the Spooktacular.

Kaitlyn Sebastian, a freshman in Human Development and Family Studies, paints the face of a local youngster.

Five local sisters, all dressed as insects (They're bugs," corrected their mother, "because sometimes they bug me!") blow big bubbles in the Orpheum's Bubble Machine.

Some local children, cousins from Urbana, enjoying the Orpheum's Spooktacular event.

LOCAL K-5 STUDENTS LEARN ABOUT DNA AND GENOMIC RESEARCH AT IGB'S GENOME DAY 2016

November 30, 2016

Around 500 visitors, both young and old, spent their Saturday afternoon on November 12th at Genome Day, learning more about DNA and genes. Sponsored by the Institute for Genomic Biology (IGB), the event featured fun, engaging, hands-on activities taught by 120+ *Illinois* students, staff, and researchers associated with IGB who were on hand at the Orpheum Children's Science Museum, where they shared their passion for genomics and introduced the visitors to the world of IGB's research.

A local youngster learns about the role genes play in animal development while experiencing fossils and skeletons.

Nick Vasi, IGB Director of Communications, describes the goal of Genome Day: "So K-5 kids get an introduction into what DNA is, what genes are, what genetics are." He says the outreach also emphasized things like "how food fuels your body, or how DNA works inside you, or how cells are made, or the size of things—like how big a cell is, how big DNA is, things like that.

Participants received a "passport" that was stamped after they completed each of the 18 activities listed below. The secret code that was revealed upon completion? "My genes are not pants!"

1. Short Names
2. Dancing Plants
3. Build-a-Bone
4. Plant Plasticity
5. Tiny Things
6. Krazy Chromosomes
7. DNA Extraction
8. Delicious DNA
9. Giant Genomes
10. Glowing Genes
11. Crack the Code
12. Extremophiles
13. Mammal Phylogeny
14. Your Senses
15. Genome Assembly
16. Bio Bistro
17. Punnett Eggs
18. Broken DNA

While advertised as for K–5 students, Genome Day appealed to visitors of all ages, ranging in age from very young (infants) to senior citizens—local grandparents who tagged along to enjoy the event with their grandkids.

"We say it's K–5," says Vasi, "but it's really learning for anyone who wants to learn more about science or get more interested in DNA or genetics."

According to Vasi, between 350 and 500 people usually attend the event each year. "So it's just a wonderful way for us to get engaged with the community," says Vasi.

Vasi adds that it's important to not only engage the community, "and have them experience what's going on in the scientific disciplines, but also let them know what kind of research takes place at the IGB."

But in addition to exposing the public to IGB's research, Vasi says another goal is to show

visitors how the research might impact them personally:

"Our scientists and our students, our post-docs, and our faculty— they're all working on these really interesting, real-world issues that might apply to your life in ways you never understood before. And that's one of the ways we like to bring this to the community."

IGB post-doc John Ferguson explains about Phentypic Plasticity, how plants can change their appearance via a genetic response to environmental stresses.

Vasi admits that for him personally, he sees the event as a way to recruit more youngsters into science….maybe even to *Illinois* and the IGB.

"I really like to see that the young kids get an interest in science. My biggest hope is that they'll get enticed by something they see today and maybe a couple of years down the road, they get more interested in science, and a couple of years down the road after that, they maybe come to the U of I, and maybe they come through the IGB one day. I would love to see more scientists come out of engagement activities like this."

IGB's Communications and Outreach Specialist, Katie Metcalf, hopes the young visitors learn some things at the event that they're not necessarily exposed to at school.

"Genomics isn't really taught in schools, and we really appreciate the opportunity to bring this kind of education to our community," she says. And while it's part of her job to be at the event, Metcalf admits that even "If it weren't mandatory, I would've volunteered anyway. This is such a great event."

In charge of a coloring activity, Metcalf was really impressed by how engaged the young visitors were: "[The kids] have been really into coloring. I honestly did not expect that. But they've been so bright, they're remembering these big words, they're really engaging with these concepts."

A young visitor to Genome Day learns about genomics as she chats with an Illinois grad student.

Also excited about the level of the children's engagement was John Ferguson, an IGB post doc who works in Andrew Leakey's lab, which studies the mechanisms of plant responses to global change, including rising CO2 and O3 concentrations, temperatures, and drought stress. Ferguson believed he definitely had interacted with some future scientists.

A local youngster and Illinois grad student at the "Dancing Plants" activity are positioned in front of a green screen in order to see themselves "dancing with plants."

"Most of the activities here deal with experimental aspects; they're much more hands-on and perhaps more fun, but there's a whole big area that's rapidly developing in genomics that's very important and, without which, would be very difficult to move forward in personalized medicine—and this is computational genomics."

She explains that their exhibit dealt with short sequence alignment and genome assembly. To help participants better understand, she and her colleagues at the booth tried to explain the concept by having participants match short pieces of a sentence, "The crazy fox jumped over the lazy dog," with one another to eventually construct a full sentence.

A local mother who says her daughter is interested in science and wants to learn, brought her to Genome Day in hopes of exposing her to things kids aren't currently getting in school.

"I think they have exhibits that are so hands-on, this is the best place for her to ask questions and learn about new things that the school might not [offer]… they'll get to it, but not yet. So she gets an opportunity to get excited about what to look forward to!"

"Some kids are really engaged in it, and it's really exciting to see; the future looks bright, for sure."

Ferguson says he participated because he wanted to give something back to the community.

"I would have loved something like this when I was growing up," he acknowledges, "and there wasn't anything around that I could remember. So it's a really nice opportunity to try and teach kids and the general public about the kind of research we're doing."

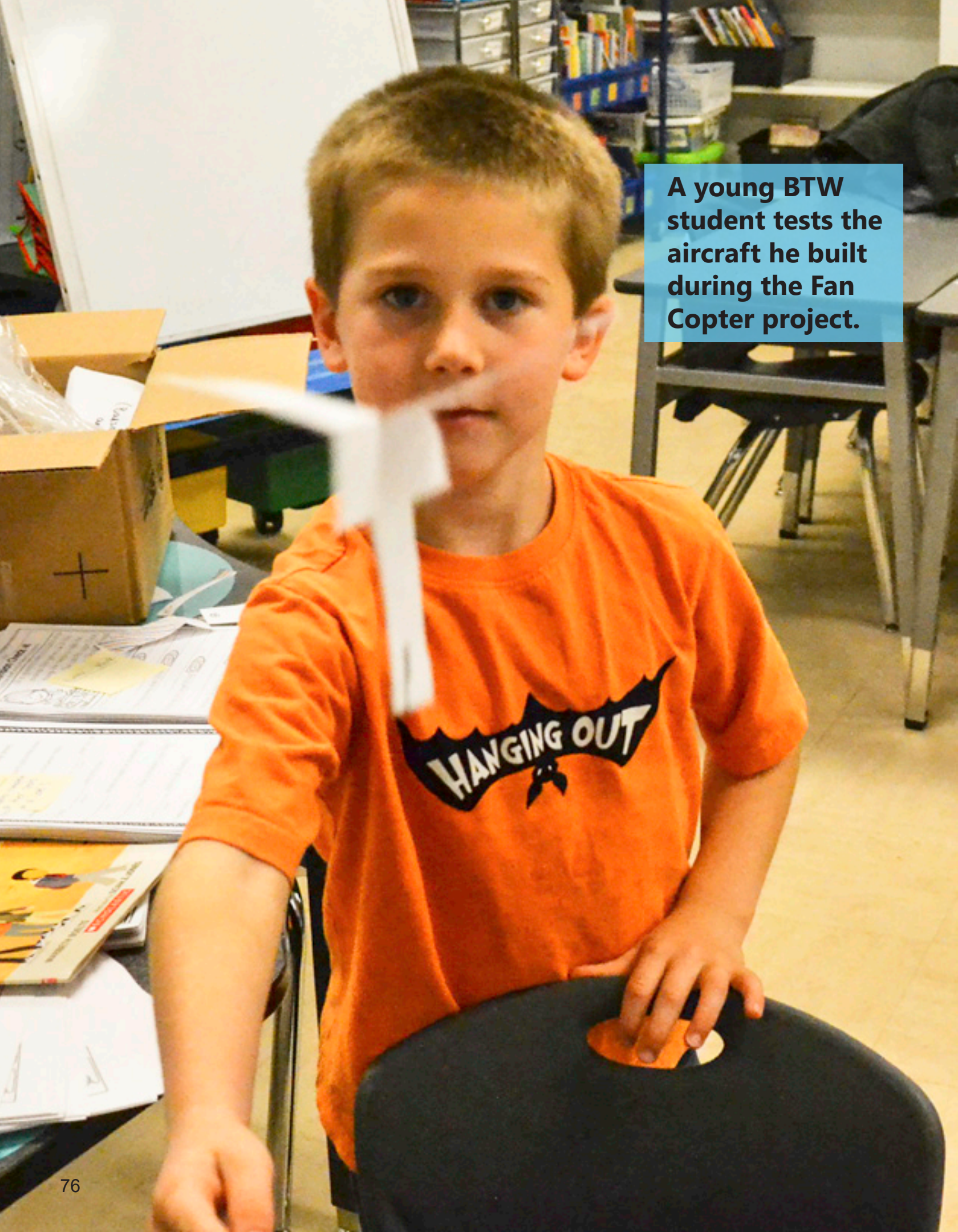
Helping out at the animal skeletons and fossils exhibit was a local high school student, James Carter. A junior at Central High, Carter says he helped with the Genome Day exhibit to get more experience in his chosen field: zoology.

"My mom signed me up!" he admits. "She said it would help me later on in my work field. I want to be a zoologist." How did he decide to be a zoologist? He indicates, "I wanted to know the behavior of animals, so I looked up what I have to do to do that, and I have to be a zoologist and neurologist."

Ludwilla Mensor of NCSA, who says she's been participating in Genome Day since it started in 2012, helped staff a booth about the computational aspects of genomics.

This is the projection the youngster and grad student above saw of themselves "dancing with plants."

A young Genome Day participant at the "Plant Plasticity" activity learns about how plants change their appearance via a genetic response to environmental stresses.



A young BTW student tests the aircraft he built during the Fan Copter project.

AEROSPACE ENGINEERING OUTREACH TAKES OFF WITH SUPPORT FROM ILLINI AEROSPACE OUTREACH

December 6, 2016

As its name implies, Illini Aerospace Outreach (IAO) is all about Illinois Aerospace students sharing their love of aerospace engineering with local students. IAO's goal? To pique students' interest in aerospace—or STEM in general. While IAO members do numerous outreach events themselves, the organization also serves as the main point of contact for organizations and schools seeking outreach from one of Aerospace Engineering's numerous RSOs (Registered Student Organizations). IAO's third job? To babysit a huge, Rolls Royce Concorde airplane engine.

Two students enjoy the flight of a fan copter during a recent IAO outeach at Booker T. Washington STEM Academy's Family Engineering Night.

IAO was begun three years ago when Rolls Royce (bet you thought they only made expensive cars!) donated a Concorde engine to Aerospace. So the organization was created to not only be in charge of the engine, but to show it off, making sure that plenty of eager young students got to see it (but not necessarily touch it!) at events such as EOH (Engineering Open House) or tours of Talbot Lab. However, it's not just the younger students who learn from the engine; it also facilitates the instruction of *Illinois* Aerospace students, who study it during different classes.

While minding the Rolls (and its little brothers—Aerospace has several smaller Rolls Royce engines too) was rewarding in terms of showing kids how cool Aerospace can be, the engine was obviously too big to cart around for show-and-tell. So the group also got involved in other kinds of outreach. For instance, IAO visits Champaign's Orpheum Children's Science Museum once a semester to do outreach.

A BTW student creates her wind turbine blades with the assistance of her dad, BTW Principal Ryan Cowell.

Plus, IAO members also do outreach in schools. This fall, for example, the group sent teams of students to Booker T. Washington STEM Academy (BTW) to work with Kindergarteners at its after-school Engineering Club, and to BTW's recent Family Engineering Night on November 29th, 2016, to work with youngsters of all ages.

IAO has perfected several hands-on activities. In one, kids build (and launch!) Alkaseltser rockets. In another, Fan Copters, kids build paper helicopters which they then "launch." (This reporter was

amazed...every single one of those babies flew at BTW's outreach, whirling around just like helicopters!) In their Wind Turbines lesson, students learn about how wind turbines provide renewable energy, then design turbine blades. While outreach lessons feature fun and exciting hands-on activities, IAO also strives to teach kids principles about aerodynamics and flight.

Along with special, one-time outreach events, IAO also partners with teachers to teach aerospace in classrooms. Each activity is one lesson, with an accompanying lesson plan that covers what's being taught. Also, lessons are aligned with *Illinois*' Next Generation Science Standards and fulfill one or more required science elements—a big plus for teachers.

Do IAO's volunteers ever struggle to communicate very technical college-level, information at a level kids can understand? Not really.

"Most of the stuff we do, we can explain in very simple terms," says Elijah Chen, President of IAO. "It's not too difficult to get to younger students."

Plus, they've learned a couple of key outreach principles about engaging kids. One, "If it involves hands-on work, they will be very excited about it," Chen admits.

Something else they've learned? Should things get bogged down, there's always a go-to activity that works every time: "Kids are always interested in explosions!" he admits.

ISO's Daniel Yu explains the principles regarding the Wind Turbine project.

A BTW student tests the wind turbine blades she designed, which successfully generated enough power to light up the LED on the turbine.

Although IAO mostly works with K through middle school students, a rocket competition for local high school students is in the works for some time next spring.

In addition to its members doing outreach themselves, IAO serves as an umbrella over 10–15 Aerospace Engineering RSOs. So when a school or organization wants a group to do outreach about aerospace, they contact IAO, whose executive board then does the legwork and schedules one or more groups to accommodate them.

Chen, a junior in aero, whose dream job is to design airplanes for Boeing, explains his passion for outreach:

"I just want to teach younger students what aerospace is. I feel like the younger the student is, and the earlier they are exposed, the more likely they will go into aerospace engineering. I just like teaching younger students what I do. It's a really fun topic, and it's very exciting."

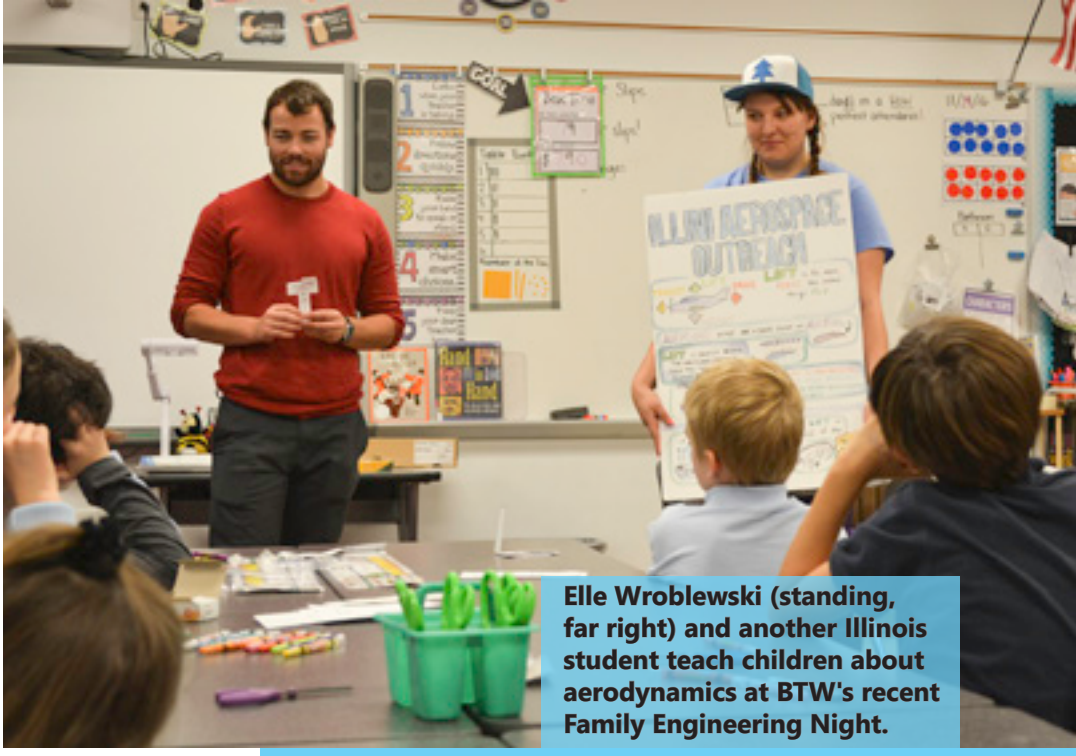
Another member of IAO's Executive Board, vice president, Elle Wroblewski, helped supervise outreach activities at BTW's recent Family Engineering Night.

A 3rd year grad student pursuing her PhD in Aerospace, Wroblewski seeks to reduce drag (the

force [the wind or air resistance] that opposes, or pushes in the opposite direction as an aircraft moves through the air).

She tests wings that have been theoretically optimized to minimize drag, and is also is developing a hybrid electric drivetrain simulation to be implemented into a full-scale, aircraft performance model.

Her dream job? To make the industry less damaging to the environment by improving the efficiency of aircraft to reduce harmful greenhouse gas emissions.



Elle Wroblewski (standing, far right) and another Illinois student teach children about aerodynamics at BTW's recent Family Engineering Night.

Wroblewski got involved in IAO because, as a kid, nobody came to her school to teach her what Aerospace Engineering was; so she hopes to remedy that for some of today's kids.

> **"I think that for kids, being exposed to engineering concepts in a fun, hands-on way can be really beneficial for how they view engineering later."**

She particularly hopes to target girls before they reach their pre-teen and teen years, which research has shown to be a "black hole" in terms of science: "I know that once girls reach middle school and high school, they're much more likely to stop being interested in science, from a lot of institutional and societal factors."

Wroblewski also hopes to boost kids' confidence that they can do STEM:

> **"I'm hoping that by being involved in my community, I can help kids who might not ever think, 'Hey, I could do this,' about engineering to realize they are actually interested in it. From my perspective, being interested in it is all it really takes—since that's what can motivate you to put in the work."**

Wroblewski believes succeeding in engineering (or STEM in general) is not so much about being super smart, but being super motivated.

Elijah Chen, president of the Illini Aeriospace Outreach, next to the business end of Aerospace Engineering's big Rolls Royce Concorde engine.

> **"A lot of people don't feel like they can hack it, like it's something only super-geniuses can do (the rocket-scientist stereotype doesn't really help). But it really just takes hard work and persistence, just like any other career. I think bringing engineering to schools and showing students that they can be engineers really breaks down some of those misconceptions, and could help kids be more likely to embrace STEM fields."**

A BTW student making his Fan Copter.

Did Wroblewski see any future aerospace engineers at BTW? “I think all of them could be aerospace engineers!” she exclaims, along with the caveat: “They're so young; they've got at least eight or nine years to make that decision.”

However, she admits to seeing "lots of kids in elementary school who are interested in planes and know a lot about rockets and spacecraft already.” Ironically, although she's at *Illinois* working on a Ph.D. in aero, she says that when she was a youngster she was, “really into birds and wanted to be a veterinarian!” But maybe she didn't actually stray all that far from her initial interest; after all, she was interested in things that fly.

According to Wroblewski, the goal of outreach should be to give youngsters confidence that they can do or be anything they want:

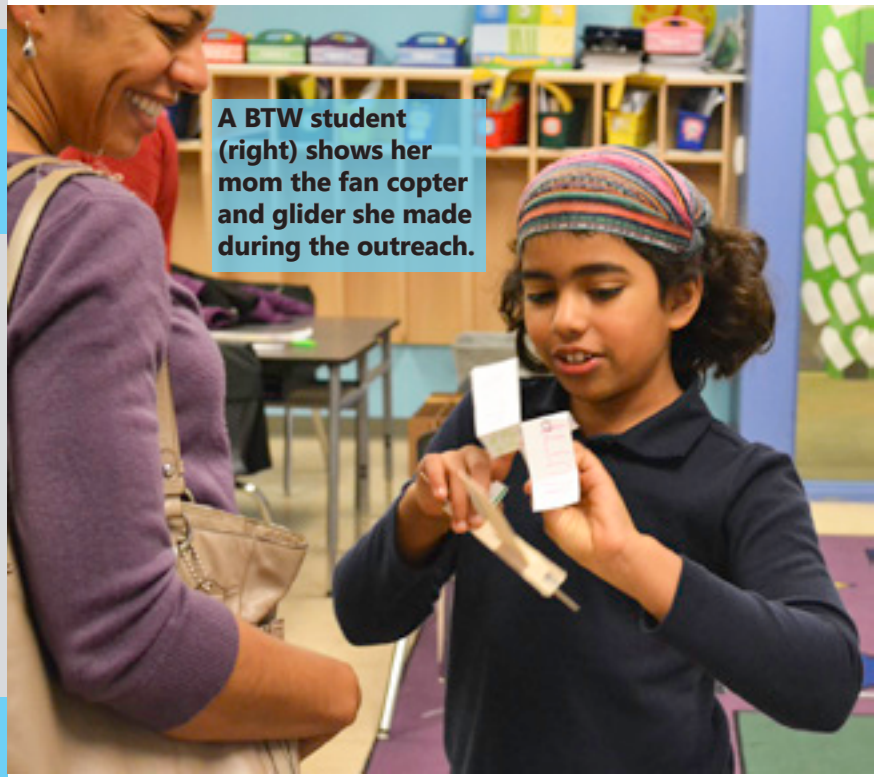
“I think the most important thing is to realize that anybody can do anything. It's our job as adults in STEM fields to expand what 'anything' is for kids by making science engaging and exciting.”

BTW's proximity to campus, and the fact that it's a STEM school, gives its kids a lot more exposure to engineering compared to kids at other schools. Wroblewski thinks that gives BTW students an edge.

“I think that continually meeting with and learning from engineers at *Illinois* can help cement the idea that they are more than capable of being engineers themselves. I think it helps for them to make a connection between what they might learn about in class to meeting people who do the work in real life in a fun, educational setting.”

According to Wroblewski, Kids aren’t the only ones who need convincing that they could be engineers. Sometimes their parents need to be convinced as well. And she believes events like BTW’s Family Engineering Night help to convince them.

“Because one of the barriers that kids can face when thinking about their future is their parents not understanding what options there are out there. By working with kids and parents, I think it makes it more likely for parents to realize that their kid has more options than they might have thought, which would help them be more supportive, regardless of what their kids end up wanting to pursue.”



A BTW student (right) shows her mom the fan copter and glider she made during the outreach.

A BTW student works on his fan copter.

Magic Show Performers Gretchen Adams, Jordan Axelson, and Christian Ray appreciate the flame of a Roman candle.

CHEMISTRY'S HOLIDAY MAGIC SHOW DOES A BANG-UP JOB SAYING, "MERRY CHRISTMAS!"

December 14, 2016

Members of the audience applaud one of the Holiday Magic Show's holiday-themed Chemistry demonstrations.

The standing-room-only crowd crammed into 100 Noyes Lab for the final Holiday Magic Show of the season discovered that even chemistry can be magical around the holidays. And after experiencing some demonstrations by several of Chemistry's top instructors, they learned that Chemistry can not only be merry, but bright…and quite loud!

The audience also discovered early on that participation is pretty much a requirement to attend the event...so they did. They hooted with laughter; clapped at the outrageous antics; chanted the show's, "It's not magic, it's science!" mantra (which they were instructed to repeat numerous times during the show); sang along to the carols; like the teacher's pet in school, raised their hands then shouted out the answers; stuck their fingers in their ears in preparation for loud noises; oohed and ahed appropriately during the pyrotechnic events; and during the show's big finale, ducked to avoid flying soapsuds (which some kids even scrambled to the front afterwards to scoop up.)

The popularity of the Holiday Magic Show was apparent even before the show started. Performers had to ask members of the audience to point out any empty seats, scoot together, even hold small children on their laps to make more room so some of those standing in the hall to watch could be seated. (To ensure crowd safety, the Fire-Marshall-established rules were that anyone in the auditorium, other than the performers, must be seated.)

Magic Show Performers Jose Andino, Don Decoste, Christian Ray, Gretchen Adams, Jordan Axelson, and Tina Huang prepare their opening number, "We Wish You a Merry Christmas!"

From the very beginning, the Holiday Magic performers exposed the appreciative audience to the magic of chemistry. Like a well-oiled machine, the chemistry crew executed one stunt after another, all exhibiting the show's trademark formula combining high-energy chemistry (emblazoned across the back of their lab coats, lest we forget), slapstick comedy, magic show, and chemistry lesson, all segued together by banter relating each demo to the holiday theme and accompanied by the appropriate holiday music in the background.

For instance, they began the show with a rousing chorus of “We Wish You a Merry Christmas,” for which the singers’ voices had either a “Three Chipmunks-esque” timbre (due to inhaling gas from Helium-filled balloons), or a “Darth-Vadar-esque” quality (achieved by imbibing from Sulfur-Hexafluoride-filled balloons). The grand finale was a huge, fountain-like explosion of soap suds (due in part to the liberal addition of dish soap by Don DeCoste, Chemistry's Education Specialist, despite being "cautioned" not to do so on several occassions), which liberally doused the Director of General Chemistry, Christian Ray, with suds, and even reached some folks in the first couple of rows in what Ray had warned was the "splash zone."

Don DeCoste and Jose Andino set snowmen ablaze.

And in between, the performers demonstrated the wonders of chemistry—Holiday Magic style: they set snowmen ablaze, ignited gas-filled balloons, electrified a pickle so it glowed (and smoked), ignited gas-bubbled soapsuds, passed fire from hand to hand, and proved logically, according to Decoste, that if potato chips are made from potatoes, and corn chips are made from corn, then sun chips are made from the sun, which he proceeded to demonstrate via an appropriate glow.

One can only imagine the criteria mentioned when enlisting chemistry instructors to perform in the show. To weed out the faint-at-heart, the job application form most likely specified:

- Relishes the outrageous!
- Fearless.
- Likes loud noises (the louder, the better).
- Appreciates pyrotechnics
- Finds bliss in a blaze.
- Savors blowing things up.

For those of you not sure what pyrotechnic means, according to Wikipedia, it’s the science of producing exothermic chemical reactions for the production of heat, light, gas, smoke, and/or sound—which pretty much sums up the majority of the demonstrations at the Holiday Magic Show.

Several of the regulars have been doing the show for a number of years. For instance, Chemistry’s dynamic duo of Gretchen Adams, a lecturer and Director of the Chemistry Merit Program and Don Decoste are regulars at so many chemistry outreach events throughout the year that they could probably do them in their sleep.

Magic Show rookie, Jordan Axelson, makes an "ice cycle" during one of the demos.

Magic Show regulars Christian Ray and lecturers Tina Huang and Jose Andino were on hand for the fun, as well as newcomer, Jordan Axelson, also a lecturer in Chemistry.

Also heavily were involved were a number of undergrads, who, while behind the scenes, were

Christian Ray prepares for the finale.

The big bang.

The aftermath.

Gretchen Adams enjoys the "Chemis Tree" she made.

integral to keeping the show rolling, as each demo required prep beforehand, then both setup and mopup during the show. Multiply that by the show's three performances (December 7, 10, and 11, 2016), and participating in the Holiday Magic Show is definitely a time commitment. So why do the performers do the show year after year?

Adams indicates that she does it "For the community—to raise awareness about science and chemistry."

But she says she also does it for the enjoyment of it: "It's a ton of fun," she acknowledges. "It's really fun to interact with little kids all the way up through old people. Everyone can enjoy science, and it's just a great time to bring the community together."

Like Adams, Decoste says he too does it "Because it's so much fun!"

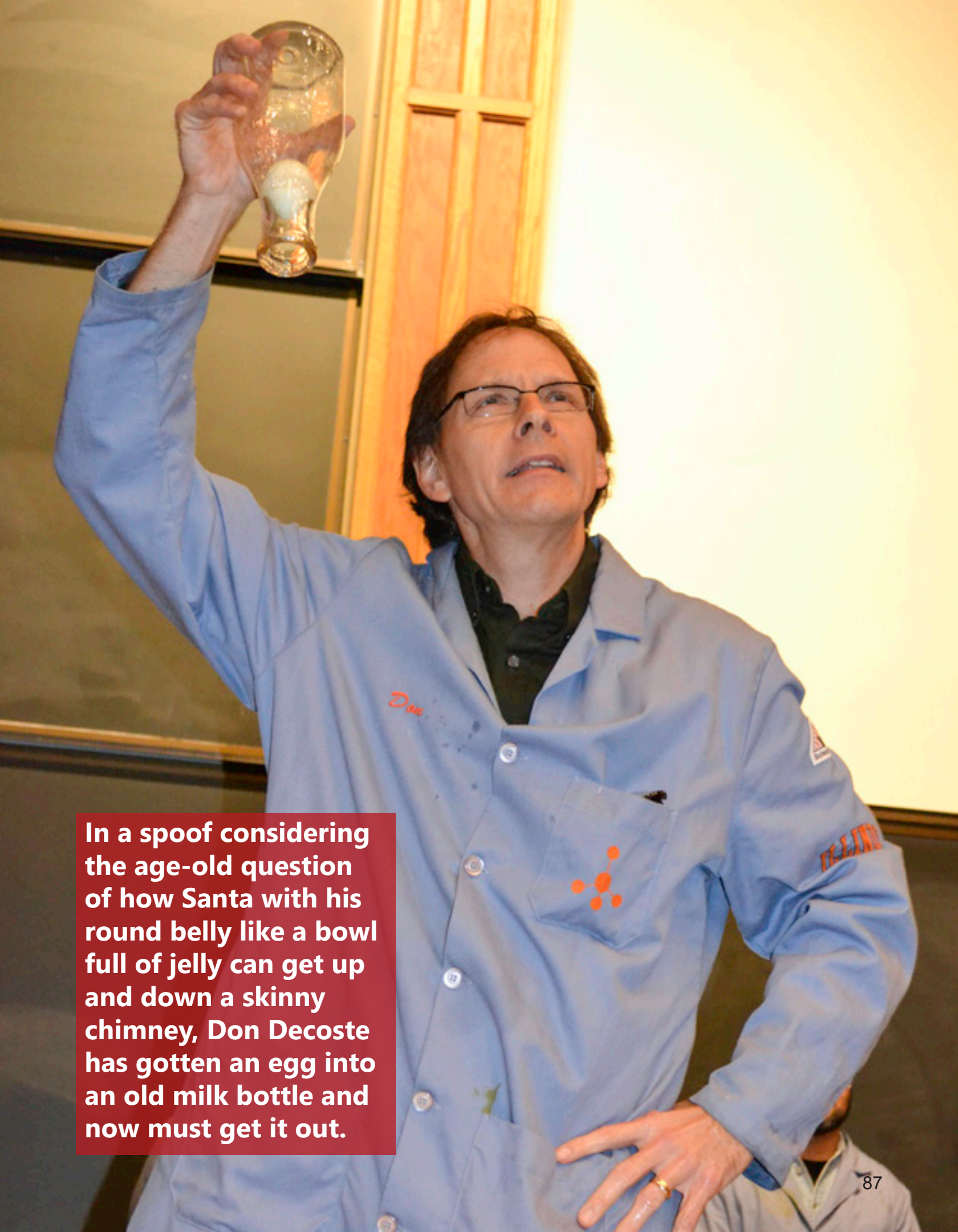
Does Decoste think they're teaching any chemistry? He says it's hard to tell. "We're doing this more for entertainment than education. When we do demo shows, that is the first thing we ask. What is our goal for this particular one? This one is much more on the entertainment side. But you never know what someone's going to find and then years later, say, 'You know, I saw something at a demo show, and it just got me thinking, or it got me interested in science.' So if that happens, it's just icing on the cake."

Christian Ray says he also does it for the sheer enjoyment of it. "It's fun. We have a great time. It's fun to work with the colleagues and then seeing the kids' reactions. You can't beat it. It's just a good time."

Chemistry's Holiday Magic show was begun several years ago by the former Head of the School of Chemical Sciences, Dr. Rauchfus. He had suggested that a Christmas lecture by the previous Director of General Chemistry, Gil Haight, who had pioneered many of the demos currently done in the show and which been quite popular with the students, would make a great addition to the holidays for the general public. And now, for many local families, it's a holiday tradition.

And while the chemistry folk who contributed to the show might never know if some of the youngsters present end up in chemistry down the road because of their efforts, based on the effusive thanks expressed by members of the audience on their way out, they do know this: a good time was had by all.

Jose Andino applies liquid nitrogen to make Olaf the Snowman shrink.



In a spoof considering the age-old question of how Santa with his round belly like a bowl full of jelly can get up and down a skinny chimney, Don Decoste has gotten an egg into an old milk bottle and now must get it out.

A high school student examines a piece of material created in lab.

EDUCATION OUTREACH INITIATIVES TARGETING UNDERREPRESENTED STUDENTS

A CPS student eager to answer a question during the Engineering Slam! at the final ChiS&E session.

CHIS&E PROGRAM EXPOSES CHICAGO PUBLIC SCHOOLS STUDENTS TO STEM...AND ILLINOIS

January 21, 2016

Instead of watching cartoons or sleeping in, several Saturday mornings a semester, 100+ Chicago Public School (CPS) 5th through 7th grade students can be found doing math and physics activities as part of *Illinois'* Chicago Pre-College Science and Engineering (ChiS&E) STEM enrichment program. Seeking to expose traditionally underserved students (and their parents) to STEM (Science, Technology, Engineering and Mathematics), ChiS&E is comprised of a number of *Illinois* faculty, staff, and students who also devote their Saturdays to work with these youngsters in hopes of increasing their interest in STEM—and possibly even STEM careers.

A collaborative University of Illinois effort, the Urbana (*Illinois*) and Chicago (UIC) campuses are partnering with the Chicago program for which *Illinois*' ChiS&E program is named: the Chicago Pre-College Science and Engineering Program (ChiS&E). *Illinois*' ChiS&E outreach offered STEM activities for four consecutive Saturdays in fall 2015; for the spring 2016 semester, activities are scheduled for six Saturdays. Held primarily in Chicago at UIC, sessions are jointly taught by both *Illinois* and UIC personnel as well as CPS teachers. On the final Saturday session each semester, the CPS participants make the trip south of I-80 to experience the *Illinois* campus via additional STEM activities and campus tours.

Right: A ChiS&E youngster uses an i>clicker to vote for the professor he thinks won the Engineering Slam!

Begun by Kenneth Hill, ChiS&E was inspired by his previous experience running a similar highly regarded program in Detroit. Hill began ChiS&E in 2008 with Little Civil Engineer, which offered STEM activities for Kindergarteners; the program has added a grade a year since and hopes, with the University's help, to eventually offer activities through 12th grade.

Illinois' Department of Mathematics' was the first to get involved with the program. In 2013, Hill, began dialogue with the previous director of the *Illinois* Geometry Lab (IGL), Math Assistant Professor Jayadev Athreya, about adding a math component to the then K–4 program's engineering emphasis.

So in both the spring and fall of 2014, the IGL did four consecutive Saturdays of enrichment activities with Chicago 5th and 6th graders. For the first Saturday, math grad students went to Chicago to lead activities, followed by two Saturdays at UIC where *Illinois* students interacted with ChiS&E participants via Skype. For the final Saturday of the program, the Chicago students bussed down to experience the *Illinois* campus.

According to Matt Ando, head of the Math department: "In fall of 2014, we had nearly 100 Chicago Public Schools kids, plus their parents, in Altgeld Hall doing math activities and seeing other parts of campus. That part is very exciting." Ando reports that students participated in the Mosaic Festival, plus saw an exhibit about math-related art in the Illini Union.

What kind of math activities are the youngsters doing? Aaccording to Ando, Math's goal was not to duplicate what the kids are doing in school, but to do fun activities that "might get students excited about math."

Left to right: Kevin Pitts, Engineering's Associate Dean for Undergraduate Programs and Sahid Rosado, Engineering's Outreach Coordinator

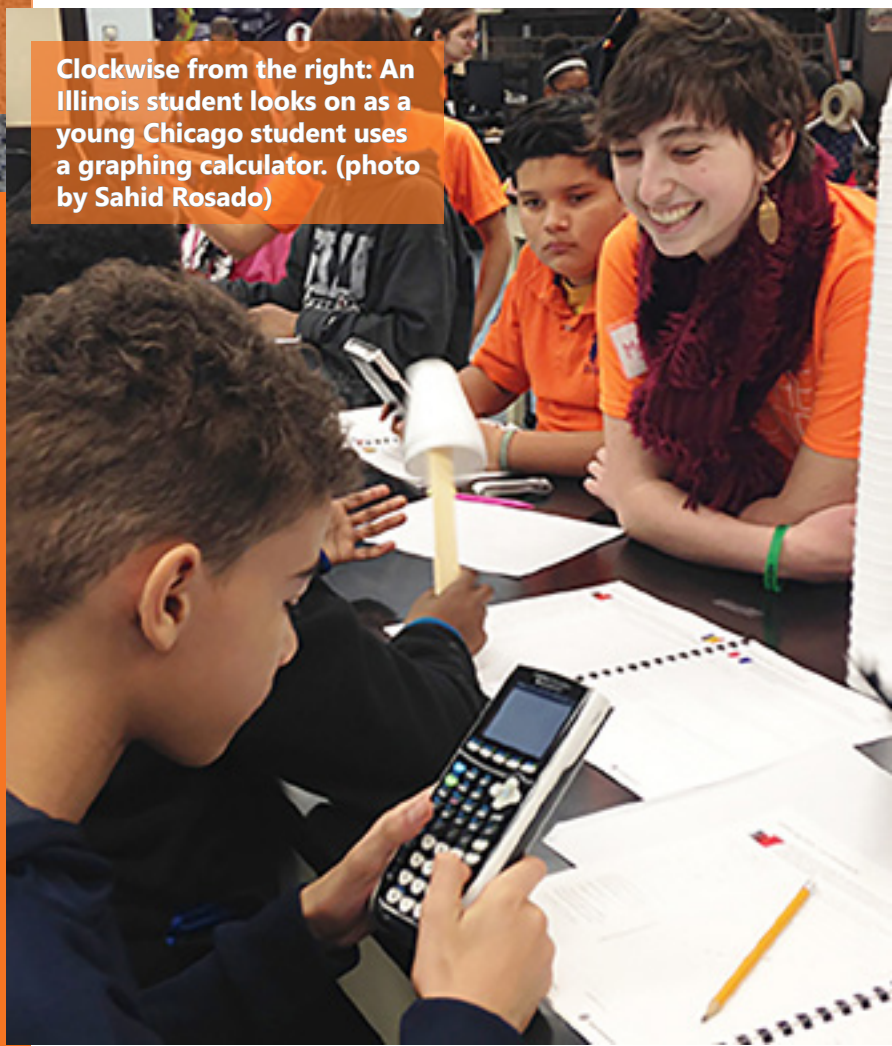
Taking particular interest in the program is Inga Karliner (whom this writer considers to be the heart and soul of the Physics Department). Always abreast of key Physics outreach, Karliner applauds Hill's philosophy regarding the importance of math.

"The math skills are most important, and math really is a language. It's like learning another language. So he knows that and he wants to provide serious enrichment in mathematics from K to 12."

In addition to Hill's math emphasis, Karliner also has high regard for the way his program exposes students to STEM early, then builds skills incrementally.

"So I think the two things that he's understanding: that math is really important and that you that have to do it slowly. And they start with kindergarten and first grade, and each year, they added a year. You can't just start in high school. Math, you have to build."

So in Spring of 2015, *Illinois*' ChiS&E outreach became multidisciplinary. In addition to Mathematics, Engineering/Physics got involved, who in turn reached out to a team of curriculum developers from the College of Education: Jana Sebastik and George Reese from MSTE and Adam Poetzel, a C&I professor in Math Education.



Clockwise from the right: An Illinois student looks on as a young Chicago student uses a graphing calculator. (photo by Sahid Rosado)

"It's not just the stuff that they see in class everyday," he says.

"The things we developed for Chi Prep, they are the kinds of fun activities that introduce kids to small parts of college-level math."

He adds, "The important thing was to give them some things to do with math that would hopefully seem to them both exciting and valuable."

After laying a foundation in mathematics, Hill's next phase was to solicit the College of Engineering to do physics-related activities. So Hill began dialoging with other key campus folk, including Engineering's Associate Dean for Undergraduate Programs, Kevin Pitts, (a Physics Professor who is no slouch himself when it comes to exciting physics outreach) and Sahid Rosado, Engineering's Outreach Coordinator, who was very involved with the nuts and bolts of the operation.

"We know what things we can do in terms of engineering," admits Rosado, "but we also wanted to make it relevant for these kids to not only be exposed to engineering, but also to brush up on their skills as well. That's when we were like, "Ok, we don't really know what kids in the 7th grade do in terms of mathematics and physics. So it was kind of an obvious choice for us to reach out to the College of Education in terms of getting a curriculum in place."

According to Rosado, a strength of ChiS&E is this cross-campus collaboration and multidisciplinary emphasis, which is reflected in the breadth of graduate students involved in mentoring:

"I think the key component to this program is definitely using our students, and I think the best part of it is that it's not only engineering students. We had a mixture of engineering students; we had math majors; we had physics majors; we had elementary education students. So it's this collaboration of so many departments, all having the same goal, which is to impact our youth. It was just beautiful to see that. To see that common goal among everyone was absolutely amazing."

Having CPS teachers help teach ensured that even more CPS students would be impacted: "Our goal of having CPS teachers lead the sessions is that they can bring the curriculum into their own classrooms," says Rosado. "We don't want just the 60 kids to be exposed to this."

Even the teachers learned some new things: "Some of the CPS teachers hadn't used graphing calculators before,"

A student proudly displays the marshmallow-spaghetti structure she built during one of the fall 2015 workshops. (photo by Kevin Pitts)

which, according to Rosado was good in a way because then we do know that we're doing something that not only helps the kids but also helps the teachers."

What most of the *Illinois* folk found exciting about ChiS&E was reaching out to students traditionally underrepresented in STEM. Rosado reports that 95% of the students participating in the program are either African American or Hispanic/Latino. Ando explains that this opportunity to serve the underserved was one reason why his department was eager to get involved:

"We thought that it was an investment in STEM education for kids that don't normally get a lot of attention—that helping the pipeline of kids interested in Mathematics and Science, particularly minority kids, is a really important project," says Ando. "We thought it was an important contribution to try to make…trying to increase the involvement of underrepresented populations in science and mathematics."

Rosado appreciates that ChiS&E exposes underrepresented minorities to STEM:

"We are serving an underserved population here, and these are kids that don't have opportunities to engage in curriculum like this in their own school, or they don't have access to calculators. So just being able to give that access to these students is awesome. Being able to do that was one of the things that really got me interested in this program."

In fact, Karliner believes a further impact of ChiS&E might be to increase diversity at *Illinois:*

"This is a really different thing. This seems to me that it has a potential to really make a difference, because it is really hard to work on diversity in the University and in the College of Engineering, and his program is really promising. I think we can really have a great connection with under-privileged communities in Chicago and families that care about education, and they will hopefully apply either here or both here and other places."

Another draw for many *Illinois* participants who day-in, day-out, face classrooms or lecture halls full of college-age students? Seeing a bunch of young faces in the crowd:

A Chicago youngster who visited campus for the fall 2015 campus visit to *Illinois* uses an i>clicker.

"It's very exciting to be involved with kids this age," Ando admits. "It's not something that we normally get to do."

Also excited about the age group ChiS&E is targeting, Karliner acknowledges that it's the age when students tend to lose interest in STEM:

"Once the kids start getting in middle school (we know there's research and books about it), we lose them; we lose them when they're 11, 12, 13, and it's really important not to do that."

Getting kids hooked on STEM early might have additional perks. Ando and company admit that the possibility that some of these kids might end up going into math or even coming to *Illinois* has also crossed their minds.

"If we showed them that this is an exciting place and that math and science are exciting, some of them will grow up and go into math and science. But, in addition, some of those students will grow up and come to U of I."

Rosado would also love to see these kids choose STEM fields: "Of course, I would love them to go into engineering, or be scientists, or be mathematicians. I think that would be awesome."

However, her main motivation is to just give them opportunities they normally wouldn't have: "But even just getting them exposed to all these wonderful concepts is enough for me," she admits.

Something special the kids experienced in ChiS&E was a curriculum designed just for them, which Rosado calls "wonderful" and "super hands-on." Also part of the fun…the kids got their hands on state-of-the-art graphing calculators:

"You had to see the kids on Saturday…it was the first time they were using graphing calculators. They were like, 'Oh, my god!'"

Another of Rosado's goals? To help each youngster understand that a career in STEM is an option.

"Because even if they decide not to go into engineering, or not to go into science or math, as long as they know what it's about, and as long as they make informed decisions about, 'Okay, I know what it is, and I just don't want to do it,' I think that's equally as awesome. So my hope and my goal with this program is really to do that for the kids, to give them access to things they normally don't have access to. If they do end up in a STEM career, that's a bonus. That's like icing on top—the cherry on top."

Like Ando and Rosado, Karliner also hopes ChiS&E influences some of its young participants to choose STEM careers.

"I think this is a great recruiting tool," admits Karliner, "and what we're hoping is that many of these kids really want to be going to college in engineering or science."

Like Ando and Rosado, she also has high hopes that it will turn into a recruiting pipeline to *Illinois*: "They are getting really good math grounding, and they will presumably, once they get to be seniors, want to come here, and they will apply here."

On a mission to defeat Harvard in the recruiting wars, Karliner also hopes the program might give *Illinois* an edge with many of these students:

"So Harvard won't steal them. Because that's what happens now. You have some really promising young person, Harvard will offer them a full ride, so they go to wherever they are recruited, and I don't blame them. And it's not so much even the name, it's the fact that private schools can now provide better financial help than state universities. Anyway, so there's just going to be a bigger pool; they will also be somewhat attached to the college."

In April of 2015, a number of *Illinois* folk traveled to Chicago to meet the 5th and 6th graders and their parents at a registration event...including the new University of Illinois President Timothy Killeen, who was there to welcome the families. Karliner shares an anecdote about Killeen's presentation.

"He just had two slides. One was for parents showing income levels depending on your education, and one was for kids. He was telling the kids, 'You work very hard, and sometimes it's tedious, but if you do science, you can do what I did,' and showed them the slide when he's in Antarctica, playing with penguins. So it was very appropriate, very short, and very touching."

What do *Illinois'* ChiS&E folks envision for the program in the future?

Citing GAMES Camp as a long-standing, successful Engineering outreach, Karliner says that down the road, there should be a summer camp. "Once the kids go to high school…The College has a lot of experience doing kids' camps."

Ando says Math's goals for the future include making the program sustainable and tweaking the curriculum to directly address the mathematics students do on standardized tests and/or in the classroom: "Developing a curriculum that really benefits them, and sustaining this for a substantial period of time—that's a bigger challenge that we need to find resources to accomplish."

Rosado reports that the College of Engineering also envisions making the program sustainable, and is seeking funding to keep adding a year at a time for 8th grade on, and also to expand the program.

"We have definitely been talking about ways to scale it up, so not only kids in Chicago, but also kids here in our own community, as well as other towns within Illinois…We definitely would love to scale this where it's a state-wide type of program, and we're impacting hundreds of kids."

Kevin Pitts leads the students in "The Wave" during his Engineering SLAM! presentation about waves.

A Civil Engineering grad student shows high school students how to work with a material they're testing.

AKONO EXPOSES INTRINSIC HIGH STUDENTS TO THE MECHANICAL PROPERTIES OF MATERIALS

March 8, 2016

How are we going to fuel our civilization in the next decades, especially knowing that we're kind of running out of fossil reserves? It really boils down to having a fundamental understanding of the mechanical properties of materials. – Ange-Therese Akono

Ange-Therese Akono, an Assistant Professor in Civil and Environmental Engineering, is passionate about building innovative, strong, durable buildings. That's why her research involves understanding the mechanical properties of materials used to construct them. Akono is also passionate about passing on her enthusiasm for materials to the next generation, particularly underserved students. So on January 18, 2016, Akono and eight of her graduate and undergraduate students hosted a Structural Mechanics Workshop for 28 juniors and seniors from Chicago's Intrinsic High School.

Akono and company hoped to expose these inner city students to STEM activities they might not have previously gotten to experience: "For now we're kind of casting a broad net for students. We want them to come to a Research I university and then get to understand what it is to do scientific research and to visit the laboratory and get to do hands-on experiments."

Intrinsic High students engage with an *Illinois* Civil Engineering student during the workshop.

The workshop involved having each student experience the concept of strength of materials on a wide range of materials commonly used in construction, then carry out experiments and analyze the results. The goal was for students to "develop scientific curiosities, scientific intuitions, and develop also kind of a taste for experimentation," says Akono.

To make the activities even more fun and exciting for the students, Akono admits that there was evidently a little bit of demolition involved. "For this we're just going to be breaking a lot of materials in the lab which is really fun, and I'm really excited about that."

Besides exposing the Chicago youth to research being done in Akono's Sustainability & Nanomechanics Lab, the day's activities also involved brief presentations by Becky Stillwell, Civil Engineering's Undergraduate Program Coordinator, and Engineering Associate Dean Liang Liu, to inform students about *Illinois* and answer any questions about the application process.

The workshop was a follow-up event to a webinar, during which Akono met remotely with the students as part of a class. During the 30-minute activity, she introduced the concepts of strength and durability of construction materials, demonstrated some experiments, then answered students' questions. Based on the interest generated during the video time, the January workshop was then set up.

Akono acknowledges that she and her students hoped to pique the Intrinisic students' interest in science and engineering: "We really want to spark this curiosity; we want to spark this interest, this scientific intuition. They are not necessarily expressing interest

Ange-Therese Akono, Assistant Professor in Civil and Environmental Engineering

in science and technology and engineering. Our hope is to really kind of create even more interest about science and engineering."

Akono reached out to Intrinsic High, which is a new school (it's only been around for a couple of years) because it has a large population of Hispanic students. Akono and company ultimately want to empower students commonly underrepresented in STEM, to help them realize that they too can do it.

"I just want the kids to feel empowered," she admits. "I went to college, and then I went to grad school, and I feel that my education has empowered me so much, and I want every student to feel that—especially when it comes to minorities and underrepresented groups. I feel like the major obstacle most of the time is that they just don't identify with the science, technology, and mathematics. They have this idea that, 'This is a very super-complicated concept related to really, really smart people and not me!'"

Akono acknowledges that she and her students not only wanted the high schoolers to believe that they have what it takes to do STEM, but also to aspire to careers in STEM: "We want them to feel that those careers are accessible, and we want them to start thinking about it, because next year they will be sending applications for college. It will require a lot of hard work, but they can access those careers in science, technology, engineering, and mathematics."

Akono hopes that this year's workshop is just the beginning of a long-term partnership with Intrinsic; she envisions sort of a pipeline into her lab, and into STEM: "We really hope this isn't going to be a one-time event, that it's going to be an ongoing collaboration where we're going to have a stream of students every year to come into our lab."

Akono sees the opportunity for the high schoolers to interact not only with her, but with her graduate and undergraduate students as being invaluable. "This is really about transferring the knowledge. We are, in some sense, educating the next generation of civil engineers. And we're starting to do it at a very small level where we have graduate and undergraduate students welcoming high school students that will be potential or prospective students in the years to come, and we're already welcoming them to the lab right now."

Akono isn't the only one who hopes to recruit some of these students into Civil Engineering. Amrita Kataruka, a PhD student in structural engineering and member of Professor Akono's lab explains that she got involved in the outreach in order to recruit bright, young high school students into her field. She explains that since she's been at *Illinois*, she's discovered how important civil engineering is:

Amrita Kataruka, a PhD student in Structural Engineering, explains to the high school visitors the differences between two kinds of materials.

One of Akono's grad students (left) explains about the properties of a material used in construction to Intrinsic High students.

"I've kind of understood why it's necessary to actually have very learned, smart people who want to contribute to the society in this field of engineering. So, I think it would be a great thing if we can even motivate two or three of them to come into civil engineering and do great things."

Jiaxin Chen, a first-year Master's student in Civil also hopes to recruit some students into her field:

"I really like this activity because if we can motivate some kids to our university or other universities to study civil engineering—it's really fun…I'm from China, and I really like civil engineering, and I traveled overseas to America to study. And, if I can let some children know about civil engineering and the meaning of doing the research or doing some civil engineering things, it's really fantastic."

How did the students do? "They're pretty good," reports Kataruka. "They're enjoying it, and that was our main aim: to put civil engineering in front of them as a fun field, instead of a very, very technical field, and I think they're liking it."

"When I see their smile, it's really fantastic." Chen adds.

While Akono would also love to have the students to enter her field, she asserts that any engineering field would do:

"They don't necessarily have to do civil engineering —they can go to mechanical engineering; they can go into aerospace engineering; they can go into another field of science or engineering and that would be awesome. That would be really great!"

One of Akono's grad students (right), Jiaxin Chen, interacts with Intrinsic High students.

COMMUNITY OF SCHOLARS SUCCESSFULLY WOOS UNDERSERVED UNDERGRADS TO ILLINOIS

April 6, 2016

Seeking to increase the number of underserved students who attend graduate school at *Illinois*, the Graduate College invited undergraduate minority students from around the country to experience *Illinois* during Community of Scholars (COS), its spring campus visit program on March 6–8. Like its name implies, the goal of COS is to show visitors that, should they come to graduate school here, they would be valued members of a much larger community of scholars and would have access to numerous resources.

According to Associate Dean Assata Zerai: "In the grad college, it's very important to us to increase the number of students who are underrepresented in graduate education, and the Community of Scholars is about, of course, recruiting some of those students into our programs and letting them know the awesome resources that we have on our campus."

Madeline Gonzalez, an undergrad at the University of Texas Pan-American.

Zerai stresses that an overarching goal for the 2-day event is that students would recognize that they are valued:

> **"I think it's just really great for students to get a sense of the fact that we're not just bringing them here to fill some kind of quota, but that they are truly welcomed and, further, that we have resources to support them while they're here. So I think that makes a huge impact in terms of their decisions about if they're going to come or not."**

One such resource introduced to the students during one COS session is the 12,000-entry Graduate College funding database available to *Illinois* students. "It's an amazing resource," says Zerai.

Madeline Gonzalez

Another overarching goal of the weekend was to show the attendees that *Illinois* is the school for them. That's why Madeline Gonzalez came. "I'm coming here to see—to help me decide," she admits. Gonzalez, who graduated in May from the University of Texas Pan-American, has been accepted to *Illinois*' Communication Sciences and Disorders Master's Program in Speech Therapy.

What was Gonzalez' favorite aspect of Community of Scholars? "I think what was most attractive was the fact that I would get to meet the department, that I would really get to see the school."

Another incentive to attend that she found attractive? The Grad College footed the bill: "If I'm honest, it was also funded—the travelling and the stay. I more than likely would not have this opportunity had it not been for the Community of Scholars. I would've had to make my graduate decision based on the website."

Since she's thinking about going on for a Ph.D., Gonzalez also appreciated the exposure to the grad students and their research. "It was really interesting to see what other graduate students are doing. Part of what draws me to this university is the research, because the Master's thesis is optional in my degree, but it's something that I want to I pursue so that I can see if I would like to pursue a PhD. It's been great to learn about fellowships or what PhD students are doing. I'm like, 'Maybe I'll be part of that world one day.'"

Dillinger James

Another undergrad attending COS was Dillinger James from the University of Washington. James has been admitted to Illinois' Industrial and Enterprise Systems Engineering Department and has accepted the offer. COS was actually his 2nd visit to campus; his first visit through the MERGE (Multicultural Engineering Recruitment for Graduate Education) program sealed the deal. However, COS helped him make connections and find his niche in his department.

Dillinger James, who will be a grad student this fall in Illinois' Industrial and Enterprise Systems Engineering Department.

"This visit is also a better opportunity for me to actually meet with individual faculty members, talk more about research, different funding opportunities, and then just getting more familiar with the campus and the culture. So I'm very fortunate that they invited me, and I'm glad to be here."

James hadn't actually planned on grad school until he started getting letters from schools—including *Illinois*. "I've never heard about it, because I'm from Seattle," he admits, "but once I researched the University of Illinois, I became very intrigued, and I was very impressed. Excellent engineering school, well credited, such a diverse population, very diverse research areas."

Like Gonzalez, James is another student on whom the *Illinois* students made quite an impression.

"I'm somebody who needs to meet people face to face, I need to see things with my own eyes. So having this as my 2nd visit, it has been different. I've gotten to speak with undergraduate students, speak with graduate students from varying disciplines, hear about their research, their experience here. They're not paid recruiters, they're here to give me an open and honest opinion. It is quite staggering the overwhelming enthusiasm every student has had about being a student at *Illinois*."

Jessennya Hernandez

Hernandez, an undergrad from Cal State, Pomona, says: "I would not have had the funds to come here to visit. Everybody who I've heard from who are graduate students said you have to visit the school before you make a decision. I wouldn't have had the ability to do that if it wasn't for this event...For me it's just really looking at the school, and looking at the department will be what I'm most interested in, talking to them, getting a feel for what kind of community I would be living in and working with. That's what's most important to me.

Jessennya Hernandez, undergraduate student from California State, Pomona

Like Zerai said, the thing that impressed Hernandez the most was that COS made her feel valued: "It lets me know that as a minority student, I'm important. There's resources for me and outreach as well. Other schools didn't give me that impression. They noted that I was a minority student but they didn't go a step beyond that. I had to reach out to them and ask them 'As a minority student, what can be done for me?' This made it

***Illinois* graduate student Lynette Strickland, who presented her research during COS.**

all happen without me realizing it. So that was a big thing. It's impressive to me."

But COS isn't just for visiting students. According to Associate Dean Zerai, it also benefits current *Illinois* students. "It's about building community amongst students who are already here, and so we have our mini conference, and we had a group of presentations both yesterday and today…So this allows us to support our students that are already here and to show off the awesome work that they're doing to the prospective students who are coming for their visit."

For example, some *Illinois* students got to brush up on their presentation skills. "The students that are already here, I think, are benefitting from the opportunity to present their research to a friendly audience," Zerai says. "I think they're also benefitting, of course, in terms of another resume-building opportunity. Also, I think the more opportunities they get to present their work, they're better able to refine their ideas because they're getting feedback from their peers, feedback from faculty and administrators that are attending the mini conference, and that's always good for them."

Lynette Strickland

Lynette Strickland, one *Illinois* grad student who presented at COS, would agree:

"For me it was incredibly beneficial to present my work to such a diverse audience. When I'm constantly presenting to only ecologists or evolutionary biologists, it's easy to to assume that everyone listening knows what I'm referring to. However, presenting to undergraduates and even to scientists from other fields…sharpens my communication skills. When I was presenting to the audience, I was really thinking about putting my work into a broad picture so that I could share the significance in a way that everyone in the room can understand. In my opinion, this is the most important skill for a scientist to develop, communication with the public!"

According to Strickland, exposing potential students to the research going on at *Illinois* is extremely valuable: "I think COS is helpful for the undergraduate students to see the breadth and diversity of research that goes on at UIUC. I think seeing and learning about the types of research that go on here is the best avenue for understanding the caliber of research that is coming out of this institution, and hearing it from other grad students helps prospective students to see themselves doing research here and pursuing their own interests."

COS Background & Impact

COS is actually the brainchild of Ave Alvarado, the Grad College's Director of Educational Equity Programs, and Zerai is quick to give her credit: "I thank Ave Alvarado, in particular, because she's the one who spearheaded this and started it many years ago."

COS was first held at *Illinois* in 2004. Alvarado claims Debasish Dutta, Dean of the Graduate College, helped institutionalize the program: "I sent him what I had developed for the Community of Scholars, and he thought we should do that again. He thought it was very important that we have such a program."

However, as the key architect of the COS, Alvarado isn't tied in to something because that's how they've always done it. She remains flexible about changing aspects of the program in order to best serve the students: "They evolve and change," says Alvarado,

Two COS participants who will be attending grad school here in the fall.

Left to right: Graduate College Associate Dean Assata Zerai and Ave Alvarado, Director of Educational Equity Programs.

in describing the different activities they've provided over the years. "They have to adapt and adjust to the change in the kinds of students we bring in. We do have room always for those changes to take place to make sure that it works for the next group of students."

So, over the years, COS has featured a variety of components. Early programs featured presentations by community folk to apprise visitors of opportunities for volunteerism or resources. For several years, they brought in big name national speakers, such as African-American economist Julianne Malveaux and Connie Rice, a civil rights activist. However, in recent years, COS has featured big name speakers from *Illinois*: the keynote speaker for the 2016 COS was Dr. Ronald Bailey, Head of *Illinois*' Department of African-American Studies. Most years, the program has included a research symposium and having students visit their perspective research departments.

And as always, inherent in COS is fostering a sense of community. So COS encourages prospective students to meet and network with current *Illinois* grad students. Alvarado admits:

> **"It's still important for our current students and prospective students to connect with each other so that they can get a real understanding of what life would be like for them in graduate school at *Illinois*."**

How are COS participants selected? Alvarado says the onus is on the departments: "They identify the students that they want to bring to campus. Depending on what the budget looks like at the time, then we try to take as many as we possibly can for this 2-day event. It's really the department that's pushing to get students here."

Regarding its mission to increase the number of underserved students at *Illinois*, since its inception in the early 1970s, the Educational Equity Programs Office (then called the Office of Minority Affairs) has been charged with providing access to populations who are from racial and ethnic populations who are underrepresented in our undergraduate programs at Illinois: "So the focus has been on racial and ethnic domestic students from those populations," says Alvarado. "The vast majority of the work that we do in the Educational Equity Program Office is with that charge in mind. We're trying to provide access and inclusion to those underrepresented populations."

Is COS working? Alvarado believes it is: "We, in our office, can do quite a few things to advance inclusion, but it really is incumbent upon the departments and what they're able to offer a talented student that is being courted and recruited by any number of other institutions. The student has to weigh what is going to be provided to them if they choose to come here.

Alvarado does caution students considering offers by different institutions to look at more than just the bottom line. Like the cost of living in Champaign-Urbana: "In addition to getting one of the best educations in the world, on top of not having to pay a lot out of pocket to do that, if you compare what it's like to live in California to what it's like to live here in Champaign, you are living very well on that same amount of money."

Two COS attend a presentation by an *Illinois* graduate student during COS.

She also cautions students about hidden costs: “Sometimes you are offered funding but you’re never really clear on what all it is going to have to cover.” She says sometimes a student’s stipend is going to have to go toward paying health insurance.” So sometimes I do talk to students about being very careful of what they are accepting,” she continues. “You can’t get much better than Champaign-Urbana, as far as I’m concerned.”

Alvarado admits that she finds what they’re doing to increase the underserved at *Illinois* very rewarding. “I’m very proud of the work we’re doing here. The Community of Scholars and several of the other programs that we operate out of our office are programs that I have designed and developed, and the deans have been so wise to say that this is what will work, and this is what we should do.”

How successful has COS been in recruiting students to *Illinois*? According to Zerai, the numbers speak for themselves: “Last year 86% of the students that participated in Community of Scholars ended up matriculating here, so this is a very successful program.”

An anecdote Alvarado shares underscores the impact COS is having. During a meeting, the diversity officer from another university asked her what the Community of Scholars was. Evidently, a student who had planned on attending their school had changed his/her mind after attending COS, and was coming to *Illinois* instead.

Despite COS’ stunning 86% success rate, Alvarado modestly sums up its impact: “We’ve done quite well in getting students to enroll at *Illinois*…We give them the full deal about *Illinois*,” she claims.

Jazmin Wilkerson, a COS participant who will be attending Graduate School at *Illinois* in Library Science.

During COS, Lynette Strickland, an *Illinois* graduate student and member of the VinTG IGERT, gives a presentation about her research on different kinds of beetles in Panama.

LOCAL STUDENTS LEARN ABOUT DNA DURING I-STEM'S DNA DAY OUTREACH

May 3, 2016

A group of 29 local high school and middle school students from Urbana High School and several Champaign middle schools and high schools visited campus on Friday, April 29 to participate in "DNA Applications: Interdisciplinary Perspectives for STEM Careers." Hosted by the I-STEM Education Initiative as part of the National Institutes of Health (NIH)-sponsored National DNA Day activities, the event, introduced local students to DNA and exposed them to some of the DNA research done on campus.

MCB grad student Michelle Goettge (left) supervises two Champaign middle school students as they extract DNA from strawberries.

To begin the day's activities, students received a brief Introduction to DNA by Caitlin Mearns Marlatt Davis, a Center for the Physics of Living Cells (CPLC) postdoc, who presented the historical discoveries of DNA, including an introduction to Rosalind Franklin, who played a crucial role in determining the structure of DNA using X-ray diffraction.

Students then participated in a series of three hands-on activities in Loomis Lab. These activities were planned and led by CPLC's Caitlin Davis and Katie Molohon Hess, CPLC's K-12 Education Postdoctoral Fellow, as well as MCB (School of Molecular & Cellular Biology) graduate students who are members of a newly formed graduate student association, the MCBees.

According to CPLC's Katie Molohon, the idea was to give students "an overview of how DNA was discovered and the order in which it was discovered. So we started with isolation and moved to DNA diffraction, which talked about the structure, and then we could model the structure using the yarn." Following are the three activities, and the main thing students were to learn about DNA:

1. Extracting DNA from strawberries: DNA is fibrous.

2. Simulating DNA Diffraction: DNA is helical.

3. DNA Modeling: DNA forms supercoils.

In the "Extracting DNA" activity, students mashed strawberries up, then slowly added isopropanol to extract the DNA.

It didn't go like clockwork. A few of the students encountered some problems...just like real researchers do.

A local middle school student uses a laser to stimulate DNA diffraction.

"I saw a number of students that maybe didn't get the DNA right in the beginning," explains CPLC's Katie Molohon, "and they added more isopropanol, and they were able to extract their DNA. Even though they didn't get it the first time, their graduate students explained to them, 'Well, why don't you try adding a little more isopropanol?' and they did, and they saw DNA. So they were able to trouble shoot, problem solve, work together in teams."

In the "Simulating DNA Diffraction" activity, the students used laser pointers to simulate Rosalind Franklin's key experiment, then

observed the diffraction patterns that led to today's familiar image of the genetic material inside all of us.

The third activity, DNA Modeling, involved taking different strands of colored yarn and weaving them together, then folding them over into a tiny ball, to illustrate how DNA is able to fit into a tiny space.

"It was a real mystery how you could have something that small—code, the genetic material—but also be something small but very long," explains Molohon. "How does the cell use all that genetic material at one time? We basically talked about how it can fold, and how it is inside."

During lunch, there were talks about how to apply for admission to *Illinois*, and resources available to help students navigate challenges they might encounter in getting a college education. For instance, Curtis Blanden, from the Office of Minority Student Affairs, gave a presentation about TRIO Programs.

According to Blanden, he was trying to convey to the students: "the understanding that they will all have obstacles in life but, through people and programs, offered excuses can be eliminated and dreams can become a reality."

Blanden indicates that he hopes he helped the students "understand that TRIO programs at the University of Illinois at Urbana-Champaign (Academic Talent Search, Upward Bound, Student Support Services, Ronald E. McNair Scholars Programs) can have an impact in their lives as they transition from middle school to high school, and high school to college/career."

Blanden hopes "something that was said entered their thought process to influence their understanding that you can 'Turn roadblocks into opportunities.'"

Also giving a brief presentation during lunch was Alejandra Stenger, MCB Merit Program Coordinator, who discussed how her program is a resource for students in biology, chemistry, and math.

Also present was Daniel Wong from the Graduate College's Educational Equity Programs office, who spoke on "Mentors, Opportunities, and Culture."

Wong's hope was that sudents would take away, "the importance of mentorship in preparing for a STEM career, particularly from faculty members and graduate students in their prospective fields of interest." Wong also shared with students "about the opportunities available to them as *Illinois* students, as well as the opportunities available nation-wide for students from traditionally

An MCB grad student, Pooja Agashe, discusses with a local middle school student how DNA can fold to fit into such a small space.

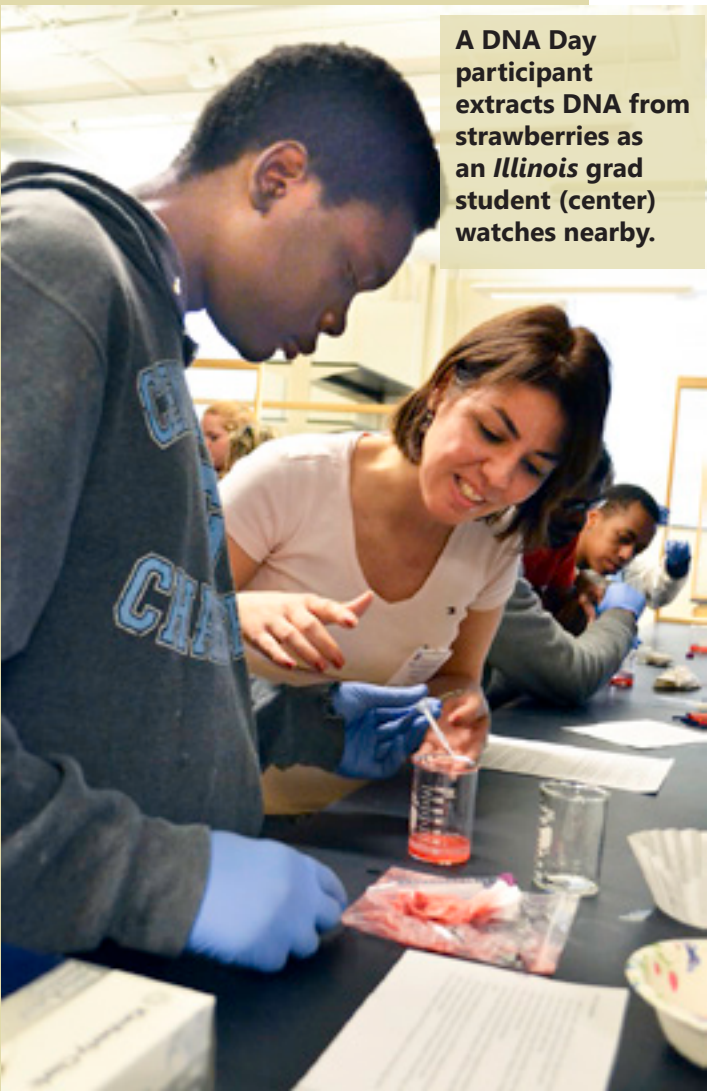
Top left to bottom right: Curtis Blanden, the office of Minority Student Affairs; Courtney Cox, IGB Outreach Manager; Luisa Rosu, I-STEM Director; Alejandra Stenger, MCB Merit Program Director; and Daniel Wong, Associate Director of the Educational Equity Programs office.

underrepresented populations." Finally, he addressed "the 'culture' of research at an R1 institution like *Illinois* and how students can best position themselves to be successful here, or at a comparable institution."

During this section, Wong also planted a seed, suggesting to the students that the advanced degree, Ph.D, was something they could attain to, then introduced some programs from his office, including SROP (Summer Research Oopportunities Program), and the SPI (Summer Pre-Doctoral Institute), which could help them achieve those goals. Wong also held a question-and-answer session in order to answer any questions the students had about *Illinois* or pursuing a STEM career.

Next on the agenda was a hands-on activity related to health research being done at the Institute of Genomic Biology (IGB). Brian San Francisco, an IGB Postdoctoral Fellow in the Mining Microbial Genomes Theme, and Courtney Cox, IGB's Outreach Activities Manager, led an activity designed to show how easily infectious disease (both bacterial and viral) can be spread via one's hands.

Brian San Francisco (right) does a hands-on activity with several Champaign middle school student to illustrate how easily disease can be spread through touch.



A DNA Day participant extracts DNA from strawberries as an *Illinois* grad student (center) watches nearby.

During the activity, which could be described as the epitome of a "hands-on" activity, student volunteers' hands were liberally sprayed with Pam, then sprinked with glitter. The volunteers were then encouraged to shake hands with other students to demonstrate how easily disease can be spread through touch. As part of the activity, students also had the opportunity to view microscopic images of different viruses and bacteria.

In the afternoon, I-STEM's young visitors took a tour of the IGB (Institute of Genomic Biology), organized by Courtney Cox, the Outreach Activities Manger for the IGB. The tour highlighted the collaborative research done at the IGB and the Core Facilities that house its state-of-the-art microscopes. Following the tour, students were exposed to a presentation about Ancient DNA with Professor Ripan Malhi of Anthropology, along with several of the graduate students in his lab.

The final activity for the day was a visit to IGB's Art of Science Exhibit held in downtown Champaign, Illinois, also led by Courney Cox. The Art of Science is an exhibition comprised of images from IGB research addressing significant problems in the environment, medicine, and energy use and products. Images are selected to highlight the beauty and fascination encountered in daily scientific endeavors.

"Scientific research can sometimes feel far removed from the joys and struggles of our daily lives. The aim of the Art of Science program, created by the Carl R. Woese Institute for Genomic Biology at the University of Illinois in 2011, is to make science more applicable by presenting it to the public in a way that is visually pleasing and intense." – Art of Science Image Guide 2016

A Booker T. Washington student with the gumdrop/ toothpick dome she made during the Family Engineering Fair.

COWELL, BTW'S FAMILY ENGINEERING FAIR SEND A MESSAGE: STEM = FUN

May 26, 2016

Booker T. Washington (BTW) Principal Ryan Cowell admits that he got the idea for his school's Family Engineering Fair during their Engineering Night this past winter. He recalls standing there watching the families having a good time, when the thought crossed his mind: "What if we waited for the weather to be nice and did this outside? And because it's outside, we could do it much, much bigger!" So he immediately started the ball rolling. He had a conversation with Joe Muskin, Mechanical Science and Engineering's (MechSE) Education Coordinator. "I think that night I went to Joe, and I said, 'Hey, what do you think?' He, of course, is up for anything. He thought that was a good idea, and it started to roll from there." So with the help of a number of local partners, on Saturday, April 23rd, from 1:00–3:00 pm, BTW held its first annual Family Engineering Fair.

Vet Med student Kylee Walter brings two of her friends to Open House so visitors can pet them.

A local youngster displays the silly putty she made at BTW's Engineering Fair.

Key to the event was BTW's partnership with folks at *Illinois* like Muskin, who quickly enlisted the help of a couple of outreach-minded graduate students, Matt Milner and Ashley Armstrong. The two are are passionate about outreach—so passionate, in fact, that earlier in the Spring 2016 semester, they had begun a new MechSE graduate student organization called ENVISION (ENgineers Volunteering In STEM EducatION). The two planned the fair's eleven engineering activities and helped recruit additional volunteers from their department's two undergrad engineering student groups: Pi Tau Sigma and ASME (American Society of Mechanical Engineers).

Also, because Cowell envisioned the fair as a community event, he also enlisted the help of some community partners, the Champaign Public Library's Douglass Branch Library and the Champaign Park District's Douglass Park, both of which are adjacent to BTW.

"One of the things coming into this school year that I was interested in doing was building a relationship with the Douglass Library to try to start to function as one big campus," admits Cowell. "That was a goal."

Helping with food and prizes for the fair was BTW's PTA.

Just as Cowell envisioned, the day of the fair, eleven different engineering activities were spread throughout the open area behind the school, in Douglass Park, and near Douglass Library, with a few in the library's basement.

When students registered for the fair, they received a passport they had stamped after they completed each activity. To encourage students to complete as many events as possible, students received a prize if they went to a certain number of activities.

Families were able to participate in a wide variety of activities addressing a number of the engineering disciplines. Some smaller activities that didn't take a great deal of time and could be done by a small group of kids or a family included Ball Run, Egg Carton Battery, Elephant Toothpaste, Gum Drop/ Toothpick Domes, Oobleck Wading Pool, Silly Putty, and Wind Turbines.

Two sisters work on their gumdrop/ toothpick domes during the fair.

Student helps child build gumdroptoothpick domes.

Larger events that would take a bit longer, for which participants would need a ticket for a certain time slot, included 3D Printing, Lithography, Kaleidescope (which involved Silvering Mirrors), Stomp Rockets, and Fog Ring Cannons.

A large number of BTW's K-5 students, along with their families, participated in the fair, just as Cowell had envisioned, and it was all of the volunteers who gave up several hours of their Saturday afternoon, who helped to make the event a success.

One volunteer, Mechanical Engineering student, Samantha Rivera who volunteered at the Gum Drop/ Toothpick Domes event, explains why she did BTW's Family Engineering Fair: "Because I like working with kids. It's the best way. I think, engineering starts with kids, to be honest with you."

In fact, Rivera indicates that she actually wants to go into teaching, and plans to get a Master's in Education.

Did Rivera see any young engineers in the group? "Oh, I've seen plenty," she acknowledges. "Some of them are really good. A lot of them are creative, which is what you need."

While BTW's principal isn't necessarily striving to steer all of his young charges into engineering, he does hope to make STEM fun: "I think the more kids can equate STEM activities with fun," says Principal Cowell, "the more likely it is they're going to engage with it as they get older. I think that this hopefully helps to do that."

And one way to make STEM fun was to ensure that families would have a good time together…while being exposed to STEM activities:

"I also hope it's a nice space for kids and adults to interact together and have a wonderful Saturday...I hope it's a place where family and kids can come and have a really good time playing with science and engineering-related experiments. I think it's really cool to see families engaging in that way."

Cowell's third goal for the event was to foster a sense of community: "I hope it opens us up to the community even more than we already are."

Because this was the school's first year to do the fair, Cowell chose not to advertise the event beyond the school because of concerns about having enough volunteers. However, he was definitely open to nearby residents seeing the hullabaloo and dropping in, and a few members of the community did show up, as he had hoped:

"I hope we put on enough of a spectacle that people in the neighborhood and the community start coming over, because I think it's important that we become open to the community around us in ways that don't always exist unless you purposely seek them out."

Cowell's dream for the future is that the Fair would become larger than just a BTW thing: "My vision for this, if this is successful, is that we can grow and it can become a community event."

Two *Illinois* engineering students wait as the chemical reaction they started resembles "Elephant Toothpaste."

Two youngsters watch as the "Elephant Toothpaste" takes shape.

MERGE PROGRAM GIVES STUDENTS A GLIMPSE OF GRAD SCHOOL AT ILLINOIS

September 30, 2016

What's it like to be a graduate student at *Illinois*? What kind of funding is available? How cold does it get here?

These are some of the questions that the 48 students who participated in the College of Engineering's MERGE program hoped to get answered during their campus visit on September 30–October 1, 2016. The goal of MERGE (Multicultural Engineering Recruitment for Graduate Education) and the engineering departments who invited these African-American, Latino/a, Native American, and female students for the weekend was that they might experience *Illinois*—its research, resources, and students—get their questions answered, and ultimately come to graduate school here.

According to Rhonda McElroy, Engineering's Director of Graduate Programs and MERGE Coordinator, the program received around 119 applications to participate in the two-day event. She worked with all 12 departments in Engineering to decide which students to invite.

MERGE participants enjoying one of the presentations.

"These students are very impressive," McElroy said. "It's difficult to choose whom we extend an invitation to, because we consider everything from the students' GPA to their educational goals and research experience."

Once the students arrived on the Urbana-Champaign campus, they were the ones evaluating whether *Illinois* would be a good fit for them. MERGE planners worked hard to show the visitors that *Illinois* faculty, research and funding opportunities, campus resources, and fellow students make it the perfect destination.

On Friday morning, participants were presented with information about the College of Engineering's scholarly footprint, spirit of innovation, and societal impact by Harry Dankowicz, Associate Dean for Graduate, Online, and Professional Programs, and about opportunities and strategies for graduate research by Jennifer Bernhard, Associate Dean for Research. In a particularly well-received presentation by Joseph DeGol, a Computer Science Ph.D. student and former MERGE participant, attendees learned about the advisor-student relationship, the importance of mentoring, and how to combine graduate school with entrepreneurship.

On Saturday, Ken Vickery, Graduate College Director of External Fellowships, described external fellowships available to the participants and strategies for pursuing such funding. Ave Alvarado, Director of the Graduate College's Office of Educational Equity Programs, informed students of

A MERGE participant asks one of her questions during one of MERGE's sessions.

opportunities and resources in Champaign-Urbana and nearby metropolitan areas for recreation, housing, medical care, and other kinds of support. She also shared something else students might appreciate: the cost of living here is noticeably lower than the national average.

Yemeserach Mekonnen, who recently completed her master's degree at Florida International University, hopes to get a Ph.D. in electrical and computer engineering or systems engineering and came to check out *Illinois*. Mekonnen was particularly excited about meeting faculty in her two departments of interest who share her research interests. "I wanted to talk to them, get a feel for how they work, how research groups are conducted, what's the basic requirement of being in their research group, and things like that."

Jane Agwaro, originally from Kenya, East Africa, is currently a senior at Tuskegee University in Alabama, and is interested in pursuing a Ph.D. in chemical engineering or biomolecular engineering. "I really want to know how versatile the research projects are here at the U of I. I'm interested in meeting the professors and just seeing how passionate they are in their programs," she said. "I'm also interested in knowing the funding availability that they can give to students that have the potential to invent and be innovative, and just see the culture, and see how I can adapt and thrive in this program for the next five years of my life…or six or seven!"

McElroy realizes she has a responsibility to help MERGE attendees understand the full picture.

To this end, each MERGE participant was matched up with a current *Illinois* graduate student ambassador, usually from the prospective student's preferred department, to learn from their experiences and start to build relationships. "Those one-on-one interactions are very important because students are often more comfortable asking questions of their peers than they would be with a faculty member or administrator." Also, on Friday evening, the MERGE visitors were treated to bowling, pool, and pizza at the Illini Union, where current grad students had a chance to get to know them further. Also fostering communication was a panel session on Saturday morning, where the visitors could ask current grad students questions they might have about campus life.

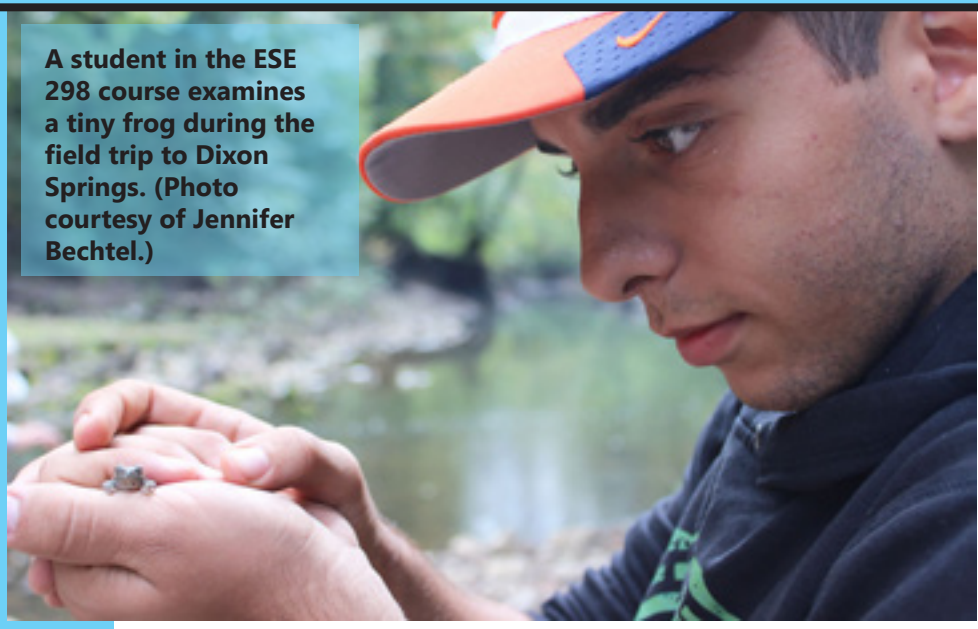
"We want them to leave really knowing what life would be like here at *Illinois,*" McElroy explained, "and to share this experience with their friends and peers." Even if it gets cold here in the winter, she said, "we want them to envision *Illinois* as their future graduate school home, where they can thrive and grow."

Mechanical Science and Engineering's MERGE participants.

Mara Livezey, student in the Biochemistry Department, working in the lab.

STEM EDUCATION REFORM FOR UNDERGRADUATE AND GRADUATE STUDENTS

NO LONGER JUST FOR SLEEPING, ILLINOIS RESIDENCE HALLS PROVIDE LEARNING VIA LLCS



A student in the ESE 298 course examines a tiny frog during the field trip to Dixon Springs. (Photo courtesy of Jennifer Bechtel.)

November 13, 2015

It's not your mother's dorm any more. In fact, according to Alma Sealine, Director of University Housing, and Nathan Sanden, Assistant Director of Residential Life, in the university housing world, dorm is a four-letter word—and not just because of the number of letters it has.

"The 4-letter word dorm means that you only eat and sleep in that location," explains Sealine, "whereas we like the terminology residence hall because it accounts for the living and learning that occurs, in addition to just sleeping there." Thus, the name Living-Learning Communities, or LLCs.

What sets LLCs apart is their specific academic or theme focus based on student interests. For instance, just as their names imply, WIMSE (Women in Math, Science, and Engineering) is specifically for women in STEM majors; Health Professions is for students pursuing careers in health professions. For other communities, it's based on a theme; LEADS' theme, for example, is leadership.

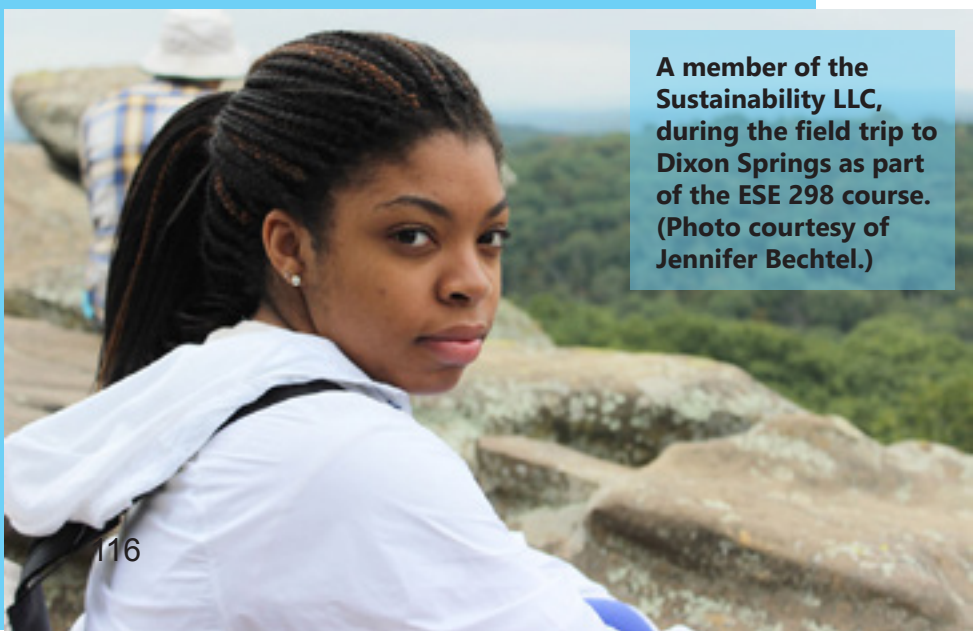
"LLC's allow that programming to be more focused to what the students have told us are their interests based on living in that community," says Sanden. "With WIMSE for example, we're able to bring in faculty and speakers who can speak specifically on women in STEM fields…and provide opportunity for students to do research specifically in those fields... It allows some of those more focused co-curricular opportunities for students."

Illinois was one of the first schools in the country to start a living-learning community: Unit One in Allen Hall, way back in 1971. "There were a few schools doing it," Sanden explains, "but we were right on the cutting edge of the movement."

Sealine adds that LLCs became very popular in the 1990s. "That's really when the big push started," she says, and housing professionals started "finding ways to connect to the educational mission of the institution." But *Illinois* has always been seen as a leader in this area because by the 90s, Unit One had already been around for 20 years.

"It continues to be a focus of how you highlight the education that happens in a residential area," says Sealine, adding that *Illinois*' definition of an LLC is that it's attached or aligned with an academic unit, while other campus' definitions might be different.

Illinois currently has nine LLCs; they're listed below, along with the year each was begun, and its academic or thematic emphasis. (Honors LLC will begin in 2016, upping the number to ten. (As an aside, Sanden says there was to be a Unit Two, a Unit Three, and so on, but the naming protocol didn't take.)



A member of the Sustainability LLC, during the field trip to Dixon Springs as part of the ESE 298 course. (Photo courtesy of Jennifer Bechtel.)

- Unit One at Allen Hall (1971) – began with requests from Art & Design and several other academic departments
- Weston Exploration (1997) – designed for students who are either undeclared or declared but still considering other majors. Works with General Studies Division.
- LEADS (1999) – focuses on leadership education and service. It features an Introduction to Leadership course (AG ED 260) and a leadership seminar series. LEADS is intentionally kept very broad, not designed for any specific major.
- Global Crossroads (2000) – focuses on cross-cultural communication and understanding from a global perspective. It's 50% domestic and 50% international students. Begun by a variety of academic departments, study-abroad office, and student affairs departments.
- Intersections (2004) – parallel to Global Crossroads, it focuses on cross-cultural communication and understanding from a U.S. perspective.
- Health Professions (2007) – for students exploring health majors.
- Innovation (2010) – which focuses on entrepreneurship and innovation, started in 2010.
- WIMSE (Women in Math, Science, and Engineering) is for women in STEM careers.
- Sustainability (2012) – The newest one LLC, partners with School of Earth, Society, and Environment and also with NRES, and the Student Sustainability Committee.
- Honors LLC (2016) – this multidisciplinary LLC will work primarily with James Scholars and honors students.

What are some benefits of participating in an LLC? "Courses that are taught in the residence halls that count, that are part of the curriculum for that particular living-learning community," Sealine explains. So when it's five degrees below 0 in the middle of a blizzard (and everyone knows *Illinois* never closes, despite the weather), students don't have to suit up and trudge across campus through snow drifts, but can just head to the LLC classroom in their residence hall.

Sohinee Oswal, a member of both the Innovation and Sustainability LLCs.

In addition to the convenience of a classroom that's in close proximity, the courses are high quality. "They're intentionally small," boasts Sanden. "Most of our LLC courses are 20 students or fewer." He says that even large GenEd courses held in auditoriums might have a smaller section in an LLC, which allows students "to have much more contact with faculty and instructors that they would outside of the LLC."

In addition, while some LLC courses might be smaller discussion sections of larger lecture courses, some are unique to the LLC, and not offered anyplace else.

"I think it makes the largeness of U of I small," explains Sealine, "and it provides opportunities for individuals to really intersect and interact with individuals one on one. They may not have that opportunity in a large lecture hall, but if they can take advantage of those courses in the LLC communities, then they have a more intimate interaction with the faculty and also an understanding of the curriculum."

Sanden agrees that LLCs allow students to meet and get to know faculty better. And faculty who agree to teach an LLC are encouraged to provide co-curricular opportunities in addition to just teaching a course.

"The fact that they teach within LLCs, they have an understanding that they'll be doing a little more than just teaching. So the leadership course, for example, they might present other workshops to the students so the students get to know them outside

of the classroom as well, which is a really important thing for students."

While the activities are sometimes co-curricular, specifically tied to the course, sometimes they're purely extra-curricular. "We have faculty who will have some of the students in their courses over at their house, for example, to just have fun and have a meal or something so they get to know faculty on a more personal basis as well."

Do certain faculty see a real benefit in being more engaged with the students and, thus, get involved with LLCs?

Left to right: Nathan Sanden, Assistant Director of Residential Life, and Alma Sealine, Director of University Housing

"Yes," acknowledges Sanden, "and those are the faculty we look for! We have a lot of faculty who have been teaching with us for years and they very much enjoy it. They get that contact with students that they may not otherwise have."

Sealine describes LLC faculty as "individuals who are willing to work outside of classroom hours. So they invest time in the early evenings to go to events in addition to the classes that they teach in that particular LLC. They make themselves available for additional hours on certain days." She says faculty might engage in different ways, "but successful faculty members see their role with LLCs as being more than just teaching a class."

In fact, when the program is looking to start a new course, they explain the history of LLCs, what they're about, the kind of faculty needed, and "the academic departments know what we're looking for," and get back to them with the names of interested faculty.

Sanden explains that LLCs also allow students to get to know other students with like interests: "When you live in a living-learning community, you know there's at least one thing you're going to have in common with them, whether it's the major or the theme of the community…For first-year students, it helps them transition to the university a little more easily when they have individuals around them who at least have some similar interests to them."

This transition for new students component is important, because LLCs are comprised of about 70–75% freshmen and 25–30% returning students. Sanden qualifies that percentages vary by community. He says Unit One at Allen Hall tends to be around 50/50 in terms of freshmen and returners. Innovation is usually made up of a higher percentage of returning students. Weston, which is designed for students who are either undeclared or considering switching majors, tends to be 90–95% freshmen, "because it's designed to be a 1-year program while they're exploring."

Sanden's role is to provide overall direction for the LLC program and to supervise the four current program directors. He explains that the position of program director "appeals to individuals who have high academic training but also very much want to focus on students and meet and work individually with students." The position doesn't exist in a lot of places, is especially appealing to people who are "passionate about working with students specifically around academics but within a residential setting."

Sealine's role is to advocate for LLCs at the campus, national, and international levels; gather information to help keep University Housing current; and to ensure that their programs provide the best experience for their students.

What do the two find particularly satisfying about their jobs? Sealine finds the great reputation of *Illinois* residence hall programs to be extremely gratifying: "No matter where I go, there's always someone that says, "You have an LLC at the University of *Illinois*; I want to talk to you about that!"

Sanden's favorite part of the job is the students: "I get to work with brilliant, creative students all the time, and that's what makes it worth all the frustration." He explains that, like any job, it can be frustrating, "but all that goes away But all that goes away when I go to Innovation, for example, and I see a ground-breaking project one of our student teams is working on where they're designing a water system that will help feed third world countries. So all that other stuff stops being important."

“That really is what gets up me in the morning,” adds Sanden, “seeing what our students are going to do next. We have projects, things that even at my age I would have never thought of. I mean, just the creativity and the brilliance of our students at U of I, honestly, is what gets me up in the morning.”

Then he goes on to boast that several LLC students have even started their own companies. For instance, he reports that the person who started Miss Possible lived in two LLCs and was an RA in Innovation.

The two are continually striving to improve their programs. For instance, to ensure that their LLCs are meeting students’ needs, they conduct a different survey for each community based on what happens there. “We ask a variety of questions about their satisfaction, but also what they are learning from living in the LLC,” Sanden explains. They also do focus groups, inviting students to come and talk to them about the courses or whether certain programs are still meeting students’ needs, how they can be improved, or if they should be eliminated.

Sealine admits, “We all try to think strategically about next steps and what’s in the future for LLCs. They have been very successful here, and we want to continue to provide that for students in the future.”

Sealine stresses the importance of their partnerships with the academic units: “In order for us to be successful in the future, we have to continue to find ways to connect with our academic partners. It’s not just a one-time connection, but it’s a long-term connection and to focus on the word ‘partner.’ We really do work to have great partnerships with our faculty, and that’s what we want to continue to try to do.”

While LLCs seem new and cutting-edge, Sanden explains that they are actually a very old notion:

“They really harken back to the Cambridge Model for higher education. If you think of when colleges in England and elsewhere started, faculty and students lived together. That was the whole idea, it was designed to be learning all the time, and we kind of got away from that a little bit in this country, and LLCs were one way to bring that back.” While faculty and students don’t actually live together, he admits that “This is the closest we can get to that increased interaction with faculty and students.”

A student in the ESE 298 course takes in the view during the field trip to Dixon Springs. (Photo courtesy of Jennifer Bechtel.)

An *Illinois* Bioengineering undergrad, Anna Whelan, performs research inside a biosafety hood during one of BIOE 306's labs.

BIOENGINEERING UNDERGRADS BUILD BIOBOTS IN NEW BIOE 306 COURSE

December 16, 2015

Biobots. The word smacks of scientific breakthroughs in the distant future, or the subject matter of some futuristic, sci-fi movie. But *Illinois* researchers are currently building and studying biobots as part of their research in this emerging field. However, they're not the only ones. This past semester, *Illinois*' Bioengineering department piloted a brand new course, BIOE 306, BioFabrication Lab, that teaches undergraduate students how to build them too. Developed as part of the NSF-funded EBICS (Emergent Behaviors of Integrated Cellular Systems) Science and Technology Center, the course distilled down cutting-edge EBICS research and initiated eight Bioengineering juniors and seniors into the mysteries of building with biology. In addition, the idea for this class was developed in part due to the *Illinois* Innovation Prize, which emphasized the need to teach the next generation of engineers and scientists how to "build with biology."

The class was a Bioengineering team effort, with several folks helping to develop and teach the course and labs: Rashid Bashir, Head of *Illinois*' Bioengineering department and EBICS Associate Director, Bioengineering Assistant Professor Pablo Perez-Pinera, who primarily taught the class; Ritu Raman, the EBICS researcher and NSF Graduate Research Fellow who helped design and co-lecture the class; and Colin Castleberry, the teaching assistant for the course.

According to Raman, Mechanical Engineering Ph.D. student: “The idea is basically that we design and build our own bio-integrated machines that

A BIOE undergrad works with the biobots she and her teammate created during the BIOE 306 course.

A Bioengineering undergrad, Audra Storm, works with the biobots she made as a final project for BIOE 306.

are powered by muscle. The goal of this class is basically to expand that expertise beyond just EBICS researchers, and teach undergrad Bioengineering students the skills they’ll need to build with biology.”

“I think this is a great example of how cutting-edge research funded by an NSF center can be disseminated to undergraduate education,” adds Bashir.

So exactly what is a bio-integrated machine, or biobot? As its name suggests, it’s part biological, part robot. Raman clarifies, “A broad definition of biobot would be anything that’s harnessing a biological tissue to do a non-natural function.”

So is a biobot comprised completely of organic, or biological, material? She says no.

“Basically it’s bio integrated or a bio hybrid. So it’s powered by biological tissue, like muscle, but it’s coupled with a skeleton that’s made out of non-biological materials.”

Raman elaborates: “A robot is something that can send some sort of signal, do some kind of internal processing, then respond to it in a certain way. A biobot is a robot that has some kind of biological tissue that’s either doing the sensing, processing or actuation, or whatever.”

How large are biobots? Larger than nanoscale, they’re at the millimeter scale, and larger than cells, since living cells are used to power them.

BIOE 306 teaching assistant, Colin Castleberry, chats with students during a BIOE 306 lab.

What's the energy source for biobots? Like with plants (and people), it's sugar. The light is the trigger which sends an electrical signal to the muscle and the muscle uses sugar in the surrounding media as energy.

"We all need food." Bashir interjects.

"It seems really obvious, because you learn those things in biology," explains Raman, "but there are times when I've bought a new media that didn't have glucose in it. I thought, 'Why aren't these biobots twitching?' That bothered me for a week until I realized there was no sugar. You need to remember these basic things."

So why study and build biobots? According to Bashir, they could be used for drug screening, such as gauging the effect of different drugs on the human body based on the response of organs or cells. Another use would be autonomous sensing and release devices to regulate toxins in the environment. For instance, biobots could be used to sense a chemical and release something to neutralize that agent.

"There's many applications like that," Bashir explains, "but our vision is broader in many ways."

In fact, he says that's just the tip of the iceberg in terms of biobots' potential. He says the course was designed to prepare students for what he terms "forward engineering with biology." For instance, according to Bashir: "Someday, anything that you see that's built out of non-biological material today could be built with biology in the future."

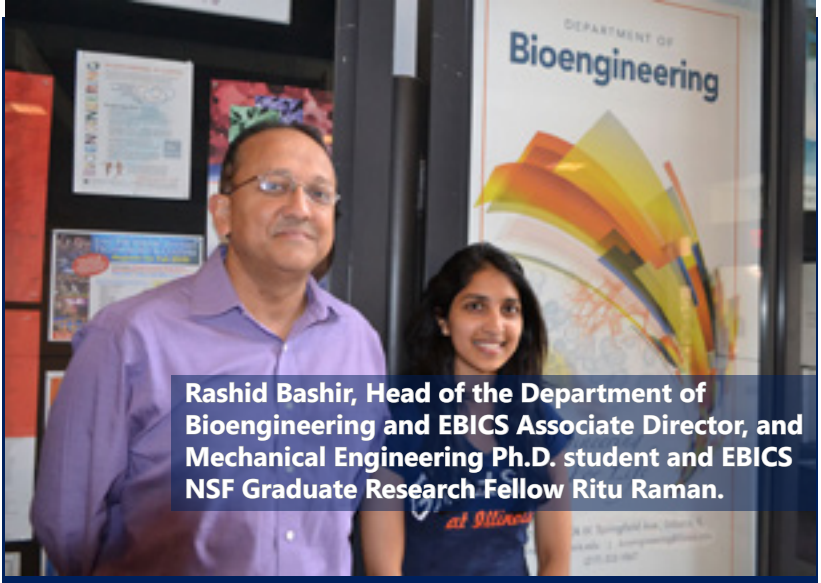
To give students plenty of hands-on opportunities with biobots, in addition to lectures, the course was comprised of five labs. Four taught students skills they'd need to design and build biobots; the 5th was like an independent project, where students designed and built their own.

Bioengineering Assistant Professor Pablo Perez-Pinera, whose work is in the area using mammalian cells in synthetic biology, is the BIOE 306 instructor. He explains why the lab component is so important:

> **"Lectures are not the only way of teaching efficiently. From what I recall, when I was a student myself, I often learned more efficiently from going to a lab every week, because then you see the connection with what you're being taught in the lectures and how everything works in real life. That's why I like the idea of using labs to support the lectures. In class, I speak of lentiviruses for gene delivery, and it may sound complex or even dangerous or scary, but then we go to a lab, learn how they function and how to use them safely and, at that point, the students understand that they are easy to build and highly efficient. It gives them a different perspective of things, and I think the students really benefit from it."**

Apparently Perez-Pinera and Bashir are on the same page when it comes to undergrads being involved in important research.

> **"Rashid and I think undergrads are fully capable of doing cutting-edge research if trained properly. So the question we asked is, 'Why not?' Why can't undergraduate students make lentiviruses or biobots? At the end of the day, it comes down to a set of instructions that they have to follow.'"**

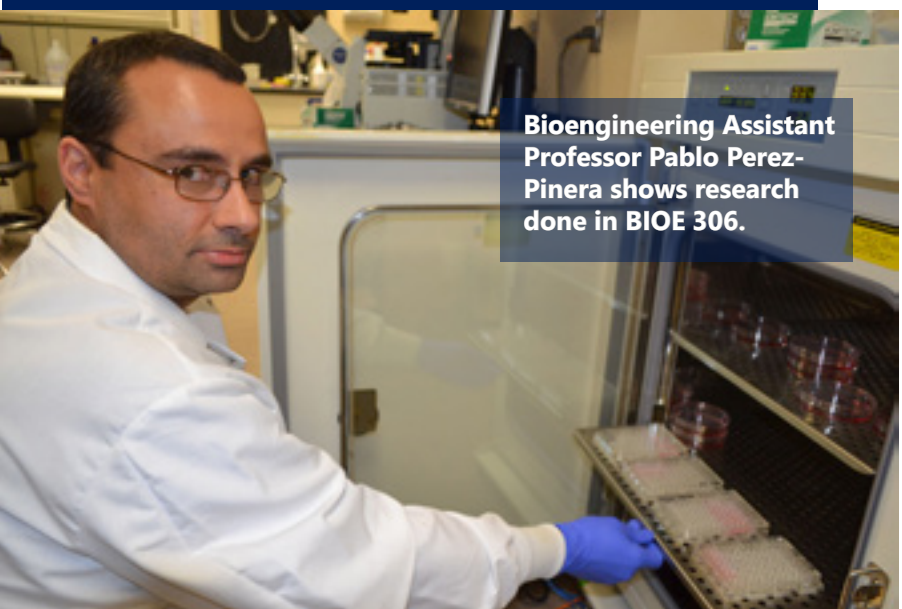


Rashid Bashir, Head of the Department of Bioengineering and EBICS Associate Director, and Mechanical Engineering Ph.D. student and EBICS NSF Graduate Research Fellow Ritu Raman.

To take the course, students must have had prior instruction in cell culture. “What that means is they know how to work inside a hood in a sterile way so that they don’t kill cells,” explains Raman. “Everything else we teach you.”

Raman says the first lab is pretty basic: to make sure students “know how to grow up cells and not kill them,” she says in an aside. She explains that 3D printing of biobots uses photo initiators, and of those available, one is good for cells; the rest are toxic. The students learned to test the effect of the different photo initiators to determine which is “the one that’s not going to kill all the cells,” explains Raman. “That’s the one they’re going to use.”

In the next lab, students made optogenetic cells. Muscle cells used to create the biobots are optogenetic. “They respond to light,” explains Perez-Pinera. “The biobot should be walking when you shine blue light.” Researchers can get biobots to do things by flashing light on them to make the muscle contract. So in this lab, students were given a regular muscle cell line then taught how to create their own optogenetic cell line which they would use for future experiments.



Bioengineering Assistant Professor Pablo Perez-Pinera shows research done in BIOE 306.

In the third lab students learned about 3D micro environments.

"We’re taking cells that we grow on a 2D plate, and trying to build a muscle in a 3-dimensional culture and controlling the behavior of those cells so that they contract on command," says Perez-Pinera.

In this course, students learned to seed cells in hydrogel to see how cells interact in 3D and remodel their environment—which they needed to understand before they could make a 3D muscle.

Next, students learned how to 3D print. They designed a 3D model in CAD, then 3D printed it themselves. While 3D printing is often done with polymers, they learned to do it with biocompatible biomaterials (similar to what’s used in contact lenses). Cells can grow on and in them.

In the fourth lab, students replicated a biobot design, trained it, flashed light on it, then got the results.

During a lab, Bioengineering undergrad, Erik Anderson, examines biobots he created under a microscope.

This data analysis is where some of Ritu’s research came into play. She taught students to “look at how much the biobots are moving, and use mechanical modeling to extract data, so we know how much power is being output by this muscle.”

“So that’s fun,” Raman says of the fourth lab, “and they learn how to make a biobot. But that’s not exciting, because they just made a biobot that I already make!” So for the pièce de résistance, they had students design their own biobots.

Perez-Pinera claims having students do their own project the last 3–4 weeks of class is something that worked out well in in his last class, so he thought it would be a good idea to do the same in this class. He tells the students:

During a BIOE 306 lab, Michael Gapinske and Lauren Grant work on their final project, which Perez-Pinera calls, "spectacular."

"Take what you have learned and do yourself a project…I'm supporting you, and I'm here to help, but it's going to be your idea and your project. It's all up to you—how creative you are. "

Perez-Pinera says the first 2/3 of the class, they're going to be building very simple biobots, so the final project gives students a chance to be creative. "So we're hoping that they'll be able to design something more complex. It would be interesting," he admits.

"And I'm hoping that they come up with ideas that we haven't thought of before," adds Ritu.

Ritu adds that for their final project, they would screen them to ensure that everyone's ideas were different, but also feasible. "And then they kind of just go rogue and make that thing!" she finishes.

For the final event of the course, students presented their projects to Professor Bashir and other EBICS faculty. In addition, they held a group discussion on ethics. "A big focus of the center is responsible bioengineering," acknowledges Raman.

Bashir says that ethics training is extremely important, especially in an emerging field:

"So we have to be very careful with that," adds Bashir. "Any new technology, people can hopefully use it for helpful things, but you can think about how it could be used for not-so-helpful things. So our goal is to make sure that we keep bringing that up, and have people think about and discuss how this technology could be used and discuss ethical implications of this work."

In fact, EBICS had already developed and piloted a biobots ethics module last summer, which he says will be used as a starting point for the discussion.

"When you are dealing with building biological structures, the question of 'How close is this to living entities?' and 'What are the ethical implications of that?' are approached. We already have a couple EBICS ethics modules. We are going to use them as a vehicle to get students started on the discussion and to discuss other things that they have on their minds and be able to talk about how to manage those concerns."

Bashir elaborates on why the ethics component is so important:

"The idea is, 'How do you let people be creative but yet put some measures that protect and prevent people from going too rogue?' We also have to be careful about how to present that to the general public…it's very important how you present it in the context of being responsible about this research in terms of how it could be used."

The hope in developing this course is that some of these undergrads end up in this field of research, but Bashir says their purpose more broadly is to take the research and disseminate to undergrads.

"So our purpose here was to try to get the research integrated with education and knowledge transfer and disseminated at the undergraduate level to get people to think about more of such applications."

He explains that EBICS's goal is to actually go beyond tissue engineering, to not just build organs but rather "hyper organs" or try to do non-natural functions and build such kind of machines, biological soft robots or "biobots."

BIOE 306 students Howard Dabbous and Alexandra Palasz look on as Ritu Raman (right) works with the biobots they created.

“The focus is more on going past the tissue engineering applications, but through this course, we want to impart the skill sets to the students to either go into tissue engineering or be thinking about this idea of 'forward engineering with biology.'”

Bashir also says that the course provided a great opportunity for Ritu to take on a leadership role.

“It’s an EBICS brainchild; we talked about wanting to do this, and she really made it happen,” explains Bashir.

One look at Raman‘s expertise explains why her participation in the course is key. Her emphasis involves higher resolution in 3D bio printing. For the past three years, she’s been developing the enabling technology: modifying a commercial 3D printer and building a separate apparatus that prints at a much higher resolution. Her other emphasis? Building different types of biological machines.

“Expanding the functionalities that we can have with biological machines. It’s been really helpful for me to have a project that’s been very focused on a tool that can be used for many different things, and then a project like biobots, which is what I would consider a specific application or focus area for that tool.”

Raman says another important goal of the course is to develop a baseline bioengineering curriculum:

“Because Bioengineering undergrad curriculums, in general, are so new, a lot of people don’t really know what a bioengineering undergrad degree is. So…we’re saying, ‘These are the tools that a bioengineering undergraduate student has. That’s something that people from mechanical, or chemical, or material science don’t have. This is the expertise that a Bioengineering person has…something unique that you’ll only get with a bioengineering degree.”

“This is something that should be taught,” agrees Bashir. “Again, this space of fabrication and 3D printing is moving very rapidly. There’s lots of applications in the space of bio engineering. It also provides a tool to do this forward engineering with biology. So, yes, we think that this should be an important part of undergrad curriculum.”

What are the plans for the course in the future? While it might eventually be disseminated for use by other institutions, especially EBICS’ partners, Bashir says the idea was to pilot it on a small scale to work out all of the bugs, with the goal of launching it fall 2016.

“I think we’re going to start here with this course, and do a good, high-quality job at it, and scale it up locally here,” qualifies Bashir.

Raman adds that it could also be disseminated as, say, a three-week lab module that could be incorporated into existing tissue engineering or bioreactor courses.

Based on this course and related discussions around building with biology, Bashir says that Bioengineering is considering instituting a new synthetic biology track, and this course might be part of that.

“Building with biology is very unique to bio engineering,” says Bashir. “So we're actually thinking of adding more courses…at the undergrad level and create a formal track."

Ritu Raman, who helped develop the BIOE 306 course.

POETS SEEKS TO CHANGE THE ATTITUDES, SHAPE OF STUDENTS IN THE STEM PIPELINE

Andrew Alleyne, Professor in Mechanical Science and Engineering and PI of POETS

March 18, 2016

Andrew Alleyne, PI of the NSF-funded Center for Power Optimization of Electro-Thermal System (POETS), says the Center's educational components are "all hypothetical at this point" and just "plans in people's heads." However, his plans and those of POETS' Co-Directors of Education, Fouad Abd-el-Khalick (K-12 students) and Phil Klein (undergraduate/graduate students), and Education Coordinator, Joe Muskin, appear to be well thought out and seek to strategically strengthen the education of targeted populations along the STEM pipeline.

Alleyne says POETS' educational program is comprised of three strategic thrusts which target K–12, undergraduate, and post-Baccalaureate students and are designed to ameliorate certain weaknesses in engineering education for these targeted groups. In addition, the overarching emphases of all education components are to break down silos/foster interdisciplinarity, plus be sustainable, intergenerational, and engage underrepresented minorities.

Change K–12 Students' Attitudes

POETS' first goal—change K–12 students' attitudes towards STEM—seeks to help students understand why STEM is important and relevant. Alleyne hopes to take the "mystery" out of STEM.

"At the very least," he says, "we want it to be understood that it's important and it's not something to be feared. You hate to hear a person say later on in life: 'I could never be an engineer because I was never any good in math or physics.'"

Here's another mindset Alleyne and company hope to change among students who end up going into non-STEM fields: "Sometimes they tend to discount STEM as not relevant to them," he admits. So one of POET's strategies is to communicate to students early on that STEM is "important, valuable, nothing to be feared, and hopefully to be enjoyed, if you do it right," acknowledges Alleyne.

Joe Muskin, who is helping design and implement some of POETS' educational components, says one K–12 program they envision for down the road is a Young Scholars Program. Around 2–6 high school students would come onto campus to do research in *Illinois*' labs for several weeks over the summer.

Another program in the works, which would obliquely impact K–12 students, is a Research Experience for Teachers (RET), which Muskin calls "novel and interesting." In traditional RET programs, teachers do complex research, then try to write curriculum around it. "Unfortunately," Muskin explains, "what they try to take back into their classrooms is the procedure they did or the

very specific thing that they worked on. Lots of times, it doesn't really relate to the content they're teaching." So POETS' RET will try to develop curriculum related to thermal and electrical processes that's aligned to the Next Generation Science Standards (NGSS). So the first two portions of the RET will be in-depth training on the NGSS followed by introductory lab experiences in several labs. "It's not the depth, but instead it's more of the breadth," explains Muskin.

During the research portion, teachers will wrestle with, "How do we take something we really like, that we think would be aligned with the NGSS, and figure out how to do it in a classroom?"

For the first year, the RET would most likely be very limited: probably two teachers at each of POETS' four institutions (Arkansas, Howard, Stanford, and, of course, *Illinois*). "We're all going to try this out and see what works and what doesn't work, and then we're going to ramp it up for future years," explains Muskin.

I-Shaped Undergraduate Students

Alleyne's goal for the middle thrust, undergraduate students, is retention through interdisciplinary, sustainable, and intergenerational programs.

Alleyne describes his vision for undergraduate education as I-shaped: "Broad at the beginning, then they go into their individual departments and it narrows in the middle…then at the senior level you broaden out again and do interdisciplinary senior design projects." To achieve this broader beginning, he proposes a more interdisciplinary, project-based freshman curriculum.

"There have been studies that point out if you silo people, they feel isolated," he says. He goes on to explain that those in technical fields often don't feel connected to the broader community. "There's a segment of the population that, even though they are bright, they can become disengaged, feel that this isn't for them." So Alleyne and company hope to prevent this disengagement early on via a cross-disciplinary, first-year experience. "Studies have shown if you do that common, first-year experience, the retention rate in the first year goes up significantly."

Alleyne's a huge fan of a common (or undeclared) first year, which he claims gets better retention numbers "because people have a year to figure out whether they really want to be a computer scientist, electrical engineer, physicist, etc. That first year, people tend to track into things that suit them better."

While *Illinois* has undeclared engineering students, it doesn't have a common first year; being undeclared is optional, not required. So Alleyne proposes to "take the current structure, where we have departments, and institute cross-disciplinary, first-year experiences," adding that, "We want to do the pilot to make sure that will work."

They envision freshmen taking first-year design courses that introduce them to a number of engineering disciplines to see if this increases retention. He proposes to "start with a pilot group, have them work through a semester's worth of design topics, and see if that cohort has higher retention numbers. I anticipate that they would, because we try and create authentic experiences—something somewhat realistic they can see in everyday life."

In line with their overarching emphasis on sustainability, Alleyne would like to see the first-year interdisciplinary emphasis instituted college-wide. "When you're starting something and you're trying to make it last and be sustainable, you want to get some very key tangible wins early. If we are able to demonstrate among these key departments that we can actually get integrated design experience, then we can start to institute and decide if we want to broaden this, make this a policy across the college because we've seen the numbers and have the data to make our decisions."

POETS Educational Coordinator Joe Muskin teaching during a recent teacher workshop.

POETS PI Andrew Alleyne (center), with Pramod Khargonekar, NSF Assistant Director for Engineering and NSF Director (left), and France Cordova (right) during POETS' fall 2015 kickoff event.

So plans are underway to get some projects in place, do some curriculum design, then hopefully pilot a course in fall '16 with around 5% of the engineering freshman class. "That's a healthy number to start with. That's a strong evidence to try and make something more institutionalized."

According to Alleyne, making the first-year initiative sustainable, or institutionalized, is "the critical part of the middle piece…POETs is built to stick around. Going to take time to make sure to get it right. Because we're trying to build this thing to last, we don't feel that we have to get results to write an article or a paper in year two or year three. The goal is bigger than that."

So they intend to take their time and do it right. "We want to run that [first-year experience], get the learning assistants' feeding back, get the intergenerational thing built up. Then the people that did it their first year, we would want to give them a similar type of experience their last year to bookend that."

Getting rich data regarding the effectiveness of the first-year program will be crucial. "If it works," acknowledges Alleyne, "we're asking the College of Engineering, one of the top five engineering programs, to change how they do things. They've worked pretty well for a long time, so if we're not pretty thorough in how we gather the data to make that suggestion, there's far too much risk to change what works very well."

Contributing to the first-year program's sustainability would be another key emphasis of POETS—intergenerational experiences. For instance, Alleyne envisions older students "looping back" to impact the freshmen. "First year experience is bolstered by people that do well in the first-year experience and really like it. When they go to their second and third year, they loop back and interact with the first-year students as learning assistants."

To further contribute to undergraduate retention and to engage under-represented students, POETS intends to implement a Research Experience for Undergraduates (REU), which would go beyond traditional activities, exposing participants to not only research and reporting results via posters, but how to write graduate research fellowship applications. This summer's REU would probably start small, around 4 or 5 students in each of POETS' institutions.

Another undergraduate research program being considered is a continuing REU program. They envision that it would eventually involve 20–25 campus undergrads who'd be housed in the

POETS office and involved in an ongoing, year-long REU experience. By alternately engaging these students in both research and working with industry, students would hopefully learn some additional tools and eventually end up with a good toolset.

T-Shaped Post-Baccalaureate Students

POETS' third thrust is shaping post-Baccalaureate or graduate students who are comfortable in an interdisciplinary environment. "Our goal there would be the T-shaped engineers that people talk about. They have depth in one area. You go to grad school to gain some depth and become an expert in a particular area," Alleyne acknowledges. But in addition to depth, they would also like their students to have breadth: "to become experts, but also be relatively broader than the average engineer. They will have to understand that coming in. It will take a while to build that culture, but this will be the culture we are trying to build."

One strategy to encourage this seems fairly simple on the surface (although it might involve some infrastructure changes): "We're going to go with an open office type of plan, which we don't have here on campus very much. Open office—you don't have walls or dividers; it fosters collaboration. You get to learn about what other people are doing by osmosis. You have to be willing to work in that environment to succeed."

Alleyne indicates that over time, students' willingness (or lack thereof) to work in that environment might cause some self-selection. "The folks that want to do their own thing may not choose to come here. But I think there is a large enough section that want to be a part of something bigger than just what they're doing."

What Alleyne is proposing actually goes beyond changing the infrastructure; he calls it a culture shift. "There's a big difference between being multidisciplinary through email versus you living and breathing in the same space with those individuals every day. You can tell the difference. The way we're doing it is a culture shift. Right now, each grad student is in their own office...It's different than if we don't have walls."

"If successful," he adds, "it will change the way we do things here on campus."

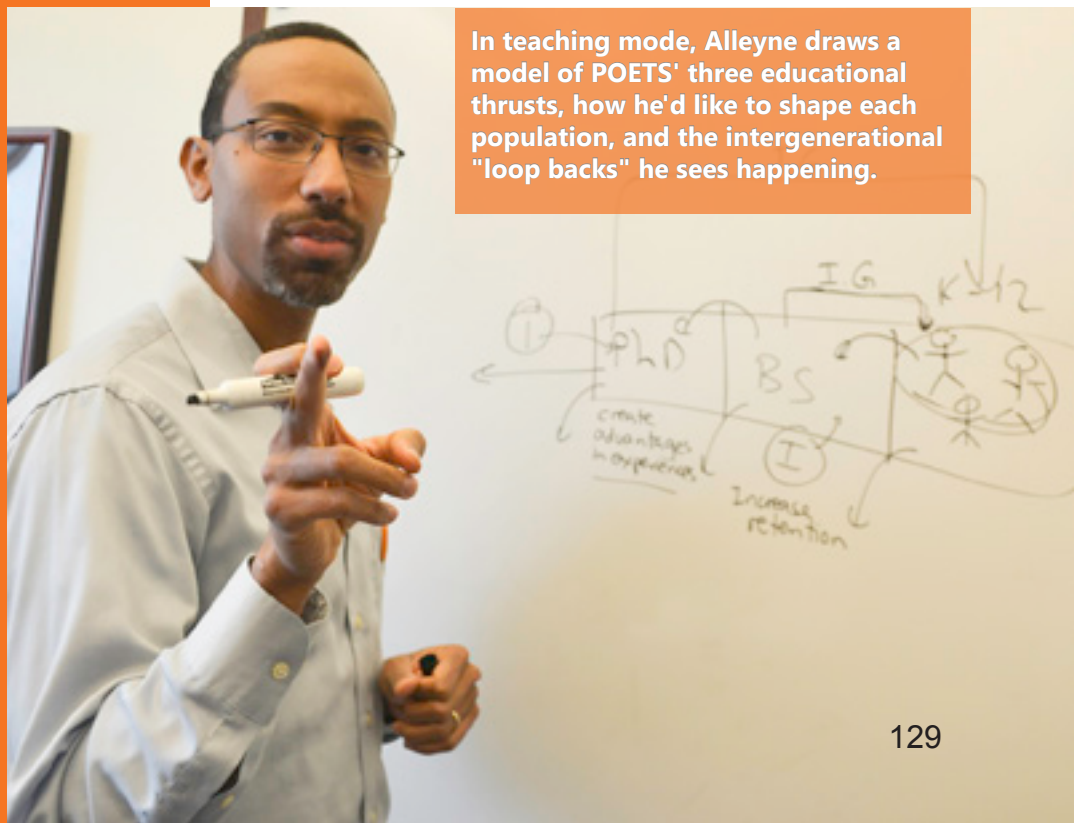
Alleyne explains that their research revealed that what they hope to implement would take a certain kind of people: "a significant demographic shift in terms of age demographics about people that are more comfortable working in an open environment. Younger people, yes. Also certain cultures are not as receptive."

So POETS has come up with several strategies "to generate that agile, interdisciplinary, multidisciplinary type of person—a person that's comfortable in many different environments." Alleyne says, "Training people to work in more open collaborative types of environments is part of the education." They also hope to get students off-campus experiences with international partners, plus expose them to industry. According to Muskin, breaking down silos is "Not just interdisciplinary… So two big walls to break down. One is the departmental walls, but also the walls between academia and industry."

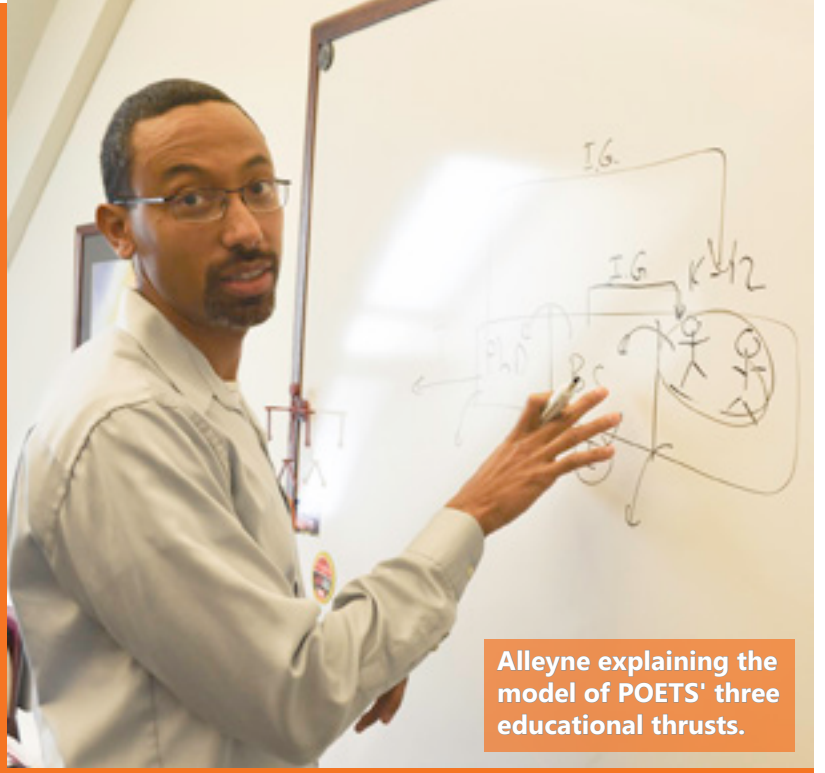
Intergenerational Experiences

Regarding POETS' intergenerational thrust, Alleyene offers a pithy proverb that epitomizes his philosophy: "The sales department in a company isn't the whole company, but the whole company better darn well be the sales department."

In other words, he expects sold-out engineers produced by his system to "sell" it to the younger ones.



In teaching mode, Alleyne draws a model of POETS' three educational thrusts, how he'd like to shape each population, and the intergenerational "loop backs" he sees happening.



Alleyne explaining the model of POETS' three educational thrusts.

"The post baccalaureate will loop back and interact with first years and seniors in undergrad," he envisions. "Some will loop back with K-12 to try and change the idea of what STEM means. People have a stereotype of people going into STEM. When you start bringing back advanced degrees, they show that there are many types of people that can like this and be successful."

And he intends that they become perpetual ambassadors of the program: "The hope is that it gives them a broader and richer experience. When they launch their own careers, they understand that they're part of an organization. They understand that to be successful, it's not just what they do, but what they do in a context of a larger team. Part of that learning process is how to communicate efficiently and effectively to people of different backgrounds."

Reaching Out to Underrepresented Minorities

Another goal of POETS is to increase the number of underrepresented minorities that enter the STEM pipeline. POETS' programs, such as the REU and the Young Scholars programs, will specifically target underrepresented minorities and women.

According to Muskin, one reason is to increase the number of engineers. "It's important to broaden the pipeline," he acknowledges. "We want to make sure that we bring in underrepresented minorities. That's a large focus on a lot of these efforts, because we really need to expand the number of people engaged in engineering. Unless we start engaging the underrepresented populations, we're never going to have enough engineers."

He also acknowledges that a diversity of perspectives is needed to solve society's problems:

> **"Bringing in more people, you get a lot more solutions, a lot more creativity. People see things differently, and that's so important. If we're going solve the world's problems, we have to have people solving them from different perspectives. We have to have different ideas coming in, to get creative. You don't get that unless you really expand who's involved in engineering."**

One key emphasis for POETS, a 5-year grant with a possibility of renewing for five more years, is sustainability.

> **"We're putting the time and effort in so it's built to last," says Alleyne. "Many of the decisions we're making and have made were with sustainability in mind. Does that mean we will suffer on some other metrics? Yes, but that's a strategic decision we've made consciously."**

Alleyne believes the interdisciplinary, adaptable graduate students POETS produces will ensure its sustainability: "We want our T-shaped engineers to be several years ahead of their competitors and peers when they come out. Sustainability. If we are able to generate students like that, people will want to see this continue. It will be easy to recruit partners because they will benefit from this."

Does Alleyne want all of the students POETS impacts to end up with PhDs in his field, or at least end up in STEM? Not necessarily. He calls the STEM pipeline a "leaky bucket, leaky pipeline. There's only so much you can do."

But he does have specific goals for the young people his program works with. "You want to get as many people here that are capable of making that next step, but if there are people that decide to get off the STEM pipeline after 12th grade, at least they understand why STEM is important. Grad students, at least when they come out, they are able to work in interdisciplinary teams. They're benefiting from this multidisciplinary type of working across different areas and cultures and teamwork. PhD, they have the T shape to them. It's ambitious."

MCBEES HELP PROVIDE STUDENT SUPPORT, RECRUIT, & SHARE THE JOY OF SCIENCE

April 26, 2016

In the past, new graduate students coming into *Illinois*' 10-year-old School of Molecular and Cellular Biology (MCB) didn't have much interaction with other grad students who had been in MCB for a while. During their first six months at *Illinois*, they were somewhat isolated as they rotated from lab to lab to find their niche, then got further divided as they entered one of MCB's four departments: Biochemistry, Cell and Developmental Biology, Microbiology, and Molecular and Integrative Physiology (MIP). Then, once that first semester was done, they didn't really come into contact with their classmates any more, "because you kind of get busy with your work," admits Biochemistry grad student Amruta Bhate, "and you only meet people from your department."

So a group of MCB grad students decided to do something about it. They got together and started a GSA (Graduate Student Association). They call themselves the MCBees. Their goals? To become a source of support for graduate students, especially incoming first-year students; to help MCB with recruitment; to foster relationship-building among grad students via social activities; and to do outreach.

Microbiology grad student Maryam Khademian came up with the idea for the group when comparing MCB's somewhat isolated environment to the sense of family she had experienced during her undergrad years.

"That was an amazing experience…a very friendly group of people where everybody helped each other," she says. "We got support from each other." She claims that as an undergrad, she got to know a great network of people who are "still my great, great friends." So she decided that it could be the same in MCB:

"Well, we have like 250 students here who are all potential friends," she thought to herself. "Grad school can be just as fun, and as cool, and as amazing as my undergrad experiences if we help students to know each other and to make friends."

So at their first meeting in November, 2015, they picked the leadership, working to ensure that all the departments were represented. In January of 2016, once they became an officially registered GSA, they started recruiting MCB grad students via email. So far, around 100 of MCB's 250 students have become members. Following are the MCBees' leadership team members, their roles/ responsibilities, and their departments:

Several members of the MCBees leadership team (clockwise from the lower left): Maryam Khademian, Amruta Bhate, Nayab Abidi, Kirsten Eckstrum, Omid Gholamalamdari, Mara Livezey

- Maryam Khademian, President, Microbiology Department
- Prita Rao, Secretary, Microbiology Department
- Omid Gholamalamdari, Treasurer, Cell and Developmental Biology Department
- Michelle Goettge, Communications, Microbiology Department
- Amruta Bhate, Academic, Biochemistry Department
- Nayab Abidi, First-Year Liaison, Cell and Developmental Biology Department
- Kirsten Eckstrum, Social, MIP Department
- Mara Livezey, Outreach, Biochemistry Department

Biochemistry's Amruta Bhate isn't worried by the number of students who have joined so far; she knows that it might take students a while:

"I have realized that doing something like this does take a bit of your time away from your lab, and not everybody wants to do it. But I still think it's something that you should do because there is something apart from just going to lab and working in the lab. But I took four years to realize that."

One of the MCBees main goals is "to be a platform of support for grad students, where they feel that they are at home and get to know each other and make friends," says president and founder Khademian.

She hopes the MCBees will become a family—friends that will, for instance, supply the affirmation and recognition that is often missing: "We will appreciate each other, because nobody actually recognizes the grad students who did that. It's like four years you have been spending time on this; now the paper is out, and it's in your advisor's name."

And as with her undergraduate friends, she hopes they all become life-long friends—"bring that experience for their lives, not even just for the years that they are here. They gain something that they can actually take throughout their lives."

The MCBees leadership team members also especially hope to foster networking across MCB departments. Amruta Bhate, over the Academics committee, says "So there isn't a lot of holistic communication between grad students between different departments. That is why we felt we should have a grad student association where we can come together and network."

The MCBees also hope to do more than just network. They have big plans for the future:

Amruta Bhate at work in her lab in the Medical Sciences Building, studying how the mechanism called "alternative mRNA splicing," impacts liver maturation and regeneration.

Maryam Khademian, MCBees President

academic events, drawing clubs, journal clubs, science-based competitions, social hours, outreach. Bhate adds that they also hope to: "have an early source where the incoming grad students can just contact senior students just to know how this school works."

Remembering how lost they all felt in their first year in MCB, this idea of fostering communication and mentoring between those who have been in MCB for a while and new grad students is another key MCBees goal. According to the head of the First Year Liaison Committee, Nayab Abidi, "Senior students weren't communicating with the junior ones. New batches would come in; you wouldn't have any idea who the new students were, and new students wouldn't be able to ask for any guidance or help from the senior ones because there wasn't any means of talking with each other." So the MCBees formed a GSA to help resolve this dilemma.

Nayab Abidi in her lab in CLSL. Her work involves using fruit flies as a model organism to study wound repair and tissue regeneration. Her research seeks to search for and identify genes that play an important role in the process of regeneration.

There's another void the MCBees hope to fill: "We're working on recruitment," explains Kirsten Eckstrum, head of the Social Committee. For instance when prospective students visited campus earlier this semester to interview with faculty, they also met with the MCBees, who held a social hour which included a game to help potential recruits "learn a little bit more about graduate life here and about Champaign-Urbana."

First-Year Liaison Committee Chair Abidi reports hearing a coordinator say that recruitment week hadn't been having "enough interaction between the grad students who were here and the new ones that are coming in. So this event specifically is meant to further the interaction between the incoming students and the ones that are already here."

"If you decide to come to the U of I for your PhD," adds Bhate, "essentially you are committing five years of your life, at least, so you want to get a feel of this school, and we are trying to give them that."

For prospective students who couldn't make the first visit in Februrary, MCB scheduled an alternate weekend in mid-March. For that event, the MCBees sponsored the MCB Rapid Fire competition in the form of elevator speeches. Labs or grad students had three minutes to present their research to the audience.

"It's like an elevator pitch, but in a fun way," explains Bhate. "To be catchy, it has to be general so that people from every discipline can understand it, and it has to be short, and sweet, and funny." While still a competition, the plan was that "the candidates/recruits will get an idea of the breadth of research going on."

The MCBees also did another fun, research-related event for MCB recruiting week: a research photo contest. They had students send them photos related to their research with a description, which they printed then showcased during the recruitment weeks, "so recruits would actually see what's going on," explains Khademian. "They see what research actually is like."

"These are actual research images, actual data from somebody's lab, but they are also visually appealing," adds Bhate. "So you'll have a cool image that's also actual raw data. It has both things going for it."

What were some other fun events they did as part of their recruitment week activities? They collaborated with the grad college to show the PhD movie, and held "a happy hour for all the grad students in MCB as well as for the new recruits" says Kirstin Eckstrum, in charge of social activities.

Omid Gholamalamdari, Treasurer, Cell and Developmental Biology Department

Another emphasis of the MCBees is outreach. According to Outreach Coordinator Mara Livezey, “We all do science; we all love science.

But for one reason or another, we got into science because someone taught it to us, and I feel like we have to go out into the community and teach others because, how else can they be exposed to it really?”

In fact, one outreach idea the MCBees have is to perfect the Elevator Speeches highlighting their research that they did for the March recruiting weekend, making them for general audiences.

Omid Gholamalamdari, the MCBees’ Treasurer, explains that they borrowed the idea from the Graduate College’s Research Live! competition held for the public, during which *Illinois* grad students were given three minutes to talk about their research.

“So this can be a kind of outreach someday if we just plan it for a public audience,” he explains.

Maryam adds that doing “Elevator Speeches” for the February recruiting weekend was kind of a test run; the plan was to “do it on a smaller scale just to work out the nitty gritty details of the event, and then we’ll eventually go big.”

Omid even wants to tackle the apprehension the general public often feels about research.

“We were thinking of just asking MCB faculty to come and talk about the science that they’re doing in their lab so people will get what the scientists are doing here and what’s the real impact on the world. Because there’s a huge gap between the normal audience and the scientists; they have no idea what is going on inside the labs. The best way to fill it is to ask the faculty to come and talk about what they are doing exactly.

The MCBees also recently participated in Dr. Williams Elementary's STEM Night on April 14th, doing two interactive activities for students in grades 1-5. They taught the youngsters about the different parts that make up human cells, and had the students extract DNA from strawberries. In addition, they set up a microscope so the students could see live cells moving.

The MCBees have other big plans for the future:

For one, they hope to collaborate or interact with other organizations or different departments on campus, not just in MCB. In the past, MCB didn’t have any organization to do that; now they do.

Passionate about outreach, the MCBees Outreach Coordinator Mara Livezey recently headed out into the community to Next Generation School's Science and Engineering Fair to serve as a judge. Here she is chatting with a student whose project she is judging.

Abidi would also like to take it a step further: to foster multidisciplinary research collaboration: “We don’t interact a lot with other departments like, say physics or engineering…We could use this as a platform to interact with other disciplines. One of the great things about *Illinois* is what a multidisciplinary campus this is, so we can really benefit from the other departments. Who knows? Maybe we can set up different collaborations or team labs just by talking to different people that you might not know. The work that they’re doing could be beneficial for what you’re doing in your lab.”

The committee has also discussed starting a book club or journal club. While they haven’t ironed out the details, the idea is that if “Something really cool comes up, we have a journal club or somebody presents the coolest thing out there and then people are made aware of this. Or read a book about a scientist, get more of an idea about how they went about it so students can draw inspiration out of it.”

The MCBees leadership team's hopes for their GSA are pretty much related to the goals of the individual committees they chair. For instance, while Mara Livezey says, "I hope for the graduate students that as a group, we can bring everyone together and form more of a community within MCB," of course, her hopes are also related to outreach:

"For younger people or people not within the university, I just hope we can spread the word of science and get some excitement about what we do every day."

Nayab Abidi's hopes are, of course, related to the first-year students: "Once we got separated into departments, even though we all were the same year, we had zero interaction with each other. Like we're the same department; we're the same school, and the same batch, and we still don't interact with each other. So I felt like that was one of the biggest lackings in MCB; that there wasn't much interaction with people you were so close to the first 6 months you were here." So I guess that would be one of the main things—have more interaction."

One of the winners of the Research Photo Contest. This image by Whitney Edwards is entitled "The Pituitary is the Master Gland. Our Gland Tells your Glands what to do"

Abidi is also passionate about the mentoring aspect: "The first years, when you first come in, you don't have a lot of guidance by senior grad students. So that would be another thing we would be able to help remedy. When the grad students are coming in, they have more interaction. They'll be able to get into the MCB community easier."

Kirsten Eckstrum's purview is social activities, and she hopes the MCBees provide that for students:

Kirsten Eckstrum, Chair of the Social Committee, Department of MIB.

"I hope that we set up a way for everyone to have fun, because we know that grad school is not always fun. It can be very frustrating and draining on you. So I want to set up something where we can all get together and have fun and get to know people from other departments so we're not so alone, so that we can know that other people are going through the same things we are and having the same struggles that we are having in grad school."

Nayab echoes what was said about the struggle of grad school. "A lot of the time, somehow a grad student's effort is not being highlighted…This is where we could act as a really good support system for each other also. I think that is where the MCB GSA is going to be really important as well, acting as a support system for all the grad students."

Pritaha Rao, the MCBees's Secretary, indicates why she got involved in the MCBees: "This was a group dedicated to represent the graduate students in MCB program. I thought this was a good opportunity to interact with people from the department outside the classroom setting and meet as individuals who are interested in various cultural, academic, and outreach activities so that we would all have something other than our research to look forward to during graduate school."

Although the MCBees have only been in existence for a few months, Rao believes the group has begun to have an impact: "We have already organized a couple of events highlighting our research and an outreach event with kids from elementary school. I can say that these events have helped graduate students, including me, realize the importance of the work we do, think of simpler ways to describe the complicated science we do. It has also been immensely satisfying to be able to reach out to the community and help them with our expertise."

Rao hopes the MCBees will become "a support system for the graduate students, to address the issues they face during their time in graduate school, as well as give them opportunities to enhance their graduate career."

Bhate hopes the MCBees serves to disseminate information about the research going on in MCB:

“We hope to broadcast what we do here at UIUC in these departments to other people who are not related to UIUC, like schools…The other thing is also have a platform where we can broadcast what the grad students are doing. We are trying to have something set up if somebody publishes a paper, we highlight that. Something like that so there is recognition, so grad students also feel appreciated.”

Amruta also believes the MCBees can benefit not just first-year students, but a specific subgroup: international students: “I think this would also be a good resource because you are coming into a completely different setup, so you kind of need somebody to help you navigate through that…

A local youngster gets to see live cells moving through a microscope during Dr. Williams Elementary's STEM Night (photo courtesy Mara Livezey).

That is going to be very important for the first-year students and maybe moreso for the international students.”

Unlike the other MCBees, Omid Gholamalamdari isn’t necessarily passionate about his position of treasurer; he accepted the role to meet a need: “We had an empty position that nobody wanted and that was the treasurer,” he admits, “so that was how I wanted to help the MCBees to get us started.” However, he is passionate about the group’s outreach:

“I really like discovering things and learning about things,” he admits. “There is just a joy in that, and it’s great to share that joy with other people. I like the outreach part of MCBees the most because it’s just sharing the joy with other people.”

Pritha Rao at work in her lab in the Chemical and Life Sciences Laborabory.

MECHSE GRADS MILNER & ARMSTRONG TRADE IN SPORTS OUTREACH FOR STEM VIA ENVISION

April 26, 2016

Mechanical Science and Engineering (MechSE) graduate students Matt Milner and Ashley Armstrong were both student athletes while getting their undergrad degrees in STEM. And they both cut their teeth on athletics outreach—but back then, they did sports camps, not STEM camps. So when they arrived at *Illinois* to continue their education, both were sensing an outreach-shaped vacuum in their lives and felt it was important that they share their passion about STEM. But since there didn't appear to be a vehicle through which they could do STEM outreach, they decided to build one—called ENVISION.

MechSE grad students Matt Milner and Ashley Armstrong, creators of the ENVISION MechSE grad student outreach group.

Both Milner and Armstrong were fairly unique among their fellow undergraduate athletes, in that they were both enrolled in difficult programs of study. Even more unique—both excelled at academics as well as sports. While getting a degree in Mechanical Engineering at University of Notre Dame, Armstrong played women's golf and was an Academic All-American—twice. Milner, who played football at East Carolina was also a two-time Academic All-American—while studying Physics.

Once they arrived at *Illinois*, they actually got to know each other at a rather serendipitous encounter while working up a sweat at a local gym. They each noticed that the other looked familiar, asked, "Hey, aren't you a part of Mechanical Engineering?' and immediately bonded over their love of engineering and athletics. "We've been friends since," says Milner. That's when they also learned of their mutual interest in outreach, and each acknowledged that they were missing it.

"I think in the transition from student athlete life to grad student life," acknowledges Armstrong, "we both realized that there was a big gap of no outreach. We decided to kind of address that issue."

"Because we did outreach in a different manner during our undergrad, through athletics," adds Milner. "Ok, we've shifted. We've set aside our sports gear, and now we're looking at, 'Ok, how do we do outreach with this new role? How do we involve all kids, bring them into engineering and STEM education in general?...So we actually started up a group—ENVISION: ENgineers Volunteering In STEM EducatION," explains Milner.


A young visitor to BTW's Science and Engineering Fair enjoys the Oobleck Pool.

After firming up their plans during the fall 2015 semester and over winter break, the two officially began ENVISION in the Spring 2016 semester. The grad student organization currently has around eight or nine MechSE students, but depending on how the prototype works out, they're thinking about possibly opening it up to graduate students from the entire College of Engineering.

Their goal: to “provide an outlet and some way to get to know people who want to do something in the community as well,” explains Armstrong.

Armstrong reports that last semester, she did an outreach program that not many people knew about.

“I realized that I had had to dig kind of deep and find these outreach programs,” she indicates. “So the goal with ENVISION is to make it very accessible.” Their goal isn’t to “beat out other groups that are currently providing outreach opportunities, but maybe make a calendar of events so that people can go to our website, ‘Oh, this group is doing this outreach event.' So just to make outreach more accessible in general,” explains Armstrong.

One of their strategies that they believe is unique among the different outreach groups? They emailed MechSE professors this past semester to let them know that ENVISION is available: “We are a resource for them,” says Armstrong, “so if they want to try out any outreach for grants, if they need people to try out ideas…We’ve actually had professors reach out to us this semester so far.”

Their target audience: elementary and middle school students. “We want to show them that it’s cool,” says Milner, then admits. “I probably got made fun of for studying physics in undergrad football, but I stuck to it, and they probably didn’t have any idea what I was talking about.”

Was he the only physicist on the football team? “Yea, yea,” he admits. “But it’s not a bad thing to have an interest in and have a love for science.”

Was he able to apply physics while playing football? Evidently he’d been asked that question before:

“During my undergrad, I gave an interview, and they asked, ‘How does physics relate to football?’ According to Milner, football is replete with examples of physics. Such as throwing the football, or something he did on his end of the field: “Anything. Like momentum,” cites Milner, giving a concrete example he evidently had put to good use when blocking opponents as a defensive end at East Carolina. “In order to have the most momentum, I want to have the most mass, and I want to be the fastest, and I want to have the most velocity in order to punish that opponent!”

Mechanical Engineering student Samantha Rivera helps a BTW student build a gumdrop/toothpick structure during the Family Engineering Fair that Milner and Armstrong helped organize.

Armstrong adds that they have strategies for reaching out to both girls and boys: “Make it seem like it’s cool, especially for young boys. Also we want to get girls involved to show them that it’s a really good avenue, and there are girls. It’s not just old science men in labs conducting weird experiments.”

And that works out, because out of the people who’ve participated, they’ve had both guys and girls—about 50/50.

The fledgling group has participated in five outreaches so far: a 3D printing activity at King Elementary; a LEGO Robotics MindStorm activity at the Champaign Public Library with Edison Middle School students; Science Night at King Elementary, and Science Night at Leal Elementary.

A BTW student proudly displays the mirrors he made in preparation for making a kaleidoscope.

There were also some larger events that would take a bit longer, for which folks would need a ticket for a certain time; the first two of these, the students would get to take home as souvenirs:

- 3D Printing, Lithography,
- A Kaleidescope, which involved silvering mirrors
- Stomp Rockets
- Fog Ring Cannons

They also recruited volunteers from two undergrad Mechanical Engineering student groups: Pi Tau Sigma and ASME (American Society of Mechanical Engineers).

Also, taking a page from Disney World, students had a passport they stamped after completing each activity. To give students an incentive to go to as many events as possible, students who went to a certain number of activities received a gift card, such as Jimmy John's.

In addition to the different University groups, the event also had a couple of community partners: the Douglass Branch Library and the Champaign Park District, along with BTW's PTA group.

"I think it's good to also bring people in the community together," says Miler regarding the different partners for the event, "but also utilize all these different avenues that we have." Some of the bigger events were held in the basement of the Douglass Branch Library, to get folks familiar with the resource.

A fifth event in which Milner and Armstrong had a significant role: a Family Engineering Fair at Booker T. Washington (BTW) STEM Academy on April 23rd. The two planned all of the events for the outreach, plus helped recruit volunteers from *Illinois*. For example, they came up with a number of smaller activities that could be done by a small group of kids or a family. "The idea of these is not to be very overwhelming, just do something that's quick and fun; to just teach a very simple, basic science concept," says Armstrong. Activities were:

- Ball Run
- Egg Carton Battery
- Elephant Toothpaste
- Gum Drop/Toothpick Domes
- Oobleck Wading Pool
- Silly Putty
- Wind Turbines

A young visitor to the Fair is silvering some mirrors for his kaleidoscope.

A BTW student stamps her passport after having completed her gumdrop/toothpick structure.

Milner and Armstrong hope the Engineering Fair piqued the students' interest in STEM:

> **"I hope that it showed them how cool science and math and STEM in general can be," admits Milner. "And that it's something to pursue. It's something to go after. You build in them a drive and a desire to want to pursue this further. Give them that curiosity and let that curiosity work its magic in them and lead them to science and math and engineering."**

Another impact the two hope the Fair had was to show kids that science and engineering are team sports:

> **"I also think a lot of kids—I know I kind of thought this growing up—they think that science is very individual, and at that age you want to be with your friends. You want to be involved with as many friends as possible. So this kind of fair is very interactive, and so it shows that in science, you have to do it in a group. It's not an individual venture."**

The event's planners, including Milner and Armstrong, BTW principal Ryan Cowell, and MechSE Education Coordinator Joe Muskin, dream that in the future, the Fair would become a large community event: "It would be hosted by Booker T. Washington, but other people could come," Armstrong envisions. "Because we mentioned a lot of activities, but if you saw the size of this field, we could have put a lot more. So hopefully, in the future, it grows into a huge event. It would be cool to make it like an engineering fair."

As if seeing in his mind's eye the large crowd of community folk to prepare for in the future, Milner makes one last stab at recruiting: "We're always looking for volunteers," he claims. "We're always looking for any help."

A BTW family watches to see if their ball hits the targeted receptacle on the Ball Run activity. (Photo courtesy of Jeremy Innes.)

STUDENTS ACQUIRE HIGH-PERFORMANCE COMPUTING SKILLS DURING BLUE WATERS' PETASCALE INSTITUTE

June 20, 2016

NCSA (the National Center for Supercomputing Applications) is changing the millennial generation and the future of big data with the Petascale Insititute. During the two-week institute, students go from knowing fairly nothing about HPC (High-Performance Computing) language to knowing enough to complete amazing research projects using the Blue Waters supercomputer. From May 22nd to June 3rd, 19 Blue Waters interns (undergraduate students), 10 XSEDE scholars (both undergraduate and graduate students), and four additional undergraduate and graduate students participated in the institute. While Blue Water interns will be working on their research projects from May of this year through May of 2017, XSEDE scholars have a condensed schedule where they'll be finished with their projects by the end of August 2016.

Regardless of the students' titles, they are all working on research projects that will greatly utilize Blue Waters or another supercomputer. Their wide range of research topics include synoptic sky telescopes and light curve classification, neuro-network and the cell classification of benign or cancerous cells, star formation, particle simulation for high-energy physics, and metal alloy fusion.

A Petascale Institute participant works with HPC language.

Aaron Weeden, the Blue Waters Student Internship Coordinator at Shodor, explains that they seek to help train "the next generation of competent users of high-performance computing and petascale computing" and "to give students the experience that will help them become professionals that can use HPC systems of the future." They chose to teach about the Blue Waters Supercomputer, a petascale class supercomputer, because "It's going to give the students an opportunity to see the future of what high-performance computing and non-high-performance computing is going to look like" and it "will let them see the real power of using a system like this to do science."

Sushma Adari, one of the Blue Waters interns, is an undergrad from the University of Illinois at Urbana-Champaign majoring in computer science and astronomy. When asked about her research, which she is completing with Professor Robert Brunner of the Astronomy department, she says: "There's a lot of reflux with the synoptic sky telescopes that have a lot of data that's coming in. My research is going to be automatic classification where I use machine learning to develop models that can basically classify any of the light curves that come in as a result of data collection."

Before attending the institute, Adari was fairly unfamiliar with HPC and thought the experience "was really eye opening, where I was like, 'Oh my gosh, look, there's so much information; there's so much resources that I could use!'" She also enjoyed learning at

the institute compared to learning in a classroom because “in the class, you’re always worried about your exams or grades. Coming here, it’s like you’re learning for the sake of learning, and you’re here because you love it, and because it’s your passion. It’s based off your research, so it’s much more fun, and I feel like I get so much more out of it.”

Another undergraduate Blue Waters intern, Tom Corcoran, attends Hood College in Frederick, Maryland. Corecorean is majoring in computer science and minoring in mathematics. Before the institute, he had no experience with HPC. His assessment of what he’s learned: “It’s really amazing. Just the scale of everything is really blowing my mind and the ability to handle huge amounts of information in a really succinct and timely manner and do problem size I could never even imagine before.”

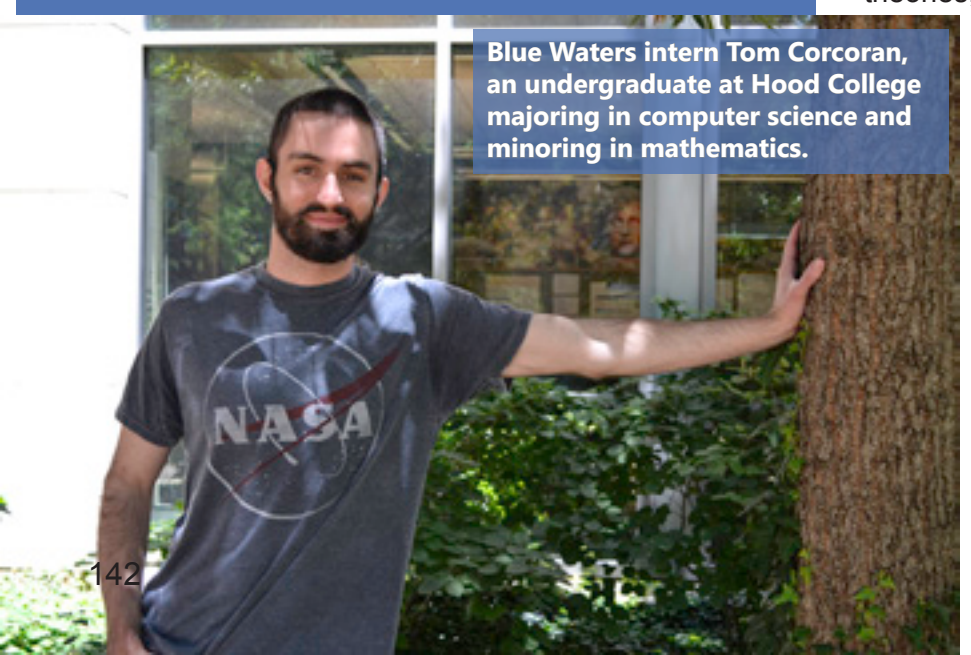
Corcoran explains that his research problem is “related to training neuro-networks to automatically add color to black and white images, and the goals of this research is to actually take this technique, which already exists, and apply it to automatically detecting whether or not the image of the cell is benign or cancerous.” Using a supercomputer helps Corcoran’s research by creating the ability to scale neuro-networks to really large sizes, which is typically “prohibitive in terms of computation.”

Corcoran has learned a lot from this process and believes the biggest things learned “are probably related to, number one, Linux, and a little bit with system administrated stuff,” as well as learning “about the C programming language” which is sort of the ‘lingua franca’ of computer programming. One of the most useful skills he’s learned is “how

Sushma Adari, an undergraduate student from the University of Illinois, takes part in the Blue Waters Intenship program.

to move data around.” If he were unable to move such large data sets, he explains, he “wouldn’t be able to do anything at all.” He is extremely grateful for this opportunity and states, “It’s opened my eyes to all of those resources and what kind of avenues you can take to learn more about this topic and just getting to meet all of these different professionals who are some of the top people in their fields. Doing this type of work is incredibly impressive, and “It’s inspirational.”

Shervin Sahba, a first year Master’s student from San Francisco State University, reiterates what many from the Petascale Institute reported about the benefits HPC. “I’ve been running simulations on a small scale,” he admits, “and there’s only so much you can do. You can create some awesome models; you can test some theories, but there’s a limitation: a limitation of size, a limitation of how sophisticated your models get, and you really compromise that when you do it on a small scale. Large scale, we can get more accurate pictures, many more pictures, test our models, test our theories, so I think it’s very impressive what they have to offer.”



Blue Waters intern Tom Corcoran, an undergraduate at Hood College majoring in computer science and minoring in mathematics.

One of Sahba’s big take-aways from this experience was the ability to think in parallel and how to delegate…but to a computer, not a person.

“In a funny way, this entire session has been, ‘How do I delegate tasks?’ but not to other people—to a machine—and how do I articulate that? It’s difficult commuting to a group of people and delegating tasks. We’ve all done that scenario at some point. This is doing the exact same thing, but with a network of computers, and how can I partition my tasks in order for them

to run parallel and seamlessly come back together. I've started to really understand the different protocols and schemes for that."

One of the XSEDE scholars, Natalie Zimmer, came to the Petascale Institute in order to understand the technical side of HPC. Zimmer, a rising senior at Louisiana State University, is double majoring in physics and astronomy with a minor in nuclear science. The professor she's conducting research with, Dr. Michael Cherry, was very excited for her to go to the Institute and said, "This is something that's going to be very useful to our project." She believes that Dr. Cherry doesn't "know the details of HPC, but he definitely knows the gist of it and how I can apply it, so it's good he can guide me." Her technical skills will compliment his conceptual skills and will greatly enhance their research on "particle simulation for high-energy physics," particularly transition radiation, about which not much is known.

Computer skills aren't the only skills being acquired at the Petascale Institute. Soojin Lee, another undergraduate Blue Waters intern majoring in mechanical engineering at Georgia Tech, says she personally gained increased motivation.

"I think I was struggling with motivation when I first came here," she explains. "I think being around people who are very motivated themselves and have some definite goal in mind, I think that helps a lot for me to kind of push through this next year."

Story by I-STEM undergrad Alexandra Peltier

A Petascale Institute participant examines a model of the Blue Waters supercomputer during a tour of the Petascale Facility.

Participants in the 2016 Petascale Institute learn about HPC.

ILLINOIS' CHRIS BARKAN AND RAILTEC CONVEY THE MESSAGE: "TRAINS—THEY'RE TERRIFIC!"

August 22, 2016

Chris Barkan, a Professor in Civil and Environmental Engineering, is passionate about trains. He knows about railroad technology and history—both in America and elsewhere in the world. Here at *Illinois*, he leads RailTEC, the Rail Transportation and Engineering Center, a world-class railroad research and educational program studying ways to make trains safer, faster, and more efficient—environmentally, economically, and energy-wise. Barkan is also devoted to educating the next generation of railway engineering professionals. And to make sure that railroads (and RailTEC) have a steady supply of bright young students, he, along with his colleague, Tyler Dick, and their rail engineering students teamed up with Angela Nelson at Next Generation School's STEAM Studio to organize and host STEAMvention 2016, where they used the fascinating and fun aspects of railroads to attract youngsters to a journey on the STEM pipeline.

America's first railroads began in the 1820s, and by the end of the 19th Century, the network had grown to connect nearly all the cities in the US and Canada. Before railroads, a journey across the continent took many months, but by the dawn of the 20th Century, railroad passengers could travel coast to coast in mere days. Where have all the passenger trains gone? While high-speed trains have kept Europe's passenger rail industry booming, outside the Northeastern US, we don't use trains as much here. Why? America's love affair with the automobile spawned the growth of a government-funded network of interstate highways across its wide open spaces and nearly caused the demise of passenger trains. "Cheap fuel and highways made it easy and convenient for people to use their cars," says Barkan.

So, based on the number of semi's we pass when driving on the interstate, will America's freight soon be obsolete too? Barkan says no.

"It's actually the opposite…This is a common misunderstanding. Passenger rail has declined significantly, however freight rail has continued to thrive." In fact, since the deregulation of railroads in 1980, "Railroads are hauling more freight than ever in history," he explains, adding, "A much larger fraction of America's freight is transported by rail than truck," providing America with a variety of environmental, energy, and economic benefits. "Ironically, Europe, looks with envy at our efficient freight rail system, much as we admire their high-speed passenger trains," says Barkan.

Chris Barkan, RailTEC Executive Director

"As we have come to understand the importance of energy efficiency," Barkan continues, "railroads have a lot to offer. Trains are about four times more efficient than trucks. And, a corollary benefit is that they produce fewer emissions and use less land. This is part of the reason why there has been a resurgence in rail freight in the US."

RailTEC graduate student Siyao Luan (right) explains electromagnetism to a couple of STEAMvention students.

And *Illinois*' research has contributed to trains' environmental and economic efficiency: According to Barkan, there has been "more and more focus on building smarter, stronger infrastructure that can support heavier loads and higher speeds to take greater advantage of railroad economies of scale. The bigger the railcar, the longer the train, the more efficient it is. So in addition to their energy and environmental efficiency, they are also more economically efficient."

So while Europe and Asia's passenger trains may be the fastest, our freight trains are the most efficient. "We are operating some of the biggest freight trains in the world here in North America, and they are uniquely profitable," he says.

And while the American driver waiting at a railroad crossing may complain about the length of trains, the American taxpayer should be delighted with the railroads' economic bottom line: "If you look at our infrastructure: 135,000 miles of rail lines, millions of tons of goods being moved safely and efficiently every day, nearly all paid for by the private sector. It's not a burden on taxpayers," says Barkan. "a contrast to the highway system, which is taxpayer supported."

So why does Europe have high-speed rail and little freight, and America the opposite? Barkan says, "It's because today, it is difficult to have both. From both an infrastructure and an operational perspective, high-speed passenger and high-efficiency freight trains do not mesh well, and there are a lot of technical questions about how it can be accomplished. Developing solutions to these questions is one of our core research areas."

What are we missing out on in America because we have no high-speed rail? According to Barkan, "High-speed rail offers a number of benefits to travelers. It's less expensive, more convenient, and more comfortable to use compared to highway or air." Another plus? "They're also safe, frequent, and fast!" says Barkan. In Japan and Taiwan, trains may depart every 10 minutes and travel more than 180 mph. But while the U.S. has only limited high-speed rail between cities (along the Northeast corridor), a number of large cities, including Chicago, have extensive commuter and urban rail transit systems. "You can't move that many people in populated areas without some form of mass transit system, and rail is the most effective option," says Barkan.

RailTEC graduate student Arthur De Olivera Lima (center) discusses railroad tracks with a STEAMcation student.

While RailTEC was created in 2010, *Illinois* has had a strong railroad engineering program since the latter 19th Century, "because of railways' importance to the nation's economy," explains Barkan. Chicago was (and is) the largest rail transportation hub in the country, so the major railways had to pass through *Illinois* to get there. Consequently, the rail supply industry is also concentrated in the region. "So from the earliest days, the university has had a strong academic presence in railroad engineering involving partnerships with both railroads and suppliers," he says.

RailTEC Ph.D. student Chen-Yu Lin (left) helps a student use the simulator.

"Many of the academic leaders of the industry were faculty with expertise in railway electrical, mechanical, and civil engineering." Until the late 1930s, *Illinois* had a Department of Railway Engineering. It was housed in the Transportation Building, which was newly built for them in 1912. In those days, land transportation was virtually synonymous with railroads, hence the building's name.

Barkan says that, in addition to the Transportation Building, they also built a dynamometer lab.

"Do you know the only building on campus that's not aligned with the grid?" asks Barkan. "It's the dynamometer building. At that time, it was a state-of-the-art lab built to test locomotive power." It is at an angle so that locomotives being tested could drive right into the lab on a spur track connecting it to the tracks of the adjacent Illinois Terminal Railroad that ran just south of Springfield Avenue (behind present day Grainger Library).

Another interesting bit of trivia: a locomotive built in the U.S. for Czar Nicholas II to haul his train across Russia was tested in the *Illinois* lab before being shipped to Russia.

Barkan goes on to discuss some industry pioneers at *Illinois*, such as Arthur Newell Talbot, for whom Talbot Lab is named. "He was unquestionably the leading academic railway civil engineer for more than three decades from the late 1890's until the 1930's. Talbot led a committee that studied and solved many fundamental issues regarding track structure and laid the foundation for our understanding that remains important to this day." Today, with heavier freight cars and higher train speeds, new questions derived from Talbot's pioneering work continue to be important, and RailTEC is conducting this research in their new, state-of-the-art laboratory, Research and Innovation Lab (RAIL).

Another leading railway engineering professor was William W. Hay, who taught at *Illinois* for more than 30 years and wrote the textbook, "*Railroad Engineering*" that remains the standard text in the field. *Illinois* had a number of other leading professors in railway mechanical engineering, electrical engineering, and railway transportation economics.

Today, *Illinois*' railroad engineering program is the premier program of its kind in the country. Barkan credits former dean, William Showalter, who in 1998, understood the importance of rail based on the growth of freight traffic and had the vision to see the value of rebuilding *Illinois*' railroad engineering program. This move, and the university's long legacy in rail, positioned *Illinois* to become the leading academic rail program of the 21st century.

Barkan was hired in 1998 by Showalter and then CEE Head, David Daniel, to rebuild the rail research and educational programs. When he got here, *Illinois* was teaching just one rail class per year. Today, the program has grown to 12 full time

RailTEC Executive Director Chris Barkan watches as grad student Alejandro Reyes (right) teaches a STEAMcation student about roller resistance during STEAMvention 2016.

A STEAMvention student puts "cargo" onto his train during the Intermodal Game race.

employees and offers eight rail classes per year with a total enrollment of more than 150 students.

While much of *Illinois*' rail research during Barkan's first 10 years focused on freight, that changed in 2010 with Obama's high-speed rail (HSR) initiative. "The government realized what the private sector had already learned: there were very few railway education programs in the US. Where were they going to hire people to design, build, and operate these new rail systems?" he asks. The answer of course was, *Illinois*!

"This is where decisions by *Illinois* leaders back in the 90's helped position us ahead of the curve," says Barkan. "Most of the nation's universities seemed unaware of the growing importance of rail until the 2010 HSR initiative. By then, we were more than a decade ahead of the rest of the academic community." Meanwhile, the importance of rail freight and rail transit continues to expand, further contributing to the rail sector's hiring needs.

Consequently, graduates of the *Illinois* rail program are highly recruited. Says Barkan:

"We have top quality students getting the tremendous foundational engineering knowledge that the College has to offer. Add to that their specialized education in principles of rail engineering, which is unmatched anywhere else. Graduates of the *Illinois* program arrive on the job with a top-notch education and quickly move up in rail organizations. We have placed hundreds of students in rail positions both domestically and internationally over the last dozen years."

But it isn't just college students Barkan seeks to educate. On August 3, 2016, RailTEC faculty and students hosted 24 local 3rd through 5th graders from STEAMcation, a summer STEAM (Science, Techology, Engineering, ARTS, & Mathematics) program for elementary students at the Next Generation School's STEAM Studio.

Barkan and his team hope that the activities, besides being a lot of fun to do, helped to pique the kids' interest in STEM, especially railroads:

For the outreach, RailTEC faculty and students came up with numerous, creative, hands-on

RailTEC graduate student Chen-Yu Lin (right) explains the train simulator controls to a STEAMvention student who gets to "drive" a locomotive.

activities related to trains that students found both fun and educational (for details about the event, please see the companion article listed below).

Barkan says he does outreach events such as the STEAMvention visit, first, “Because it’s the right thing to do,” and secondly, because of “the importance of STEM,” and the need to get more kids interested:

“I think most people involved in science and engineering are excited about their field and are eager to share their passion with students.”

“So all of us feel that we want to get more kids interested in STEM, and more kids interested in Railroad transportation. And it’s important to attract this next generation of students into this field. I got the interest from my father when I was six years old, and that’s the same experience for many of the people here, and I think it’s just a good experience for kids.”

STEAMcation students explore the different types of rail cars used to carry various products with RailTEC graduate student Zhipeng Zhang (right).

A STEAMcation student compares the weight/ density of two different products: unpopped vs. popped popcorn.

VET MED STUDENTS GAIN KNOWLEDGE, SKILLS DURING SUMMER RESEARCH TRAINING PROGRAM

August 24, 2016

This past summer, 14 *Illinois* Veterinary Medicine (Vet Med) students participated in the 2016 College of Veterinary Medicine Summer Research Training Program, which provided students a chance to get hands-on research experience in their prospective fields and also gave many of them a better idea of what they want to pursue regarding their future careers. Over the course of the summer (May 23–July 29, 2016), participants not only learned a great deal about the area they were researching and developed new skills and techniques which will be beneficial both in their college and professional careers, but they grew personally as well.

Run by Professor Lois Hoyer, and funded by NIH (the National Institutes of Health) and Merial, the program also offered special training in some research-related areas. Some training was specific to their research areas, other training was quite practical, such as designing and presenting a poster—skills participants immediately called on while presenting their research during a VetMed poster session on July 27 and at the Merial-NIH Veterinary Scholars Symposium at Ohio State University on July 28—31, 2016. In addition to the skills they acquired, some students grew personally, gaining patience or self-confidence.

Eric Ledesma

One student who grew both professionally and personally this summer was Eric Ledesma, who will be in his third year of Veterinary Medicine's 4-year program this fall. He had never done research prior to his work this summer researching equine Osteochondrosis (OC), a developmental disease that affects the joints of horses. OC causes fractures because bones don't harden. Ledesma's research involved validating single nucleotide polymorphisms (SNPs) expected to be associated with the disease, and discovering any novel (brand new) SNPs. His results? He found two novel SNPs, but still has more genetic sequencing to do.

While Ledesma's immediate goal is to become a veterinarian, his ultimate career goal is to bring animal abusers to justice:

Third year Vet Med student Eric Ledesma.

"I've worked with a lot of shelter animals; I've worked with animals that have been abused, so I want to go into anatomical histopathology where I can learn how to perform necropsies [a necropsy in the veterinarian world = an autopsy in human medicine] on animals that come to, say, the ASPCA, and figure out, 'What happened to this dog?' 'What happened to this cat?' and help find evidence that may help put their abusers away in jail."

He doesn't know where he might work exactly... could be in an animal shelter, the ASPCA, or academia: “I just want to make sure veterinary forensics will be a part of my career.”

Ledesma learned more than just equine OC research this summer, he learned patience. “I guess I’m just so used to seeing results right away,” he admits, “so I’ve learned to be a little more patient. This whole thing, it’s a whole process. It takes a lot of planning out, a lot of designing. I guess it was hard to stomach that I have to expect bad results initially, because things may not work out as well as you had hoped.”

Personally, he says he also gained more confidence:

“I come from a background where I don’t really see veterinarians who look like me, or even hear too much about this type of work where I’m from. So I guess just having the confidence that I can do this, that I’ve learned how to do this, that this was possible for me, it’s possible for anyone else, and I can’t wait to go back home (Jersey City, New Jersey) and show younger students, students in undergrad who look like me, that they can do something like this.”

Another aspect of the summer Ledesma appreciated? The exposure to horses. “I had a lot of fun learning about this and working with Dr. McCoy. I’ve never really worked with horses before. I come from an urban environment, so just basically dogs and cats and the occasional reptile or ferret here and there. So it was a treat getting to work with horses—especially foals, baby horses.”

Danielle Engel

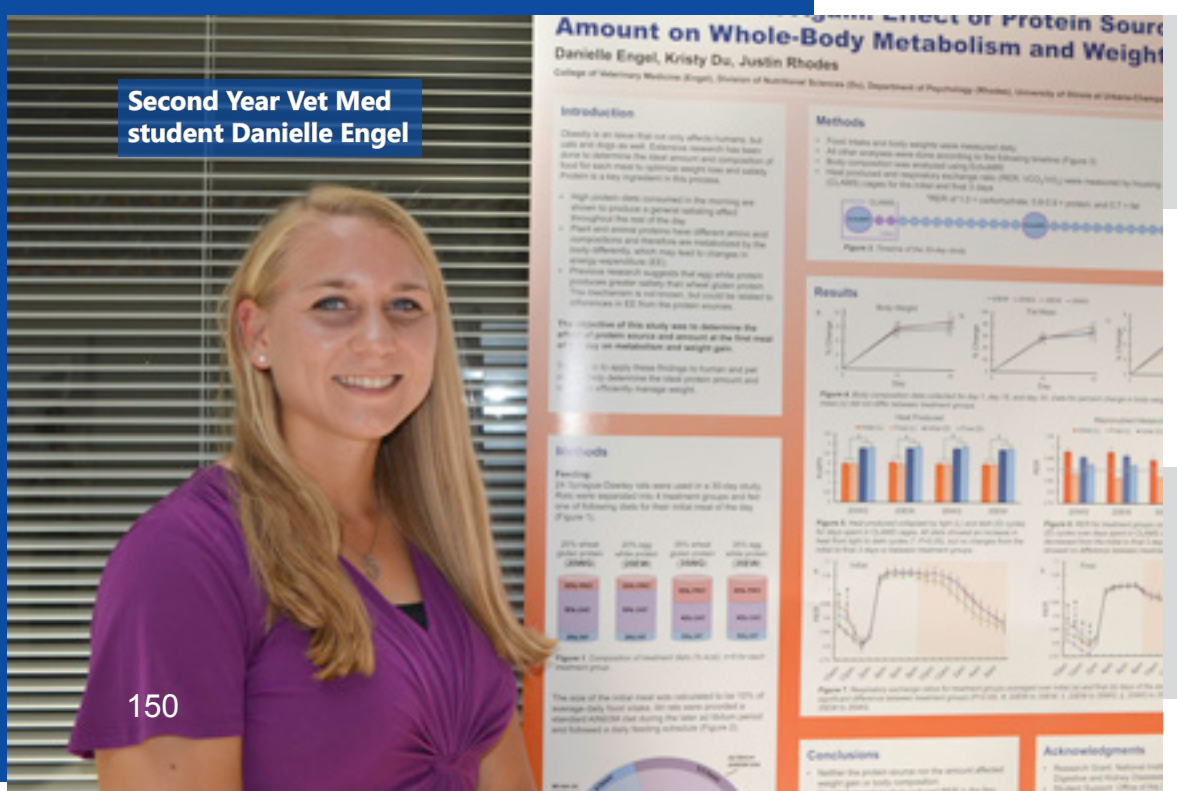
Another student who experienced research for this first time this summer was Danielle Engel, who’s going into her second year of vet school. She calls the experience “overwhelming at first, but it was a lot of fun,” she acknowledges.

Engel’s research involved analyzing the effect of protein diets on weight management and bodily metabolism. “We saw that treatment diets specifically didn’t have an effect,” she admits, “but we saw that protein in general had an effect. We saw changes that might change into weight management.”

Some skills she learned this summer were related to presenting research and data analysis.

“I learned a lot of presentation of research, just through the poster and the manuscript,” Engel says. “I also helped my grad student analyze a lot of the data. So I learned how to translate it from just numbers into something that might mean something.”

Engel doesn’t want a career in general practice, but some type of specialization.



“And after this summer, I kind of want to do research,” she acknowledges.

If she does, it would be research about animals. “I want to research something more organic or animal based, not microbiology,” she admits.

“I want to see something that has a direct effect on animals. That’s about all I know right now.”

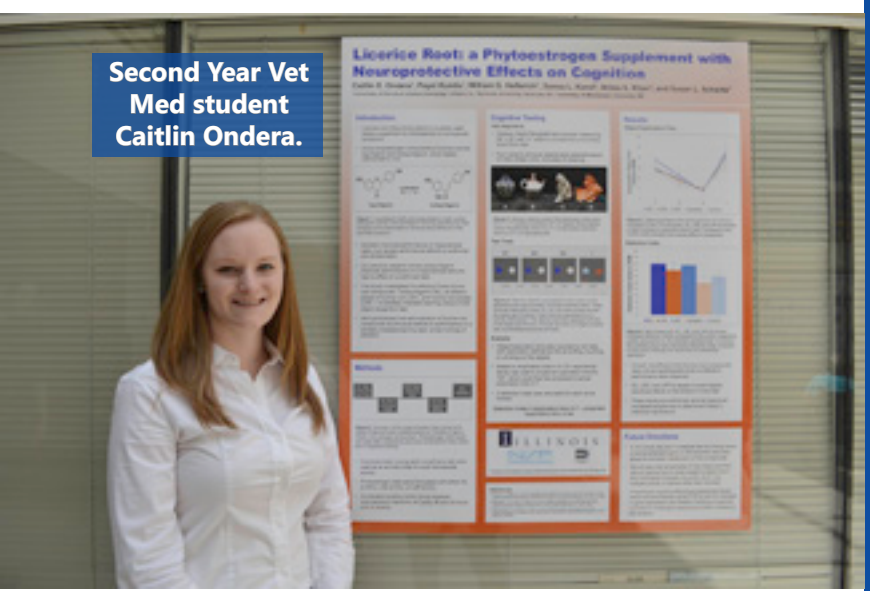
Teodora Hristova

Teodora Hristova, a third year Vet Med student, says this summer was also her first research experience, and she really enjoyed it: “It was a really good experience,” she says. “Coming into this research project, I only knew where the inferior colliculus was, I didn’t know anything about it, and I learned a bunch about what it does and certain structures associated with it." According to Hristova, it’s a structure associated with hearing.

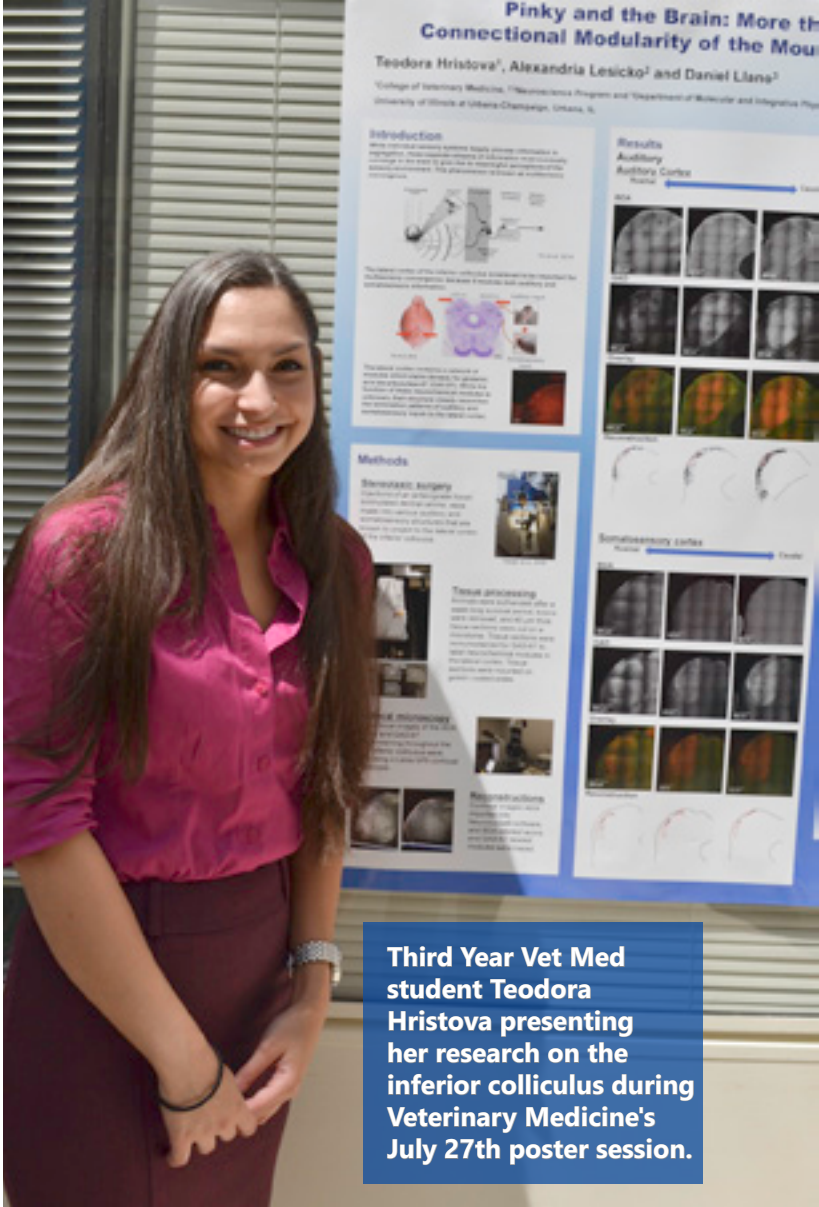
Hristova discusses her results: “Our hypothesis was that the auditory inputs terminate outside of the modules of the lateral cortex and the inferior colliculus, and the sensory inputs terminate inside the modules,” she explains. Hristova says that after processing the images using special software, “The reconstructions I did showed that our hypothesis was correct.” However, they also got some unexpected results, “It’s obviously a more complicated mechanism…that we would have to look at.”

Hristova says she also gained some new skills: “I learned how to use a microtome. I got to do a brain surgery on a mouse, which is very exciting. So it was nice to practice on my surgical skills before I head into junior surgery, even though my patients will be much bigger. I got to use a different software.”

How does one do surgery on a mouse’s teeny-tiny brain? “You do have a microscope so you can look at exactly where you’re drilling,” Hristova explains, “and there’s an atlas that you use to define where the coordinates are before you drill into the skull and then inject the tracer. And then we used a regular suture to close the skin. It was very interesting.”



Second Year Vet Med student Caitlin Ondera.



Third Year Vet Med student Teodora Hristova presenting her research on the inferior colliculus during Veterinary Medicine's July 27th poster session.

Hoping to become a board-certified anesthesiologist, Hristova thinks research will be “a part of what I want to do, not all of it.” Her career goal is to be “a clinical instructor, possibly do research projects on the side...and possibly stay in academia.”

Caitlin Ondera

Like Hristova, second year veterinary student Caitlin Ondera also hopes for a career in academia.

“Overall, my career goal is to do an internship in small animal emergency and critical care, and hopefully a residency after that. They have internships in specialty practices or at a university.” Ondera says she’s “hoping to go the academic route, where she can do a Master’s degree at the same time.”

Ondera’s research compared phytoestrogen supplements to traditional estrogen supplements for women. She investigated the cognitive effects

on the striatum caused by dosing with licorice root compound, which is a phytoestrogen supplement.

According to Ondera, the study showed that “the phytoestrogen route caused beneficial effects to the striatal task that we performed. And when compared to traditional estrogen supplement, which causes deficits, we found that it has promising effects. Hopefully we can show that’s it’s a safer treatment for women.”

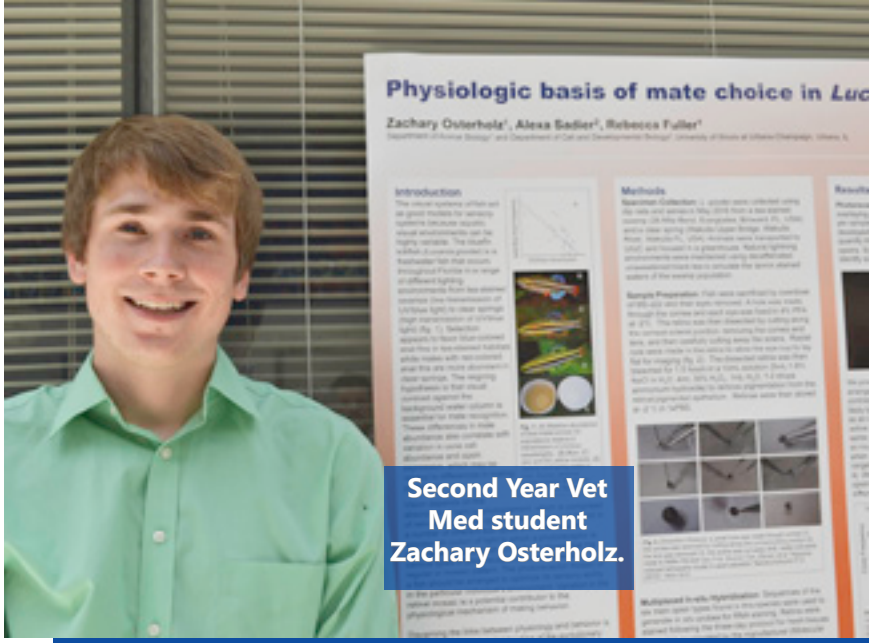
Ondera says she also learned a lot about the use of animals in research this summer. “There are a lot of negative connotations about the use of animals in research,” she explains. “But we learned about all the requirements needed to gain grant money and be able to use animals for studies. We are using rats for our studies.”

Ondera definitely thinks research might be in her future. “I really love doing research. That’s one of the reasons I hope to get an academic position—to help further the field, investigate new directions with the field.”

Zachary Osterholz

For other students, like Zachary Osterholz, a second year Vet Med student this fall, this summer was not his first research experience. Even though he’s been doing research all through undergrad, Osterholz thought the research this summer was great. “The program was really nice as a refresher. We got together as a group once a week to discuss various aspects for research.”

While Osterholz says he also learned a lot of new skills this summer, he stresses that it served as a refresher for some of his previous skills. “A lot of refreshers on genetics, so basic stuff. Stuff I haven’t done in 3-4 years. It was great as a brush up, and



Second Year Vet Med student Zachary Osterholz.

hopefully I can keep working so I don’t lose the fresh polished techniques that I have now.”

Osterholz’s research was trying to understand the physiological basis of mate choice in small fish. “So what we’re trying to do is link a behavior preferring males of particular color to a molecular level variation. So the cells in their eyes have different types of chemicals that absorb light, and we’re trying to determine if the number of cells of a particular color determine their preference for a male of a specific color.”

Osterholz particularly appreciated being in charge of his own project. “I’ve done a lot of research, and you have a lot more mentorship, and I liked taking ownership and being in charge of my own project.” Osterholz says the project was a win-win for both him and his PI. “This project would help her research as well as satisfy my interests, so it was beneficial to both of us.”

Osterholz’ tastes in animals tend toward the wild side—no dogs and cats for him. “Ideally, I want to work with exotic species. It’s a really competitive world in exotic species, so I’ll take anything I can get. I really enjoy epidemiology, so I would love to work for a government agency doing management of wild populations or for a zoo on the conservation side of their programs.”


Third Year Vet Med student Chelsea Randall.

Chelsea Randall

Another Vet Med student whose tastes lean toward the exotic species is Chelsea Randall, who will be a third year veterinary student this fall. As to her career plans, she’s still deciding. She'd like a private practice working with exotics—guinea pigs, snakes, birds, etc.—but

she's also considering doing a neurology internship and residency. Randall also might go into research.

"Possibly. Yes. I'm actually gonna work on another project that is more wildlife, so hopefully that will go well.

This summer was not her first research experience; Randall says she researched feline nutrition as an undergrad. This summer's research, sponsored by Mariel, involved looking at whether a subject's body condition score had an effect on the serum drug levels of potassium bromide, in an effort to make a better adjustment formula, so the subject would be better covered with their current dosage. "A body condition score is a way to assess the amount of lean-muscle-to-fat ratio," she explains. "So we have a 9-point scale. Can you feel the ribs, or are they more of a round shape?"

What new skills did she gain this summer? "I definitely learned a lot about epilepsy," Randall says. She also learned some very practical things: "How to write a paper, make a poster, and share with other people what I learned this entire summer."

Victoria McLean

Like Osterholz and Randall, second year Vet Med student Victoria McLean's taste in animals also leans toward the wild side—she wants a career as a zoo veterinarian. However, she's also very interested in the subject matter of her summer research—reproduction—which she hopes to apply to her work with exotic species. "This is a great experience for me to learn more about the reproductive system in any species," she says, "And hopefully I can use what I learn here and work in reproductive techniques in endangered species."

Third Year Vet Med student Victoria McLean.

McLean spent the summer studying endomeiosis, a disease that occurs in 6–10% of women, where the endometrium, a layer of the uterus, ends up in the abdomen. This causes infertility and lots of other problems. Retrograde menstruation, the title of her presentation, is the theory on how it happens: endometrial tissues move up instead of down during menstruation.

In their study, they used mice (very easy to use in the lab, according to McLean), taking tissue from the donor mouse and transplanting it into the recipient. "It's a complete mimic of that in humans," she explains. "We used these models to study what is happening with the endometrium. So eventually there might be treatments based on this."

McLean claims the new skills she gained this summer were "endless."

"'Cause I have never done any of this before. Even just organizing this poster. How to speak to people. I also have never had any lab skills before."

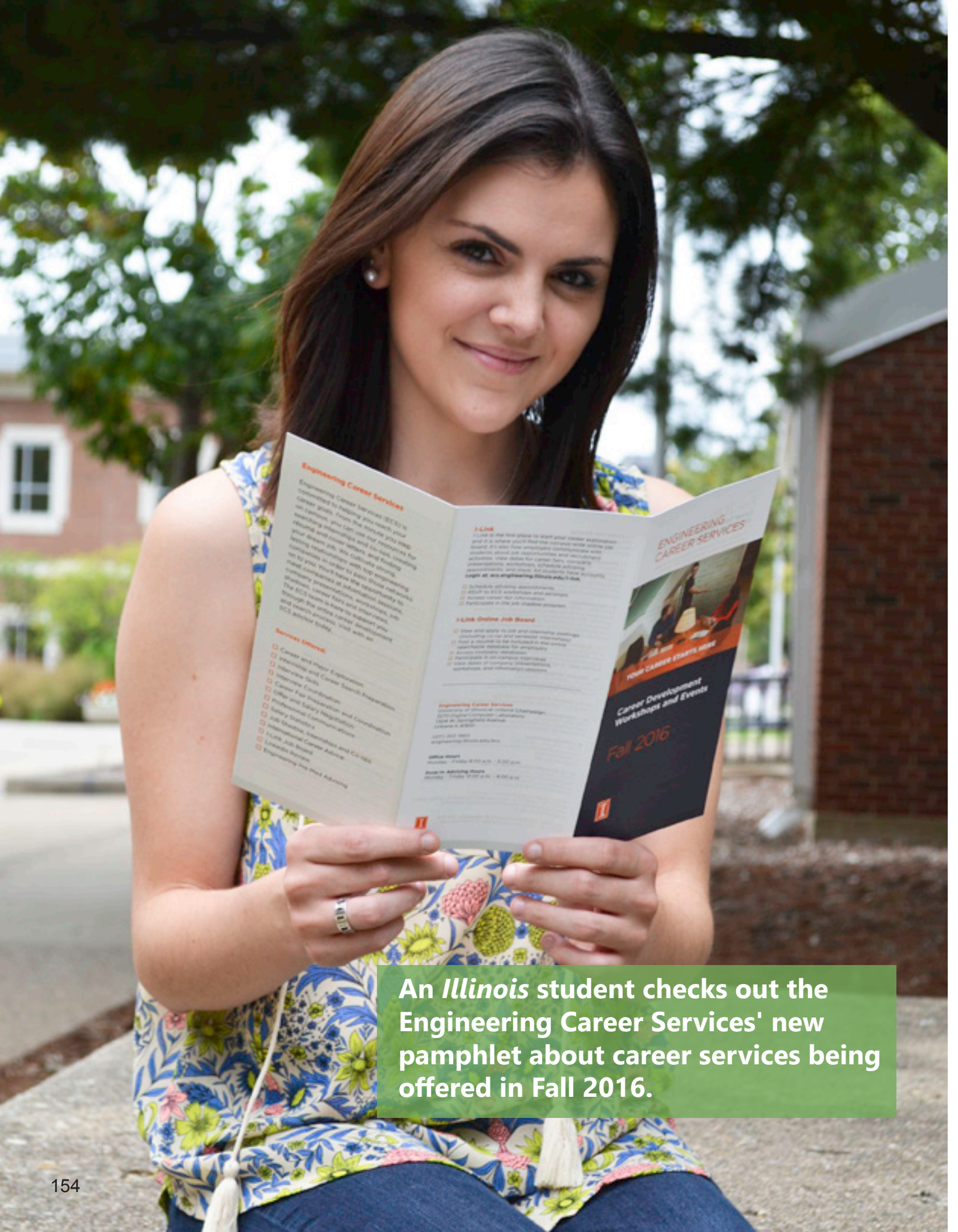
She also really appreciated the chance to do surgery early on in her career at *Illinois*, "As a second year, you don't get that much hands-on experience as I eventually will as a fourth year."

McLean says she will definitely be doing research in the future. "To be a zoo veterinarian, I have to do research and publish to get that job."

So how can a student studying to be a zoo veterinarian use the animals primarily studied here (small animals, like dogs and cats, and larger ones, like cows and horses?) to prepare for more exotic zoo animals, which are much different, like, say, a lion? McLean says that's not an issue.

"We have a really good program here, which is why I chose U of I. I work in the wildlife medical clinic where every day we see cases with different species of wildlife that the public brings in, so I get tons of experience that way. The species aren't exotic, but they are similar. For example, we worked with a bobcat this summer. That is comparable to working with a tiger or a lion."

In fact, there's a zoo department here in the Vet School: "Animals are brought in from the zoo," she explains, "and my mentor is a zoo vet himself, and he works part time here. So I'm learning a lot from him as well, and this is where I need to be."



An *Illinois* student checks out the Engineering Career Services' new pamphlet about career services being offered in Fall 2016.

ENGINEERING CAREER SERVICES HELPS STUDENTS PREPARE FOR CAREERS, UPCOMING CAREER FAIR

"It's never too early to come to the Career Services offices." Deon Robin, Engineering Career Services

August 26, 2016

On September 7th and 8th, around 6,000+ *Illinois* engineering students will get a jump start on finding the perfect job by attending the Engineering Career Fair. And according to Deon Robin, Assistant Director for Employer Engagement, Engineering Career Services has a raft of materials/events to help students not just prepare for the upcoming Career Fair itself, but figure out what career is perfectly suited for them and then land that dream job. Materials/events ECS has developed/offers include: a pamphlet outlining ECS events and services, the Lunch & Learn series, a Mock Career Fair: "Prepare for the Career Fair," RésuméMania, Engineering Career Fair, i-link, the Career Fair Plus app, Pre-Career Fair Virtual Meet-Up, ECS Workshops, and the Job Shadow Program.

Regarding the upcoming Engineering Career Fair, Robin says ECS started sending emails to students before they even got back on campus. "We start early marketing," she says. "We have a series of events that lead up to the Career Fair. The series of events is to prepare students so once they're at the career fair, they can present themselves both professionally and also on paper."

Since the fair is the first full week of September, isn't that a bit early in the semester? Will students be geared up for it?

"They come back prepared," says Robin. She says that even before classes started this fall, they were trickling into the center to print out name badges, get information. "They're asking questions; they're making inquiries about the fair," she explains.

"I thinks it's already a culture here at the University. They know that once they're back, Career Fair is happening, and they need to be prepared."

And they are. They even have their spiffy, business/professional attire ready. "I think they come back with their clothes packed. They may not have winter gear yet, but they definitely have their attire ready for the fair."

Career Services is ready for the Fair too, and wants students to be apprised of and ready for their biggest event of the year. So to help students get prepared, ECS recommends the following:

ECS Pamphlet

This colorful trifold pamphlet covers all of the workshops and events leading up to the Career Fair and throughout the rest of the semester, plus a listing of all of the services offered at the ECS.

Career Resource Guide

This 64-page Career Resource Guide is chock full of resources ranging from résumé writing to interviewing, to negotiating a job offer, some articles with both email and other etiquette tips (such as, 'Don't Slurp Your Soup'), 6 Tips to Convert a Summer Internship into a Full-Time Position, plus salary info and companies recruiting through ECS.

Lunch & Learn

During Career Week, August 29th–September 1st, ECS is hosting a series of Lunch & Learn events that cover different career-related topics:

- Résumé: Mon., Aug 29th, 11:30 am–12:30 pm, 3300 DCL
- Elevator Pitch, Tues, Aug 30th , 11:30 am–12:30 pm, 3300 DCL
- Career Fair, Wed., Aug 31st, 11:30 am–12:30 pm, 2240 DCL
- Interview Tips, Thurs., Sept 1st, 11:30 am–12:30 pm, 2240 DCL

In addition, there will be a number of other Lunch & Learn workshops throughout the fall and spring semesters.

Mock Career Fair

For the first time ever, ECS is hosting a mock career fair, "Prepare for the Career Fair," on August 30th, 5:00-7:00 pm, DCL Atrrium, 1st Floor. "Prepare for the Career Fair' is targeting freshmen and sophomores to help them do just that. "As freshmen and sophomores going to the career fair, you're going to feel intimidated," predicts Robin. "This is a simulation fair. It gives you an idea of how to present yourself, networking tips."

RésuméMania

This drop-in, résumé-building blitz over a couple of days (Wed., Aug 31st, 12:00 pm – 6:00 pm; and Tues., Sept. 6th, 10:00 am – 4:00 pm) gives students a chance to have members of industry in their own field critique their résumés.

"RésuméMania is a great event for both employers and students. Employers are the ones providing feedback and critique on student résumés." Robin says ECS has advisers available throughout the semester to provide feedback to students, "but once it's an employer telling a student how to polish their résumé, light bulbs go off—they love it."

For the August 31st RésuméMania, there will be around 10–15 employers. However, on September 6 (the day before the career fair), ECS has reserved 39 interview suites. The goal is to have them all filled with recruiters providing input regarding student résumés.

Do students need to make an appointment? Nope. They can drop in with their résumé and spend 15–20 minutes with the employer. However, they can expect long lines.

In fact, Robin says that this past spring, the event was supposed to end at 6:00 pm, but students were still coming in wanting to get their résumés reviewed. "The employers had been there all day," says Robin, "and I'm like, 'Please?'" But she says that, because they love mentoring the students, they stayed.

Robin reiterates how important it is for students to have someone from industry critique their résumé. "For students, it clicks when it's someone in their field. " She shares a scenario: "'I'm sitting with an aerospace engineer, and he's giving me advice on what I should be doing to further develop my résumé, giving me advice, suggestions, and we're discussing projects that I've worked on.' It's a light bulb for them. When it's someone in their industry, it's mind blowing for them, and they run with it."

Robin shares another scenario about a student who has also taken advantage of ECS' résumé-building services, then attends RésuméMania. "Guess what?" says Robin. "If you came to the Career Center before, and one of our career advisors reviewed your résumé, then if you come to this event, the employer may review your résumé and be like, 'Your résumé is great! Tell me about yourself.' And guess what? You're able to connect and almost get a mentor. You can say, 'Well, this is what I do. This is what I've done in the past. This is what I'm looking for. What advice can you offer to me?' And here's someone who's in the field that you're interested in who can give you feedback."

Engineering Career Fair

Robin says *Illinois*' two-day Engineering Career Fair held at the ARC (Activities and Recreation Center) on September 6th and 7th, 2016 is a big deal. Spread out at the 248 tables, 400 employers and more than 700 recruiters will be available to chat with the 6,000+ students who are projected to attend, based on past fairs.

Close on the heels of the Career Fair (the very next day, in fact), many employers conduct interviews on campus with students they met at the Career Fair. In fact, Robin says certain companies have done it so many times that they know they want 6 or 8 rooms. "It's a very popular program, and it's requested, so that's why we continue to offer our service to employers," she says. So ECS reserves 174 rooms for interviews. "To maximize their time on campus, we offer them that option."

***Illinois* Engineering student Stephanie Lona attending the 2014 Engineering Career Fair.**

Deon Robin, Engineering Career Services' Assistant Director for Employer Engagement, outside the Engineering Career Services office, 3270 Digital Computer Lab.

What companies show up? The big names you'd expect: Apple. Caterpillar, Whirlpool, plus not-so-big names too. Robin says that while she is constantly developing relationships with new companies, there are the companies that come every semester, year in year out. "*Illinois* is one of their targeted schools," she acknowledges, "so they return every year, and they are active throughout the semesters."

And a lot of the recruiters the companies send will be fairly recent *Illinois* alumni—as per Robin's advice.

"When I'm talking to employers about their recruiting strategies, I always say, 'Think about the students and who they want to hear from.' They want to hear from recent graduates because they want to talk about transition; they want to learn about company culture, things that are important to them. Because they're so close in age, they are able to connect a lot more. Once they get into that interview, then your senior can start engaging with those students. But at the Career Fair, you want to have those alumni. They have bigger impact."

Robin has advice for students too. "Definitely come to the career center," she recommends. "Participate in our workshops and our career events leading up to the Career Fair. Ask questions; do your research. Research organizations before you get there. Know the position within that organization that you're interested in or have some sort of idea so when you're talking to a recruiter, you can talk about that position you want and not just ask, 'Well, what positions is your company hiring for?' That's not the way you want to start the conversation. If that student is coming to our office, they're going to have the tools they need, so that once they get to the career fair, they're ready to execute and be successful. It's never too early to come to the career services offices! Never too early!"

In fact, in keeping with her *never-too-early* mantra, she encourages students to start the process as early as their freshman year. 'If you're a freshman, you can come and just start building that relationship, building your résumé, building that network, so once you're a junior or senior, you have something established. You can land that internship. Once you're a junior, you have some experience, then you can land that full-time opportunity. While you're a senior, you already have an offer extended upon graduation."

Regarding which companies' tables students should visit at the fair, Robin has this piece of advice: Do your homework beforehand—electronically, of course.

i-link

The traditional electronic method, according to Robin, is i-link: "Students can log into i-link, click on the event, and actually see the employers that are registered to attend, what the employer is hiring for, whether they're interested in juniors, seniors, Masters, or PhDs. Get an overview of the organization and start planning out and selecting their favorite employers. So once they get to the career fair, they know, 'Ok, these are my top ten employers; I want to be sure to visit their tables.'"

Career Fair Plus App

Also new for this year is a new app ECS is introducing: *Illinois* ECS Career Fair Plus. Students can download it onto their iPhone or their iPad from the Apple App Store. (Android users, don't feel left out; you can download it at Google Play.) Robin cites its benefits: "It's interactive. It's free. It doesn't take a lot of wifi bandwidth to download."

Robin gives us a play by play on how to use it: "I can go through the company list; I can select companies I'm interested in, and then as I select those companies (she demonstrates by choosing Apple, Caterpillar, and Whirlpool), when I go over to the floor plan, it's actually going to be highlighted in yellow…so as I'm going through the ARC, I'm going to be like, 'Ah, there it is!'"

(FYI, this reporter has already downloaded the app in preparation for Career Fair.)

Pre-Career Fair Virtual Meet-Up

Another new electronic event this year is the Pre-Career Fair Virtual Meet-Up on September 1st.

ECS is doing a small pilot "to see how our students react to being in a virtual platform communicating with employers," she explains. A small subset, 40 of the 400 companies participating in the actual fair are participating in the pilot. Through the virtual platform, employers will have their own chat room, where students can be a part of a group chat. Employers will also have a private chatroom for conversations with individual students: i.e., 'I clicked on your résumé and saw that you were in "x, y, z," or invite them to do an on-campus interviews. Students could ask, "How can I engage more in this organization?" "How can I learn more about what you're doing?" or "What programs are you developing?"

Robin says this platform allows employers, especially those who are not a household name, to have an information session and engage with students in order to build their momentum before coming to the career fair on campus. Through the virtual platform, employers could share about their company, culture, or whatever they want to discuss via PowerPoint or a live presentation, where students could see the recruiter's face or engagement within his or her office. Students get to see that, ask questions, and engage with them.

Via Virtual Meet-Up, students will be able to ask an employer, "Do you hire freshmen? Sophomores? Do you have any internships?" as opposed to waiting in a long line at the career fair (she says Apple's line is probably wrapping into another company's line), just to get: "I'm sorry, but we don't have internships," or "We don't hire sophomores."

While some schools rely solely on virtual career fairs, Robin says that ECS is just a supplement. She can't see replacing the actual career fair where students are face-to-face with an employer, and can each others' passion.

Robin cautions students against using Virtual Meet-Up as a replacement for attending the actual Career Fair: "Even if you've met that one employer here, and they've extended you an interview on the private chat, and they have you on that list to interview, you still want to come to the career fair, because you want to build engagement and interest. It just shows that you're committed and want to be a part of the organization."

As someone who is a liaison with companies and is aware of a wealth of untapped companies, especially overseas, Robin recognizes that Virtual Meet-Up could be expanded to include companies who can't travel to the actual career fair.

"If we can have a virtual career fair, that would give us a little more exposure to inviting new and unique companies to come and recruit our students," she admits. And there's definitely interest in overseas companies. "If you look at our students, most of them are international students. And then we have our domestic students who are interested in international opportunities as well."

Regarding all this new technology, ECS is always on the lookout for new things, "trying to be creative…trying to keep up with this generation. We have to give them what they want. We can't stick with the same old thing," Robin says. That's why they implemented Career Fair Plus. "We saw this career fair app and said, 'Let's give it a shot!'"

Getting an Internship

So, on a side note, what about internships? Is it a given that a student will be hired by the company for whom he or she served as an intern? Robin stresses: "About 80% of students completed some sort of internship or volunteer opportunity where they gained some sort of experience. Having that experience is beneficial to landing that full-time opportunity. What I've seen with our students is that they know the importance of internships. They seek them out."

While ECS has not collected statistics regarding the percentage of internships that lead to a full-time position in that company, Robin says, "Going forward, we want to track something that we will hopefully be able to publish."

While ECS many not have hard data, Robin gets anecdotal evidence. "But you hear it. When the students come in and say, 'Oh, I had an internship,' or we have students that work in our office, and they say 'I had an internship over the summer, and upon graduation I have this opportunity to work full time.' So you hear of those conversions."

At a recent Engineering Career Fair, an Illinois student chats with a recruiter, an Illinois alumnus who is an engineer with Union Pacific.

Engineering student Emily Matijevich (right) chats with an Abbott recruiter Claire Slupski, an Illinois graduate, at a recent Engineering Career Fair.

ECS Workshops

In addition to the Lunch & Learn series, ECS holds several workshops every month. Fall 2016 topics include: "Résumé Writing," "Interviewing," "Virtual Interviews, Is Graduate School Right for Me?" "How to Juggle the Recruiting Process," "Graduate School Applications: Tips for Success," and "Writing a Compelling Personal Statement."

Robin says students not only gain information during workshops, but they network with the employers giving the workshops, so she advises:

"As a freshman, be engaged with Engineering Career Services. There are many opportunities here where employers are the ones presenting our workshops…Coming to these workshops, you're learning a specific topic, but then you have the opportunity to engage with maybe an alum or recruiter. You can ask questions. 'This is what I'm currently interested in,' and they can give you feedback—almost a mentor. The world is huge, but if you're going to the right places, you're asking the right questions, you will learn and then you can make those determinations at the end, 'Ah, this is what I'm interested in. This little nugget is what I'm going after.'"

Robin says there are also lots of workshops offered after the career fair because students have interviews. They have offers—questions: "Ok, I got this offer. Should I negotiate?' Or, 'I have multiple offers. Which one should I go with?'" So there are numerous workshops offered to help students answer the questions that they have.

Spring 2017 Engineering Career Fair

Should students miss the fall Engineering Career Fair, there will also be one in the spring on February 7 & 8 at the Illini Union. A couple of caveats, however: there are fewer employers: only 200 tables. Plus, Robin: "Most companies tend to do their recruiting, whether it's for full-time offers or internships, in the fall, and then they're done. So when they come back in the spring, it's more for campus engagement, building relationships, so forth. Not necessarily recruiting."

How does a student determine what their perfect job would be in a company? A job for which they would be uniquely qualified and which utilizes their skills and strengths? Once again, Robin says to start early, then when the time comes, you'll have laid the groundwork and you'll know. For one, she says students should take advantage of ECS' workshops.

Job Shadow Program

This program is designed to help students identify their niche in the company they want to be in. The student says, "I know I want to be an aerospace engineer, but is there a nugget within Boeing that I want to focus on? Do I want to focus on missiles? So if Boeing signed up to be a part of the job shadow program, and I get placed in that program, then I'm going to be in that facility and see what it takes. I can ask questions and find out more." As an added benefit, he/she can focus on this particular area early on, taking courses to address the area.

So for the student, the job hunt should begin early. Robin shares from personal experience: "When I was in college, I went to career services when I was a senior. And now that I work here, and this is my profession, I'm like, 'Why didn't I do this when I was a freshman? Because there are so many opportunities, from the Job Shadow program to the Study-Abroad program, so many things that students don't take advantage of on campus until they're seniors. Then it's like, 'Oh, I only have six more months until I graduate. I don't have enough time to do all the things I want to do now!'"

Robin, who began working at *Illinois* in October 2015 is in her fifth year in career services on a campus, and she loves her job:

"I love seeing people being successful. Even though we have the career advising team that helps the students polish their résumés and fine tune their soft skills, for me it's bringing the employers and students together. And hearing those success stories in terms of 'I got an internship, and I got so much experience!' or, 'I got this full-time opportunity that's going to help me accomplish all my dreams and goals.' I think, for me, it's just seeing happiness and seeing students accomplish their goals."

ENGINEERING CAREER FAIR FOSTERS NETWORKING, HELPS STUDENTS LAND INTERNSHIPS AND JOBS

September 19, 2016

Did you notice that on September 7th and 8th, campus was inundated with scores of students who, instead of sporting the traditional September garb of shorts and orange t-shirts, were dressed to the nines in professional business attire—guys looking sharp in suits, ties, and shiny shoes, girls in stylish black business suits and even heels? If so, it was most likely some of the 6000 or so Engineering students who ventured south of Green Street to attend *Illinois*' Engineering Career Fair (ECF) at the ARC. Why'd they go? For freshmen, it was to get some experience under their belts, and to begin the process of networking with representatives from companies in their field. For sophomores and juniors, it was to possibly net an internship for next summer from some of the prestigious companies they might like to work for down the road. For seniors, it was the real deal—to land the dream job they've been preparing for over the last several years.

Two *Illinois* engineering students, Abby Pakeltis (center) and Rachel Burroughs (right), chat with a recruiter at the Fall 2016 Engineering Career Fair.

ECF at *Illinois* is a big deal, with 400+ companies on hand to secure some of the nation's top engineering students. Who were some of the companies who showed up? Lots of household names: Amazon, Microsoft, Go Daddy, Samsung, Caterpillar, Apple, Rolls Royce, Pepsico—you name it, they were there. A number of start-ups and companies none of us have ever heard of came too, hoping to attract the attention of some of *Illinois*' talented students.

Though it will be a while before they're ready to enter the work force, even freshmen showed up for the fair, some at the behest of the Engineering 100 TAs, who wanted them to get their feet wet. Jess Villie, one of the TAs, explains why she encouraged her freshmen to go:

"I have learned if you aren't pushed to go your freshman year, then most freshmen won't attend. Freshman year is a critical time to attend the career fair and get out all of the nervousness about talking to recruiters and the career fair process in general. That way, when they attend their sophomore year (when their odds of getting an internship are much higher) they will be much more prepared. I couldn't express to them enough how important networking is, and the career fair opens up so many opportunities for that."

Engineering freshman Douglas Bach chats with his Engineering 100 TA, Jess Villie, while they wait to enter the Career Fair.

Villie adds that the fair is also "a helpful time to get advice from recruiters for what they [students] can do to make the most of their freshman year and best prepare themselves for the future!"

A Senior in Civil and Environmental Engineering, Villie says her advice to the freshmen is based on her own positive experiences at the Career Fair: "I have been attending the Career Fair since freshman year (this is my fourth year). During these fairs, I have had several interactions to gain experience in communicating and networking with recruiters, as well as in participating in interviews. Overall, I feel like the Career Fair is a great way to make a good first impression and make yourself stand out—it is essentially the first round interview."

Villie relates the impact the Fair has had on her personal job prospects. She met Chevron recruiters at the 2015 Career Fair, which led to an on-campus interview, and, finally, resulted in her being offered an internship that she accepted for this past summer in Houston, Texas. "Without the career fair, my online application would have just been another resume in the pile," she admits.

One freshman who took his TA's advice and attended was Douglas Bach, who admits to being “a little bit” nervous. But he had decided he would “Just go in there and be confident, I guess."

His purpose in going to the fair was to network and get familiar with company representatives.

“Just because you’re a freshman doesn’t mean you can’t get your name out there, and also see what companies have to offer." Bach says he also hoped to discover, "Where companies are based, where you might want to work, and what you want to do.”

Another freshman, Liam Carroll, who says he was “not particularly nervous,” just came for the experience:

Liam Carroll (center) and another Engineering 100 freshman chat with a recruiter at the recent fair.

“I don’t know if I’m looking for an internship quite yet, but the experience I can get by going this year will be very helpful in the coming years to get an internship.”

Material Science and Engineering junior Devon Goszkowicz values the exposure she’s gotten to future employers. She says, “I don’t think any other university could have given me the same experience. Just between exposure with all these start-ups I’ve worked for…I love going to career fairs, even though it’s a little bit scary at times, but it feels really rewarding to be able to talk to people from your potential employers.”

Another junior, Sanjay Kalidindi, who's majoring in Electrical Engineering, explains why he attended ECF: "I'm looking for an internship this summer, so I thought it would be the best place to go for one of those." As a result, Kalidindi, whose focus is power and energy and who says his dream job would have something to do with solar panels and wind energy, had Interviews with both Leidos and with ADM. Kalidindi said he has gone to ECF every year he's been in school, but adds the caveat, "It's tough your freshman year, because ususally people aren't too interested, because you don't really have any experience yet."

But Kalidindi does believe he benefitted by going. "Oh, definitely. You learn how to talk to them. That's the most important thing, because I think that gets you the interview more than anything else. Most kids don't have that much on their resume yet, because they're still in college, so they don't really have much going on besides clubs and maybe an internship for research. So I guess learning to talk is the biggest thing you get."

Most seniors, of course, were at the Fair looking for jobs. For example, Palak Dharia, a senior in Chemical Engineering, came to the Engineering Career Fair “looking for a full-time position out of college, so recruiting starts now.” He indicates that this was his 5th or 6th time. “They have it every semester,” he says, “so I try and come.”

While Dharia feels that coming to previous fairs has helped him gain confidence and the ability to present his elevator pitch, he says the fact that most of the recruiters just graduated recently themselves makes it easier. “The college recruiters tend to be freshly out of college, so it’s not like you’re talking to someone who’s had experience for 40 years. So there’s also a little bit more of a comfort level. And they help you; they’re here to help you.” Not only that, but Dharia says his internship this past summer with Brady Corporation in Milwaukee was a result of coming to last fall’s career fair.

Rebecca Boehning, a senior in Chemical Engineering, has been to ECF every fall since she’s been at *Illinois*. She says she came as a freshman to one career fair and then has been to both the ECF and the Expo (the student-run career fair) for the last two years.

Left to right: *Illinois* seniors Kristine Carlson and Rebecca Boehning

Left to right: *Illinois* grad Danielle Joaquin chats with Michael Muelhouser about his career options at Proctor and Gamble.

Boehning thinks the career fair is a great opportunity for students to interact with recruiters on a more personal level, “that’s different than just applying online.” She says. “So by having that face-to-face interaction, it really helps your chances of getting that job. Which is, I think, one of the benefits of the University bringing all these people here together, so that I can have these opportunities.”

Like most of the students who participated in the Fair, Boehning appreciates that many of the recruiters are recent grads. “When you’re talking to a recruiter, it’s all about starting a conversation, and so with students or ex-students that have gone through the same curriculum, they know what you’re talking about when you mention some class work or projects. And it can even form a sense of comradery, which is important for trying to get a job—just making that connection.”

Kristine Carlson, also a senior in chemistry, who will be graduating in December of 2017, says this is her 3rd semester going to career fair. According to Carlson, the ECF helps students to network. “It gives you a good chance to get yourself out there and network with recruiters, and even if you’re not particularly looking for an internship at the time or a full time job, it

does give you that good opportunity to network."

Senior Michael Muehlhauser, due to graduate with a degree in Industrial engineering this December says he's "been to too many career fairs to count. Probably at least 10. I've been to the fall one and spring one, almost every semester."

Has it been worthwhile? "I've gotten internships out of them," he says. "I've had five internships during my time here."

While most folks would acknowledge the benefit of coming as a senior, did Muehlhauser come as a freshman, and if so, why? "I did," he says…"I gained confidence going up and talking to adults, and the experience of talking to recruiters. Mastering your elevator pitch, learning about your resume. I encourage younger students to do that as much as they can, because it definitely helped me. It's been a great experience."

Muehlhauser indicates that the career fair also helped him land his five internships. "The networking opportunities here at *Illinois* are definitely some of the best in the country in terms of how many companies want to come to our fair and how many students we send to different parts of the country. It's definitely helped me in terms of that."

An *Illinois* alumn, Nikita Patel, who works for Proctor and Gamble was on hand to help recruit students.

Muehlhauser has a specific type of career he's looking for (not necessarily a desk job), and believes access to the large number of companies who participate in ECF is enabling him to target those companies who are specifically offering what he wants. For instance, he's visiting a lot of companies who specialize in rotational programs:

"I want to focus more on the engineering and business side of things," he explains. "Consulting things as well. I want to be an engineer who knows how to communicate really well; I don't want to sit at a desk every day."

Students probably recognized some familiar faces among the recruiters, too—alums who had been students in their own departments a few years ahead of them. For example, Danielle Joaquin graduated from *Illinois* in Bioengineering in 2012, then with a Masters in Mechanical Engineering in 2014. Joaquin currently works at Proctor and Gamble in technical design for packaging. "So I actually do a lot of CAD (computer-aided design) work, and make sure that the concepts that our design group comes up with are able to be manufactured and actually run on our lines. So I mainly use the mechanical part of my degree."

***Illinois* Engineering student Ilana Slutsky gets some info from an *Illinois* grad who is currently working at Proctor and Gamble.**

Joaquin describes it as "awesome!" to be able to come back to Engineering Career Fair again, this time as a recruiter—and this time, not dressed in uncomfortable business attire.

"It's crazy how much the campus changes every year I come back," she admits. "And, yes, this time I get to wear the comfortable clothes. It's a lot more comfortable on the other side of the table."

Another alum, Nikita Patel, who also works for Proctor and Gamble, graduated from *Illinois* in 2013 with a Chemical Engineering degree. Patel said it was very rewarding, but also quite interesting being a recruiter looking to hire rather than a student looking for work. “It’s a rewarding experience,” she admits. “So you went through the career fair from your freshman through senior year, and now you're giving back. I wish I could have told my younger self, 'Hey, it’s not as scary as it seems to be!' But it definitely feels cool. It's weird to be with one company versus trying to find one.”

Rebecca Ficht, a senior in Bioengineering, said this was her third year coming to ECF. She participated every year except her sophomore year. In addition, she explains that there are multiple career fairs to take advantage of at *Illinois*. Besides, ECF, there is Engineering Expo, which is put on by students. She says the ACES Career Fair often has bioengineering companies too, so she has gone to that one as well.

Ficht explains the increasing importance career fair has as one advances from freshman to senior at *Illinois*:

“Freshman year, it was just to see the whole thing; it’s not something you would normally see, and it’s overwhelming at first. Going my junior year, I was going looking for an internship for that summer. And I did get one—with AbbVie—and that was very exciting. And then this year I am looking for a full time position, so it’s the real deal now.”

Electrical Engineering junior Sanjay Kalidindi

ILLINOIS' KENNY LONG AND THE GLOBAL HEALTH INITIATIVE PROMOTE GLOBAL HEALTH

September 27, 2016

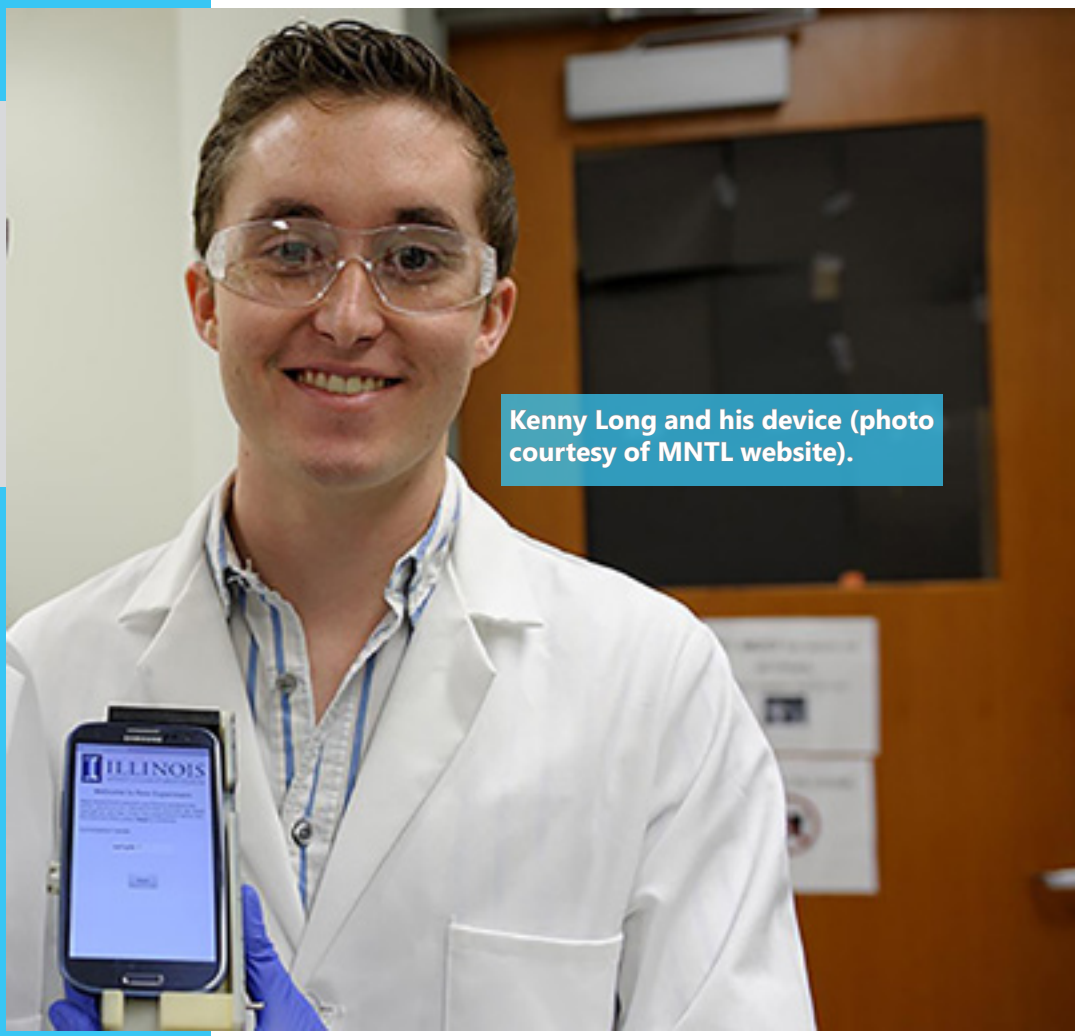
For *Illinois* Engineering student Kenny Long, just being an engineer wasn't enough. He wanted to approach problem-solving with a more interdisciplinary, holistic approach— not just fix a community's impure water supply, but solve some of the residents' medical issues related to having drunk the water. And just solving problems in his immediate vicinity wasn't enough either. Recognizing that ours is a global village, Long embraced his global citizenship and is now seeking to solve problems in some of the more distant reaches of our village. And one way Long is doing that is through the Global Health Initiative and its INSIGHT (*Illinois*-Njala Sustainable & Innovative Global Healthcare Technologies) program.

It was Long's commitment to making a difference for people outside of his own neighborhood that led to his first trip beyond the borders of the U.S. He traveled to Cameroon in western Africa as a part of Engineering Without Borders to work on a water supply project. And that trip let to a significant shift in his career trajectory.

"One of the things I noticed over the three times I went was the need for a more holistic approach to development than just doing an engineering project." Long recognized that solutions for many of the issues throughout much of the world would require people from different disciplines working together.

***Illinois* MD PhD student Kenny Long**

"It's not just engineers who can fix it; its not just doctors…all these things work together to address the underlying issues of poverty and inequality and long, complicated histories of weird political situations. It's really complicated."



Kenny Long and his device (photo courtesy of MNTL website).

At that point, Long decided that he wanted to focus more on human interaction: "I wanted more interaction with people than just being an engineer working for a company. I wanted a direct contact with people I was affecting."

So he slowly transitioned his education to a more medical focus. He changed majors from electrical engineering to a biomaterials concentration in materials science engineering. He had actually begun work on a second degree in Molecular and Cellular Biology, when he decided to seek an MD PhD.

"This realm of being able to do research, but then translate it to directly and actually impact the lives of people in a very tangible way—that was what I wanted."

What's Long's dream job? "Ok, so I really want the best of both worlds," he admits. "I want to see patients, but I also want to do research." He says he'd like to be in a large academic institution with a teaching hospital, researching fundamental technologies in his research lab while at the same time seeing patients in need of the technologies he's developing.

Long says he wouldn't be surprised if he ends up doing research on point-of-care diagnostics, which is what he's doing for his PhD research.

And while Long likes to travel to other places in the world to help people, he'd also like to be able to help them without taking one step outside of his lab. So for the last couple of years, his research with Professor Brian Cunningham's Nano Sensors Group has involved working on cell-phone-based diagnostics. He says his lab has developed an attachment that slides onto the back of a smartphone and allows its user to do optical-based tests, or tests that would normally be run on a spectrometer.

Their gadget currently enables a broad spectrum of different tests. In fact, Long reports recently using it to do a demonstration related to allergens: "I looked at peanut allergens; I went to the store and got some cookies from Insomnia and tested them for cross-contamination from just being cooked in the same place."

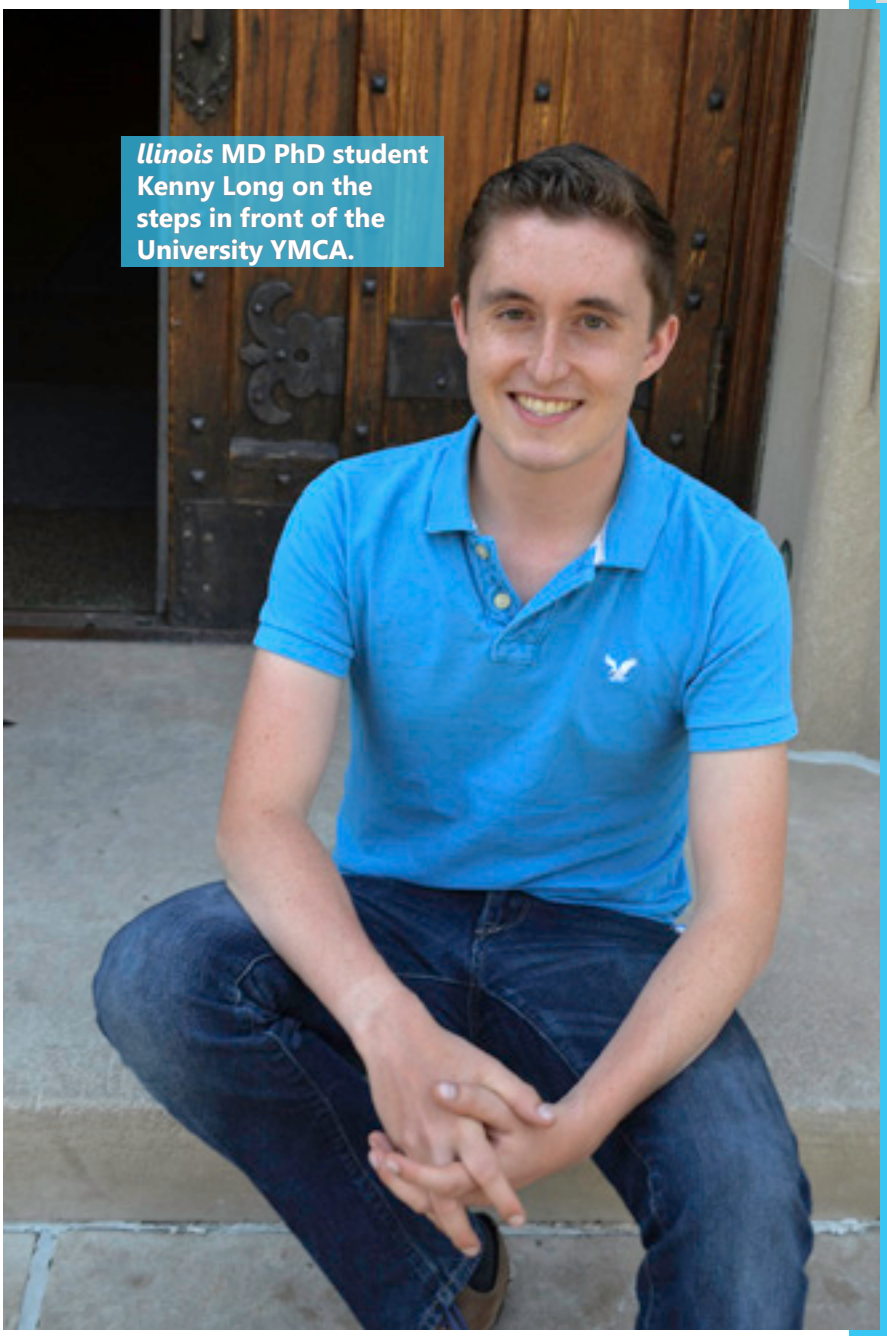
Long says the goal of their device would be to enable caregivers to do tests that could be "done in such a way that it doesn't require the fundamental infrastructure that we're dependent on here for those sorts of tests. So something that would be much more immediate, and something that would be much more applicable." In other words, he'd like to create a device that even medical personnel in remote places of the world without access to a raft of expensive equipment would be able to use to make diagnoses on the spot.

Given Long's interest in doing holistic development projects overseas, combined with his desire to impact people's lives in a tangible way, it makes sense that when he heard about the Global

Health Initiative (GHI) student organization, he got involved.

GHI had been formed in 2011 to unite the global health community at *Illinois*. The organization had received funding through a Graduate College Focal Point grant designed to stimulate new interdisciplinary research through collaborations among faculty and graduate students from multiple fields. With the grant, GHI had piloted a seminar series and an international observational experience in Cape Coast, Ghana, during the 2011–2012 academic year.

Long soon discovered some kindred spirits among the other MD PhD students who were involved with GHI at the time. Many had been to Ghana and, after the trip, felt they had discovered their niche. But they wanted to know, "Ok, what next? What do we do next?"



***Illinois* MD PhD student Kenny Long on the steps in front of the University YMCA.**

Long, who then worked at the University YMCA, was aware that the Y was looking to expand its global engagement and had developed a funding initiative, so he apprised his group of the opportunity. So GHI's next step was to submit a proposal to the University YMCA then to form a partnership with it. Long explains:

> **"The goal that we pitched was, 'There's no concerted push looking at global health from all these different disciplinary perspectives. There are lots of individuals, individual researchers doing fantastic research in the area of global health, but they don't necessarily interface with each other. They're located in different colleges, in different departments. So how do we fix that?'"**

So the GHI proposed to survey existing campus partnerships with institutions overseas, to see if one of them would be right for an expansion in the area of global health. The idea was to coordinate activities around a location with a lot of infrastructure already in place and build up an interdisciplinary structure that these activities could be based on, so people could all go to the same location to do their own research.

"Just a lot of the logistics when you're working with an international partner can be a barrier to entry for a lot of people here starting that from scratch," Long admits.

And of the overseas partners mentioned during the survey, Long reports that Njala University in Sierra Leone "just really impressed us."

So in February 2014, Long and some GHI colleagues visited Njala University. During their trip, which happened to coincide with Njala's 50th anniversary celebration, they discovered some information which pretty much cemented their relationship with Njala. The university had actually been founded in partnership with *Illinois* back in 1964. "Which is really unique!" Long exclaims. "A long-standing relationship, and that was one of the things that really drew us to the partnership at that point in time. I mean, how do you compete with a history like that?"

Back in the late 60's, *Illinois* had sent over personnel to Njala's brand new campus. Some of the first faculty members at Njala, they taught there for several years and trained some of

Njala's first students. Many of this first crop of students actually came back to the US to get their PhD's, and many came to *Illinois*.

However, this reciprocal relationship was interrupted by Sierra Leone's civil war from 1991–2002.

Once the war ended, Njala's vice chancellor reached out to *Illinois*, seeking to reestablish the relationship. One *Illinois* faculty member who answered the call, and has been key in rekindling the *Illinois*-Njala connection was the College of Agricultural, Consumer, and Environmental Sciences (ACES) Associate Professor Paul McNamara, who had established study-abroad and research opportunities programs there for *Illinois* students.

In addition to its past history with *Illinois*, some infrastructure improvements made Njala University even more appealing to the GHI team. Reorganized after the civil war, Njala had absorbed a couple of other institutions: a teacher's college and an old British paramedical campus, which became their school of health sciences.

Sensing that it was the right opportunity to renew the *Illinois*-Njala partnership, the GHI team began recruiting some other *Illinois* folk, like Bioengineering's Jenny Amos. Amos explains why she got involved. "I was brought in after the initial visit to Sierra Leone to explore partnerships that could involve engineering and specifically my experience with design. So since I have students designing medical products and working clinical environments, it seemed a good area for me to delve into. I've always kind of had an interest in global health."

Amos also felt the opportunity to design for low-income clients would be beneficial for her students.

"So I thought for Bioengineering, it would have a lot of benefits, because we tend to design with corporations, with really high-end products, and this would allow us to design for a low-resource setting, which I thought would bring a lot to our program.

So Long, Amos, and several others visited Njala University for some preliminary conversations to discuss, "How can we make this happen, and what would it look like?

Long says they "met a lot—pretty much every day for a week straight, just meeting with faculty members in the school of Community Health Sciences to say, 'Ok, you are interested in partnering with us; we are interested in partnering with you; let's put together a proposal and see if we can get funding for these sorts of things.' And so we really hammered it out together."

As fate would have it, however, during that trip, Ebola and the Zika virus began to spread in Western Africa. Within a matter of weeks of their return to campus, university travel to Sierra Leone was no longer allowed.

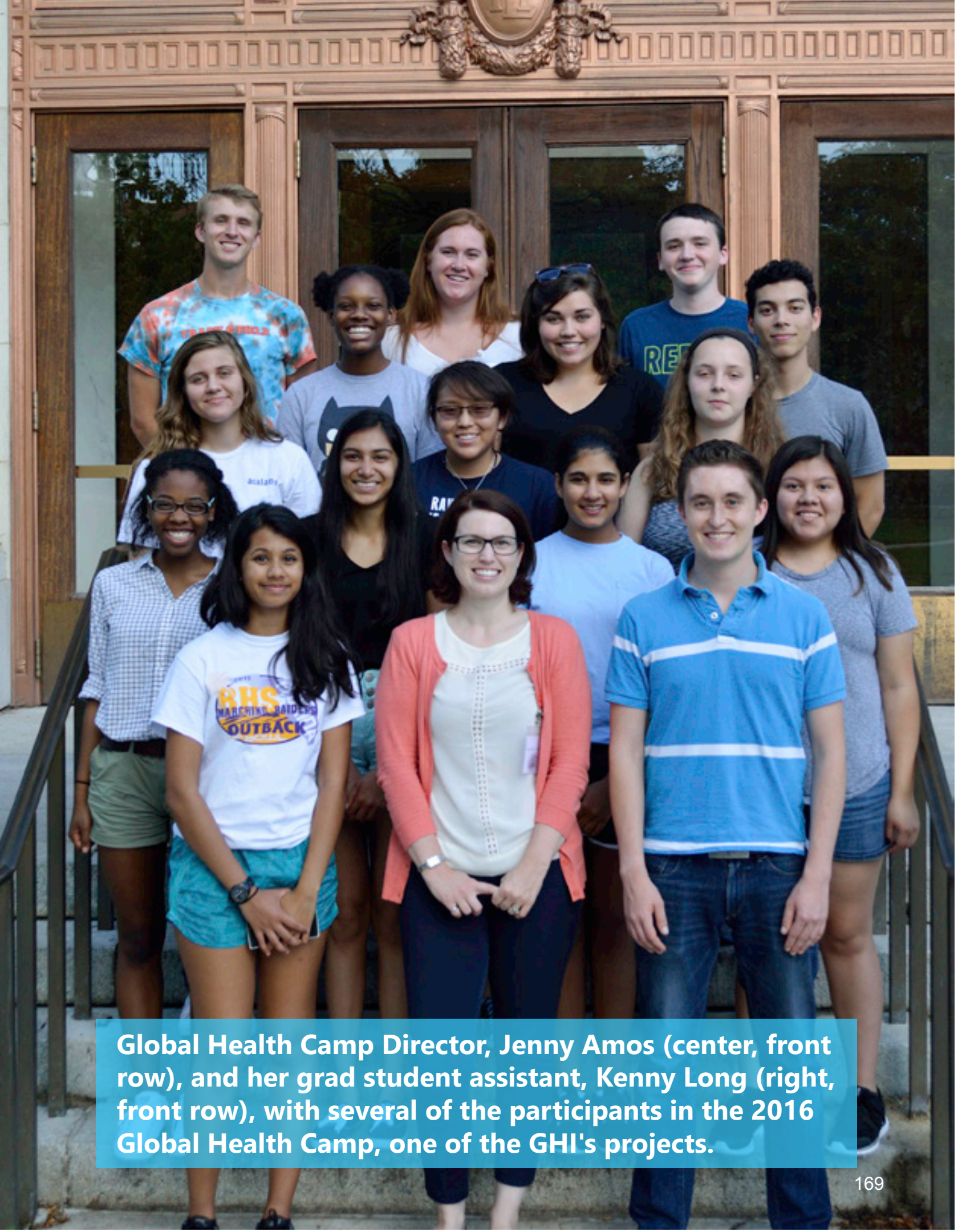
So during that time period, the curriculum development conversation began in earnest among a core group of faculty members committed to putting together a new undergraduate Global Health Certificate program.

So this fall, *Illinois* is beginning a new program, the Global Health Initiative Certificate, that not only spans several disciplines/units across campus, including Bioengineering; ACES; the College of Veterinary Medicine; and the College of Education; it spans an ocean. Key to the program is a partnership with the University of Njala in Sierra Leone, whose community health faculty and students will be collaborating with *Illinois* faculty and students to provide students in both institutions a richer understanding of and experience in global health.

As part of this, INSIGHT (the *Illinois*-Njala Sustainable & Innovative Global Healthcare Technologies) program was established, which will encourage cross-institutional collaboration by students to target specific health problems prevalent in Sierra Leone then seek to solve them via the creation of innovative yet sustainable medical devices.

Regarding his and GHI's efforts to promote interdisciplinary collaboration around the area of global health, Long says,

"Well, I think it's a really important area, which on campus has not been; there's been no effort to combine all these people from across campus, and to give them the space to have these conversations."



Global Health Camp Director, Jenny Amos (center, front row), and her grad student assistant, Kenny Long (right, front row), with several of the participants in the 2016 Global Health Camp, one of the GHI's projects.

ENGINEERING SOCIAL JUSTICE SCHOLARS PROGRAM HELPS ENGINEERING STUDENTS RETHINK THEIR ROLE

November 3, 2016

Are you passionate about righting historical inequities in our society? Do you have a penchant for STEM outreach to multi-ethnic middle-schoolers? For 18 engineering undergrads, the answer to both of these questions was a resounding "Yes!" So this fall, they signed up for Engineering's new, two-semester-long Engineering for Social Justice (ESJ) Scholars Program.

The new program has a dual purpose. One, it's designed to help Engineering students who don't believe social justice is an engineering issue to "rethink the role engineers play in society." Secondly, it's designed to provide additional mentors to help with ICANEXSEL (*Illinois*-ChiS&E Alliance for Nurturing Excellence in STEM Education and Leadership), a flourishing outreach to diverse, Chicago Public School (CPS) middle school students.

The course was created by Engineering's Outreach Coordinator, Sahid Rosado, and Valeri Werpetinski, Co-Director of Learning in Community (LINC), Engineering's service learning program. Rosado says that increasing the number of students of ethnicity in STEM is "near and dear to her heart." Werpetinski helps to develop courses where students learn about a social issue someplace in the world, such as lack of access to clean water, come up with a design, then actually travel there and build it to resolve the issue.

"We're going to do something very similar," explains Rosado, "but instead of traveling to Uganda, they're traveling to Chicago."

The course Rosado and Werpetinski developed for the program, ENG 398, is a year-long, two-semester learning experience that discusses social justice issues then encourages students to find practical solutions to solve them.

For example, in fall 2016, the introductory "Social Justice and STEM Education" course was piloted. The course addressed different issues within the social context that the CPS kids are coming from.

Illinois ESJ scholar Angel Loizzo (right) works with a CPS student on her toothpick-gumdrop structure during a Saturday session at UIC. (Photo courtesy of Lynette Lin.)

"Of course, we've heard how the Chicago Public School District has been historically underserved and underfunded," explains Rosado. "So we want to talk about those issues—why those issues matter."

Issues discussed included: Why the huge ethnic or racial disparities in STEM? Why does it happen? Why is it a problem? "So kind of unpacking those issues," says Rosado. She goes on to explain that it's not an isolated social issue, but it's pervasive around the country: "So not only in the Chicago area, but in the U.S., because it's a national problem. It's not just here."

Rosado says that because the class is essentially an outreach program, they also addressed:

What makes an outreach program successful? Why is it so important to have mentors involved in the program? Why is it important that we have them working in small groups?

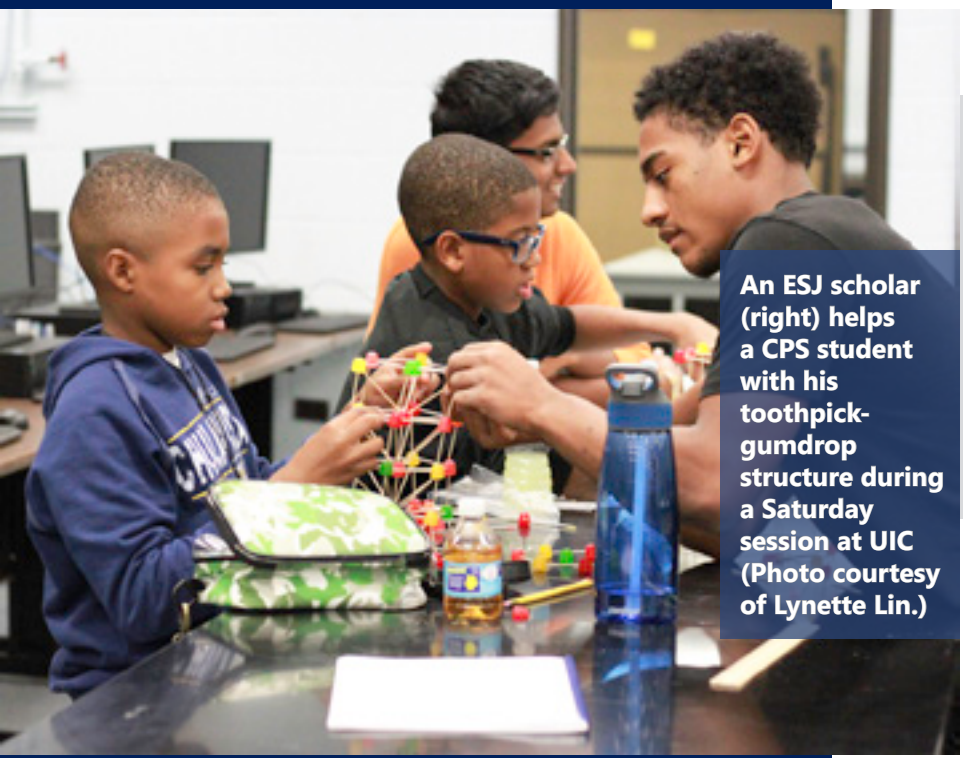
"So understanding the reasoning behind the model that we've decided to go for with the program," Rosado explains.

ESJ scholar Cheyenne Syring (right) works with a CPS student during one an ICANEXSEL Saturday outreach event at UIC. (Photo courtesy of Lynette Lin.)

Since a key component of LINC is that students get to be part of the solution to solve the issue they're addressing, a crucial second piece of the program is that the ESJ scholars not only learn about social injustice and inequities occurring in our society, but they help address them. So the ENG 398 undergrads served as mentors for the ICANEXSEL program. "Students who are registered for the course also get to actually be there with us in Chicago," explains Rosado. "It's kind of a dual purpose for the course."

ICANEXSEL is comprised of folks from two University of Illinois campuses, Urbana-Champaign (*Illinois*) and Chicago (UIC), who are partnering with the Chicago Pre-College Science and Engineering Program (ChiS&E). The outreach offers STEM activities to CPS students on consecutive Saturdays in both the fall and the spring semesters. Comprised of engaging math and science lessons, including hands-on activities and experiments, activities are held primarily in Chicago at UIC, with sessions being jointly taught by both *Illinois* and UIC personnel and CPS teachers. On the final Saturday session each semester, CPS students and their parents take a field trip south of I-80 to experience the *Illinois* campus for additional STEM activities and campus tours.

The program, which began in 2014 with sixth graders, has been expanding—adding a grade each year. For example, in 2015, they added seventh graders to the mix, then in fall 2016, eighth



An ESJ scholar (right) helps a CPS student with his toothpick-gumdrop structure during a Saturday session at UIC (Photo courtesy of Lynette Lin.)

to STEM and engineering concepts in middle school will be carefully nurtured along the STEM pipeline so that when they finish high school, they will be a promising batch of STEM-career-ready students who, because they are already familiar with and comfortable with both University of Illinois campuses, will consider and hopefully matriculate to either when it's time to choose a college.

Although ICANEXSEL had 50 undergrads volunteer last year, with the addition of eighth graders, more mentors were needed. And since the ESJ scholars needed a service project, it was a win-win for both programs.

Plus, it's hoped that while providing quality STEM education activities for the Chicago youth, the ESJ scholars begin to make a connection between disparities that exist regarding access to the kinds of resources that helped steer them into STEM that they might have taken for granted. According to Rosado:

"Access to an education, access to a rigorous curriculim, access to resources—because that plays a huge role in a middle schooler's life and decision to pursue STEM. If we never had a student see math in a different way, or play around with science topics and things, that student might very likely not choose STEM."

Rosado goes on to explain that a lack of access to things plays a huge role in this. "We do want to talk about why

that's important, and why it's important for us to do something about it. Because this isn't something that's just been happening in the last few years, it's historical. We also want to address why that lack of access happens. Is it a coincidence, or not?"

Because the ESJ Scholars program spans two semesters, the second course, Leadership in Engineering for Social Justice, is set for spring 2017. "That's really when we kind of let the students run with it," Rosado says. Students are to take everything they learned in the fall course, but instead of going to Chicago, they're going to take what they learned from Chicago and replicate the model locally. Also, in Chicago, teachers taught the lessons, but in the second semester, it's up to the students; that's the leadership component.

Also, a key strategy for the spring semester is to have students address issues happening on campus, such as inclusion:

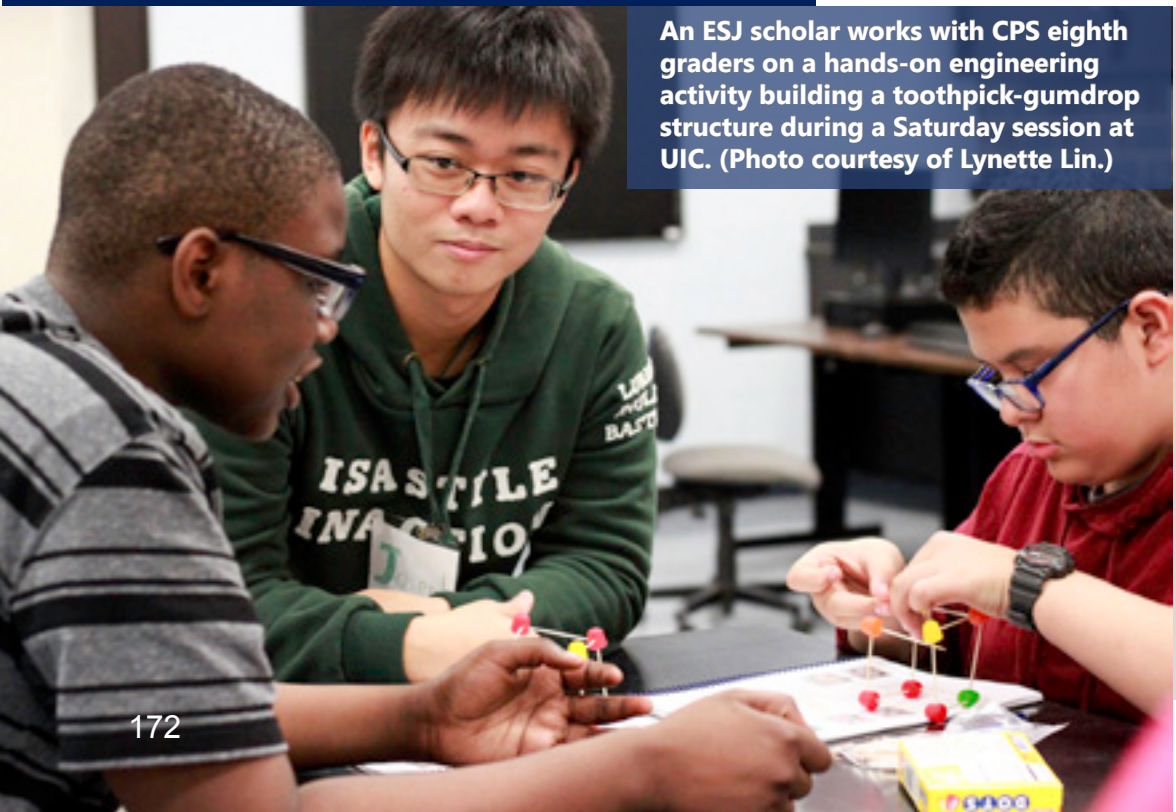
"I feel like this last year has been crazy in terms of the Black Lives Matter movement... So we also want this cohort of students to address an issue that's happening on campus. We're going to leave it up to them to choose what they feel passionate about... And they will have to come up with programming to address it."

She says one idea might be to do a speaker series open to the entire campus to talk about inclusion.

Siu Fung (Joseph) Tsang moves his team's player during the game.

cohort for them to do that. Because they've been learning about gaps in STEM…so I think they're are the perfect group of students to something about it.

Rosado believes a course addressing social justice is very timely given the number of incidents over the past year regarding race.



An ESJ scholar works with CPS eighth graders on a hands-on engineering activity building a toothpick-gumdrop structure during a Saturday session at UIC. (Photo courtesy of Lynette Lin.)

"It's a good thing that we're doing this course," acknowledges Rosado, "because we can talk about these things. I feel like there's kind of a stigma, that we don't talk about these things, or these things are sensative. That's not true. It's the complete opposite, if anything. It's that we have to be talking about these issues."

NEW ENG 198 COURSE TEACHES FRESHMEN THE ENGINEERING PROCESS, TEAMWORK, WHILE ADDRESSING PERSONAL MOBILITY

November 9, 2016

The idea behind ENG 198, the new Engineering course being piloted in fall 2016, was to give freshmen a chance to discover what it's like to be an engineer early on…with a few caveats. Working as part of an interdisciplinary team, students were to come up with an innovation of benefit to society in the area of Personal Mobility. Another caveat: course planners didn't intend to smooth out the path for the students either; they wanted the freshmen to navigate some bumps in the road—just like real engineers do. The goal was that students would learn the engineering process, experience teamwork, and come up with an end product that—while not necessarily 100% successful—would let them experience having contributed to society.

Developed by iEFX Instructor Joe Bradley; MechSE Professor and POETS PI, Andrew Alleyne; and ECE Professor Emeritus, Phil Krein, the joint iEFX/POETS course was most likely similar to other projects courses, in that the class was divided into teams of 3–5 students who, with a budget of $200–300 and a timeline of 8–9 weeks completed a project together that was to be a useful innovation.

However, the course had a number of components that separate it from Engineering's other freshman project courses. For one, students were to come up with useful innovations related to a specific theme: personal mobility.

According to Bradley, who teaches several iEFX projects courses, Engineering is moving away from the idea of just building great technology and moving more toward the model where what is built should benefit society.

"Now we're trying to turn that technology into innovation," he explains. "The way we define innovation for our classes is that it has some utility, some usability. There is some need that we are actually addressing."

Two ENG 198 students work on their personal mobility project: bicycle gears that shift automatically.

And the need ENG 198 is addressing is Personal Mobility (PM). The new buzzword among automobile manufacturers, the Detroit Auto Show Preview calls it "the new black," because most automobile manufacturers are dabbling in it.

"So we're trying to use this personal mobility course to give the students a specific theme that targets specific needs in a growing demographic of where that might be realized to help identify and shape the kinds of innovations that they might develop," Bradley explains.

One reason PM was chosen besides the fact that it's trendy? It's a big area where the demographic has changed. With baby boomers being increasingly concerned with personal mobility, it's "a place which has a lot of potential for growth," Bradley admits. "It's a growing market, and there needs to be a lot of innovation in that space."

Another reason the topic was chosen was because of its social implications. Course planners hope to

Two freshmen in ENG 198 use a drill press on their project, a foldable longboard (skateboard) to allow for easy storage and convenience.

see what impact that might have on the students. “One of the goals was to understand how students worked on a more social problem,” says Bradley. “Does it have more intrinsic motivation, and do they feel more like engineers this early?”

Bradley says that in other projects courses, students address “preset projects…taken out of a box.” But in this course, the project could potentially have future implications—be a problem for which answers need to be sought. Teams are tackling:

- **Off-Road Wheel Chair – a wheel chair for challenging terrain**
- **PackDrop – portable backpack set and back rest**
- **Foldable Longboard – a skateboard that allows for easy storage and convenience**
- **Shifters – automatic bike gear shifting**

So course planners wanted to study how exposing beginning engineers early on to things engineers in industry are currently working on changes their mindset on engineering:

“Now you are thinking about large-scale social issues from an early age. Does that have an impact on how you perceive yourself as an engineer? Do you percieve yourself as a humanitarian, and not just a technician?"

Another component sets ENG 198 apart—its interdisciplinary emphasis. While most engineering classes are comprised of students in the same discipline, that’s not how engineering is in the real world. So this course is comprised of students from all engineering disciplines, because working with engineers from other disciplines will provide a richer experience for the students.

“In practice, you won't be in a room full of mechanical, or a room full of electrical or civil," says Bradley. "It's an idea of understanding those different engineering groups, and what information they need to be successful, and what information that can tell you to be successful. And what's your part of the project? That's an element we are trying to bring into this class even at this level; we want them to have an appreciation for what other disciplines bring into the project development space."

The idea is that the students not only get sed to working in interdisciplinary teams, but bring strengths from their own discipline, thus generating products that are interdisciplinary in nature.

So students worked on projects in interdisciplinary teams grouped by interest. How were teams formed? Bradley says they went through “a brainstorming process where we put many ideas out there.” Students pitched their ideas, which were categorized on the board, then self-selected into those groups.

What kinds of projects did students select? Did they bite off more than they could chew? Yup, but Bradley’s ok with that. “I’m the kind of person who promotes just the wild ideas. I really want them to push themselves to do something they didn’t think they could pull off. So they can work through the process.”

In fact, Bradley doesn’t mind failure in the class either: “The goal isn’t that you will have a product that works 100%. The goal is that you go through the process of product development and product design, and teamwork, understand how to work in a team, and understand how to manage conflicts in a team so that you can get to the end goal.”

So how do they rein in the ambitious team whose project seeks to solve all of society’s ills before the end of the semester? Bradley has seen that too.

One of the creators of ENG 198, Andrew Alleyne, shares a session with the students about personal mobility and why it's an emerging area.

ENG 198 instructor Joe Bradley (right) works with a student on the PackDrop team.

“They have these wild ideas, and then we take some portion of those ideas that they can demonstrate at the very end, and they feel like they’ve accomplished something. We don’t expect them to solve grand challenges within eight weeks, or even four years. So we expect them to take an element of that project and say, ‘We might be able to present some proof of concept about this part of the solution.’”

Even more important than the end product, Bradley says they “hope that in the process they will learn the core objectives that the course is teaching.”

These core objectives are learning the project management process—taking your idea from a sketch on paper to an actual product or service—and teamwork, learning to work together as a team and to manage conflicts on a team while still being able to deliver. And also reflecting on the process: "We also want you to reflect on these experiences so you can learn from them throughout your engineering career," acknowledges Bradley.

Surprisingly, Bradley’s not horrified when conflict rears its ugly head. In this course, it’s a good thing, so that during this first stab at teams, students who disagree on how to proceed can learn conflict management.

“Yes, I’ve seen it in many different situations on teams. And they just have to go through the process of managing that.” Groups implemented a team charter, where students made a contract on how they planned to interact as a team. They

decided when, where, and how long they were going to meet every week outside of class. They devised a system for making group decisions, or possibly elected a group leader.

“So it maps out how they will deal with these things,” admits Bradley. “We know you might have conflicts in the group, and this can be used as a common way to mitigate that.”

Also, there were no Lone Rangers in this course…nor deadbeats, because a responsibility matrix assigned each student a task. We’ve all experienced this dynamic when working on teams. There’s the person who doesn’t trust the others in the group to do a good job, and does everything him or herself. Bradley’s seen it before. “In the past, I’ve seen that there might be just one or two students who lead the project, but they might end up doing the entire project. “

So the task matrix helps this type of person to trust others, to embrace synergy—everyone bringing their strengths to the team: “I want those students to start trusting in the competence of students around them—in what they are able to do. Because you won’t be able to do everything. Being successful requires diversity of thought and approaching things in a different way, and you being a single person won’t know every way.”

Then there’s the slacker who doesn’t do his or her fair share but takes advantage of the group. Or the quiet student who tends to disappear. The task matrix forces them to step up and take responsibility. Bradley says the matrix “gives everyone the responsibility of knowing that everyone else in the team will trust and expect some competency from them. So that’s going to affect how you approach your studies and your work…you won’t be able to just sit there and do nothing since they expect something from you.”

Another difficulty course designers factored in is that the students are freshmen who, obviously, haven’t had a lot of engineering yet, The idea is to lay a foundation they can build on.

“We try to deliver some engineering principles as well…give them assignments where they can build those skills and reflect on what engineering concepts are in their projects. They might not have taken all their courses that give them the right terminology, but when they do take those classes, they can reflect on what they did here. Then by senior design time, these ideas are skills that are almost automatic. This kind of thinking, we hope to grow in their early stages.”

Members of the team that's tackling automatic bike gear shifting work on their project.

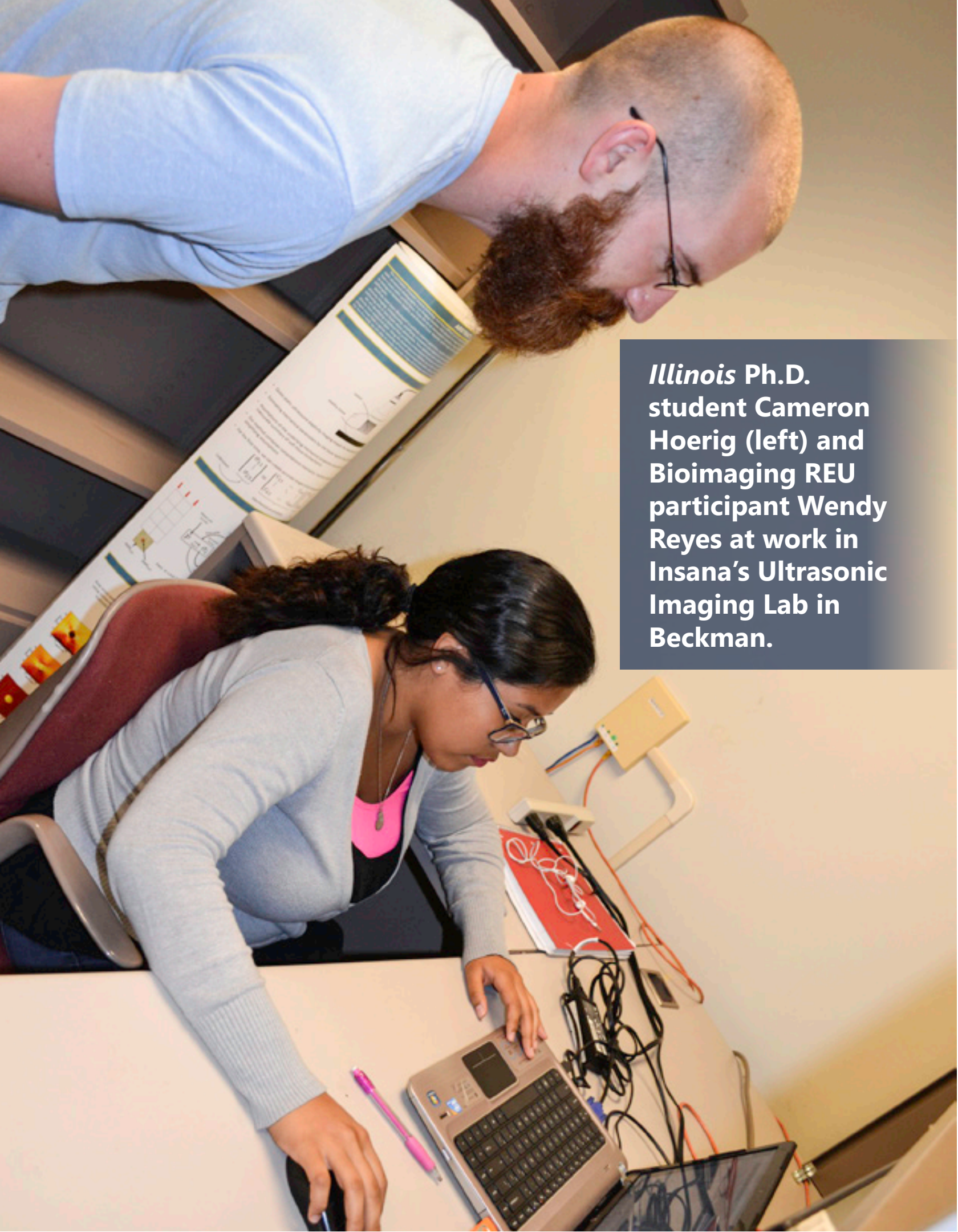
“Our goal," Bradley continues, "is that the students will gain some kind of perspective on the use and responsibilities for engineering in a wider space. Primarily in providing solutions to real problems and understanding people's needs. Working with people and not thinking they are just engineers who make technology, but people who understand how tech is useful for actual people."

Also unique about ENG 198 is the interaction with industry folk. Most projects classes don’t bring people from the outside to talk, because it takes away from students’ time to work on their project. “But, because it’s a new program,” admits Bradley, “we wanted to give them a real outside view, try something different and new, and see if this is a model we can use later on in other first-year courses.”

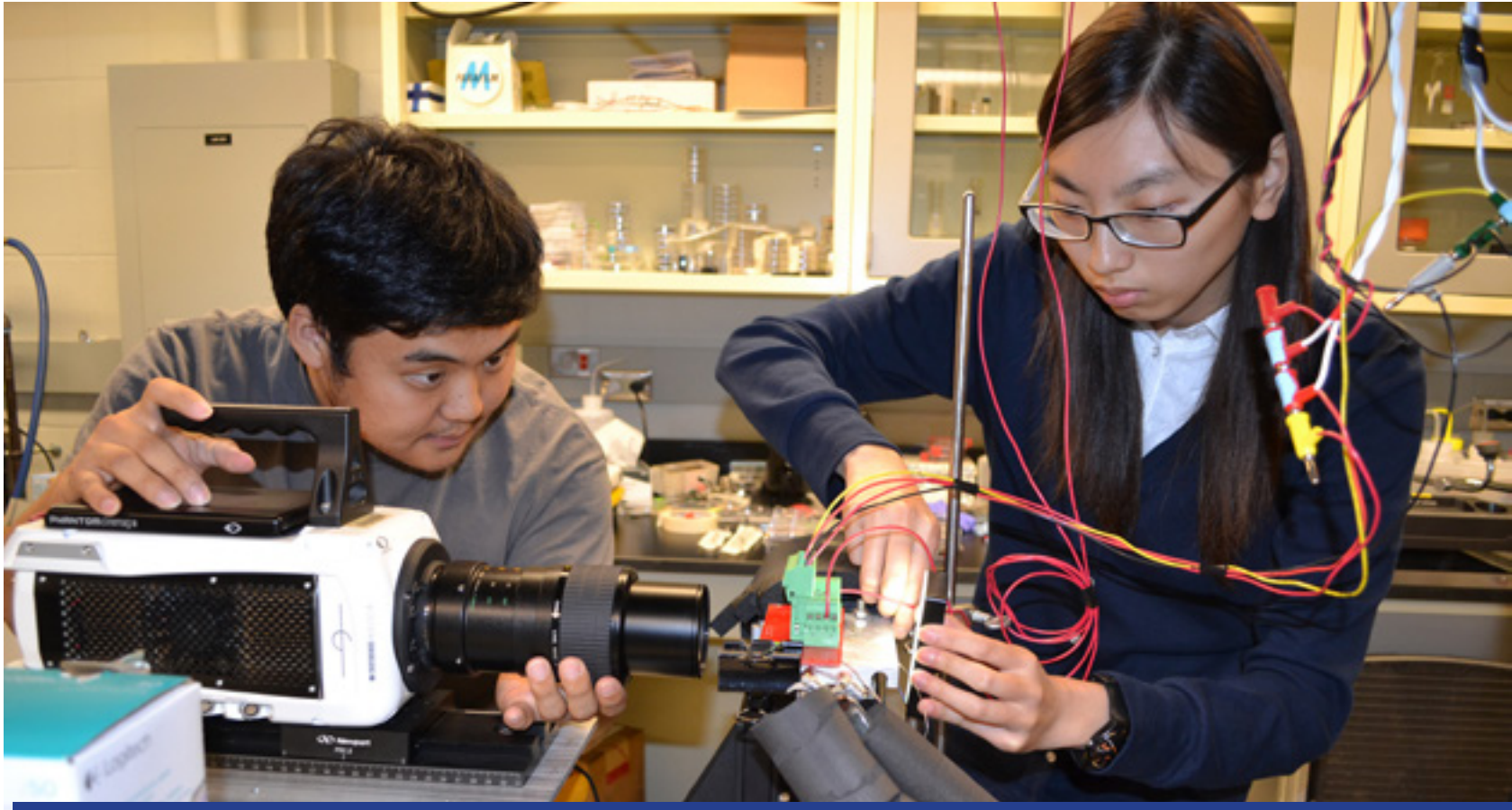
Several industry leaders presented to the class regarding personal mobility and the future of mobility. These included Scott Daegle, CEO of Intelliwheels; Ken Taylor, director of Capitol One, who focused on Big Data; Jana Lynott of AARP, shared about the changing demographics of our population, urban planning and layout for personal mobility and for the future of changing demographics; and Julian Sanchez from Caterpillar about User-Centric Design: how to put the user at the middle of the design process and really build designs that users want and can appreciate using.

At the end of the semester, on December 6th, students showcased their project in a poster presentation at an Expo for IEFX courses. “We’ve seen that when students see their peers working on all these different kinds of things, it’s inspiring to them,” Bradley explains. “When you see those expos and see your peers working on all these different projects, it inspires you to also contribute."

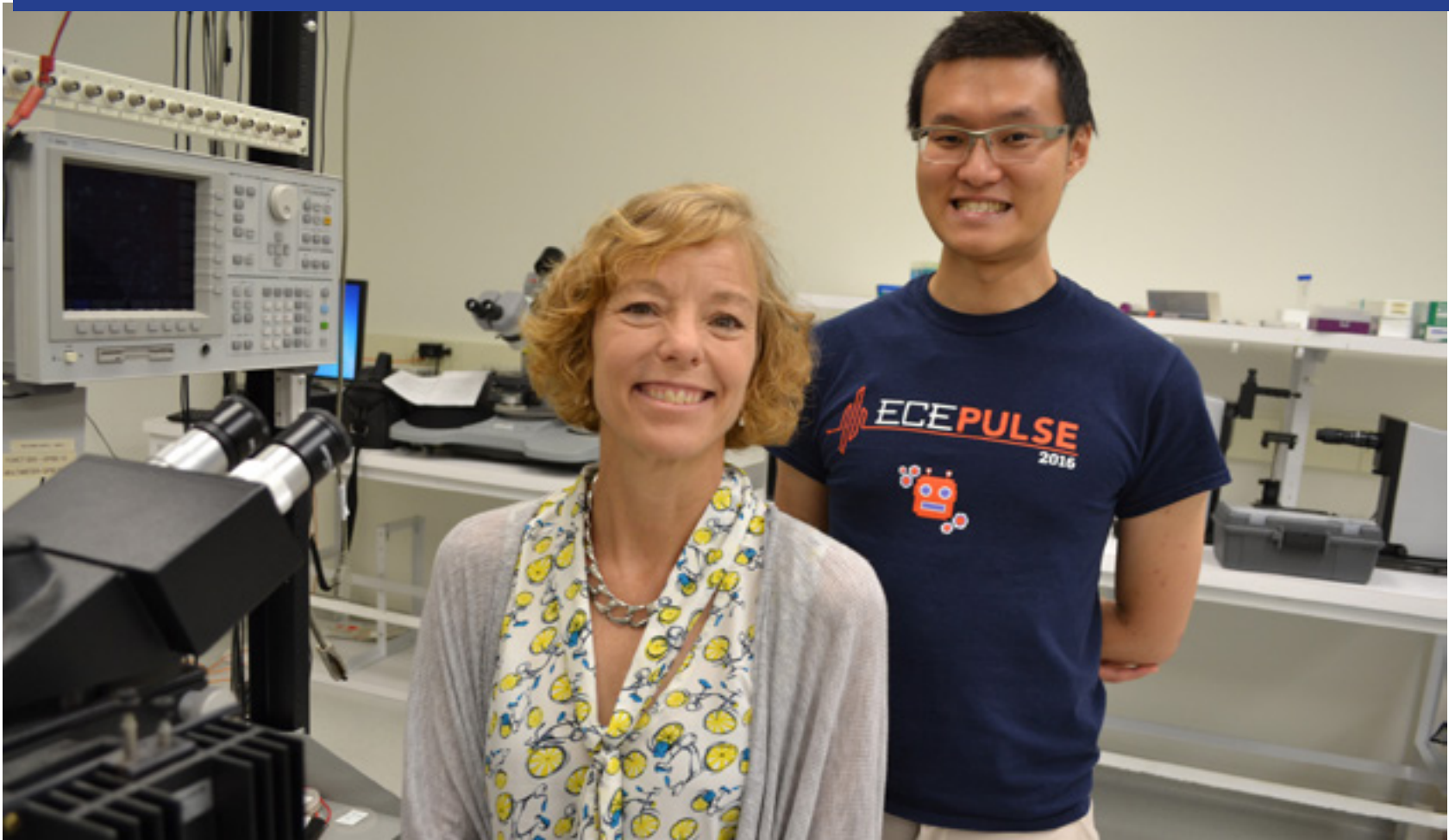
An ENG 198 student at work on her team's personal mobility project.



***Illinois* Ph.D. student Cameron Hoerig (left) and Bioimaging REU participant Wendy Reyes at work in Insana's Ultrasonic Imaging Lab in Beckman.**



STEM RESEARCH EXPERIENCES AND OPPORTUNITIES



MNTL AND ITS ROLE IN SHAPING OUR FUTURE

July 18, 2016

The Micro and Nanotechnology Laboratory (MNTL) at *Illinois* is one of the largest and most advanced facilities of its kind in the country. Home to 16 cleanrooms, 46 general purpose labs, as well as a biosafety level-2 complex, it is playing a significant role in solving real-world problems and helping bridge the gap between the developing and developed world.

Not only does the MNTL have state-of-the-art equipment and labs, but it is also home to many professors who are working on breakthrough research on a wide range of topics, including optical physics, photonic systems, nanobionics, nanomedicine, lasers, bio-medicine, integrated circuits, renewable energy, and many more.

The building was first opened as a Microelectronics laboratory in 1989; however with funding from the state in 2008, the building was expanded to assist researchers to address the toughest issues facing our society.

Nanotechnology has provided enormous breakthroughs in the scientific community, and its benefits can be seen in our everyday lives. It allows us to make materials smaller, sturdier, and more reactive. Its applications can be seen in virtually every field from cosmetics to the automotive industry to the food industry.

Trainee working on a sample in MNTL's cleanroom (photo courtesy of MNTL).

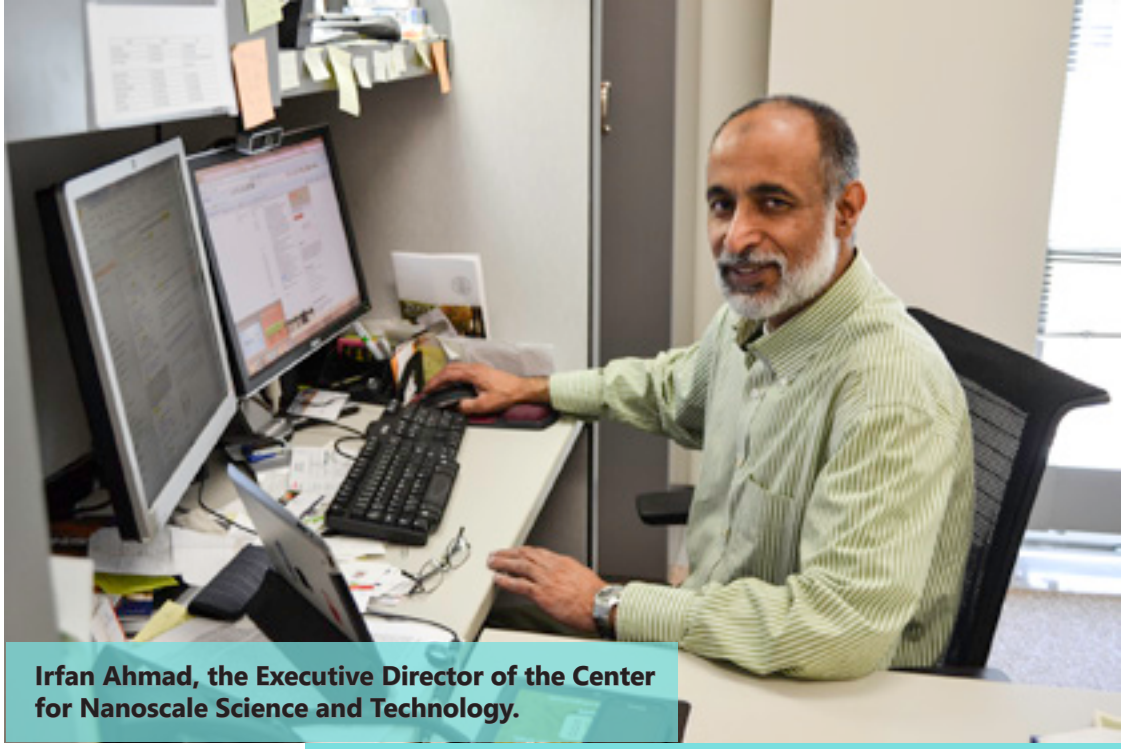
For most people, the words cosmetics and food aren't the first terms they think of when they hear "nanotechnology." However, nanotechnology today plays a significant role in many parts of the cosmetics industry in products such as shampoos, lotion, sun screen, and make-up. Shampoos, conditioners, and other hair products, for example, use nano emulsions to envelop crucial ingredients from the hair product, allowing them to seep deeper into hair.

Nanotechnology is also very widely used in the food industry. In agriculture, nano sensors are extensively used by farmers to monitor the conditions of their soil and to also detect pathogens that are causing harm to their crops. In the meat packaging industry, Nano sensors allow us to monitor the temperature and moisture of the product.

2016 nano@illinois RET teachers Kala Oglesby (left) and Beth Koplinski at work in the lab (photo courtesy of Kala Oglesby).

Irfan Ahmad, the Executive Director of MNTL's Center for Nanoscale Science and Technology, believes that nanotechnology has the maximum potential to make further profound impacts in the field of medical, pharmaceuticals, food, and environment. Knowing the significant importance that nanotechnology will play in our communities, Ahmad is one of many MNTL professors who are taking action to help spread awareness to the community about the benefits it could have

to society and to help recruit the younger generation to pick up an interest in this field and hopefully study and pursue a career in this field. For instance, MNTL offers nano@ *illinois* REU, enabling students from throughout the country to come and learn about nanotechnology. The nano@ illinois RET allows educators throughout the country to learn more about nanotechnology and the cleanroom so they can pass on their knowledge to the younger generation in classrooms and enocurage them to explore a career in nanotechnology. Ahmad states:



Irfan Ahmad, the Executive Director of the Center for Nanoscale Science and Technology.

"We know that in this country, STEM education and an interest in STEM education has been lagging. A number of NSF studies have shown that, and they have been submitted to the Congress and so forth. So, those of us who manage stuff or who can see the wider picture, can see the utility and value of these programs. The focus is to expose them to nanotechnology as a potential technology, and we have already set the stage in terms of why we pursue this."

Ahmad also believes that nanotechnology is a great bridge builder between developed and developing nations, because it can help to address global challenges—challenges that can't be just addressed by a single institution or a single country.

Gary Eden, a professor in the Electrical and Computer Engineering department, whose research focuses on electromagnetics and optics, is an excellent example of how nanotechnology has the power to have a profound impact in developing nations. Eden's research in the cleanroom, along with that of Sung-Jin Park, led to the founding of EP Purification. The work done by their research groups gave way to the work being done at EP Purification, which uses microcavity plasma technology to generate ozone for the disinfection of drinking water and for the treatment of waste water. Ozone is extremely aggressive against pathogens, more so than chlorine, which is what we often use. The EP Purification module takes oxygen from our surroundings and runs it through micro channels on a micro plasma chip, which in turn creates ozone. What makes this product ideal is that it doesn't leave any footprint, and all its components are recyclable.

Most of the shipments have been for cleaning drinking water for individuals throughout the world. These systems are powered by a simple 30-Watt solar panel, which is significant because it allows people who are off the grid to have access to this technology. According to Eden, this product is now available in almost thirty countries and is being used to disinfect water in countries such as India, Singapore, Philippines, and Haiti. By working with NGOs from countries throughout the world, EP Purification looks to keep expanding. Eden states,

"It's unacceptable that in the 21st century that anyone should drink filthy water. No one should have to do it." This, according to Eden, served as the motivation to co-found EP Purification.

When asked about the importance of MNTL, not just for the future of our society, but also the University, Eden states, "The MNTL is absolutely essential to the university, simply because the possibility of developing processes and devices is endless in the lab. I can't imagine a campus where we didn't have this capability. I think we're just seeing the beginning. It's impossible to know how to control something if you don't understand it. So the laboratory and fabrication facilities available to us allow us to restore a world that wasn't accessible 30 or 40 years ago. When you bring together a lot of smart people who study these phenomena, we will see a lot more 'aha moments.'" Eden's praise of this facility indicates how significant the MNTL cleanroom is, and how vital it could be for our future.

Story by Sanjay Kalidindi, I-STEM undergraduate student worker.

BIOIMAGING REU'S MATT KAVANAUGH EXPERIENCES CANCER RESEARCH AT ILLINOIS

July 29, 2016

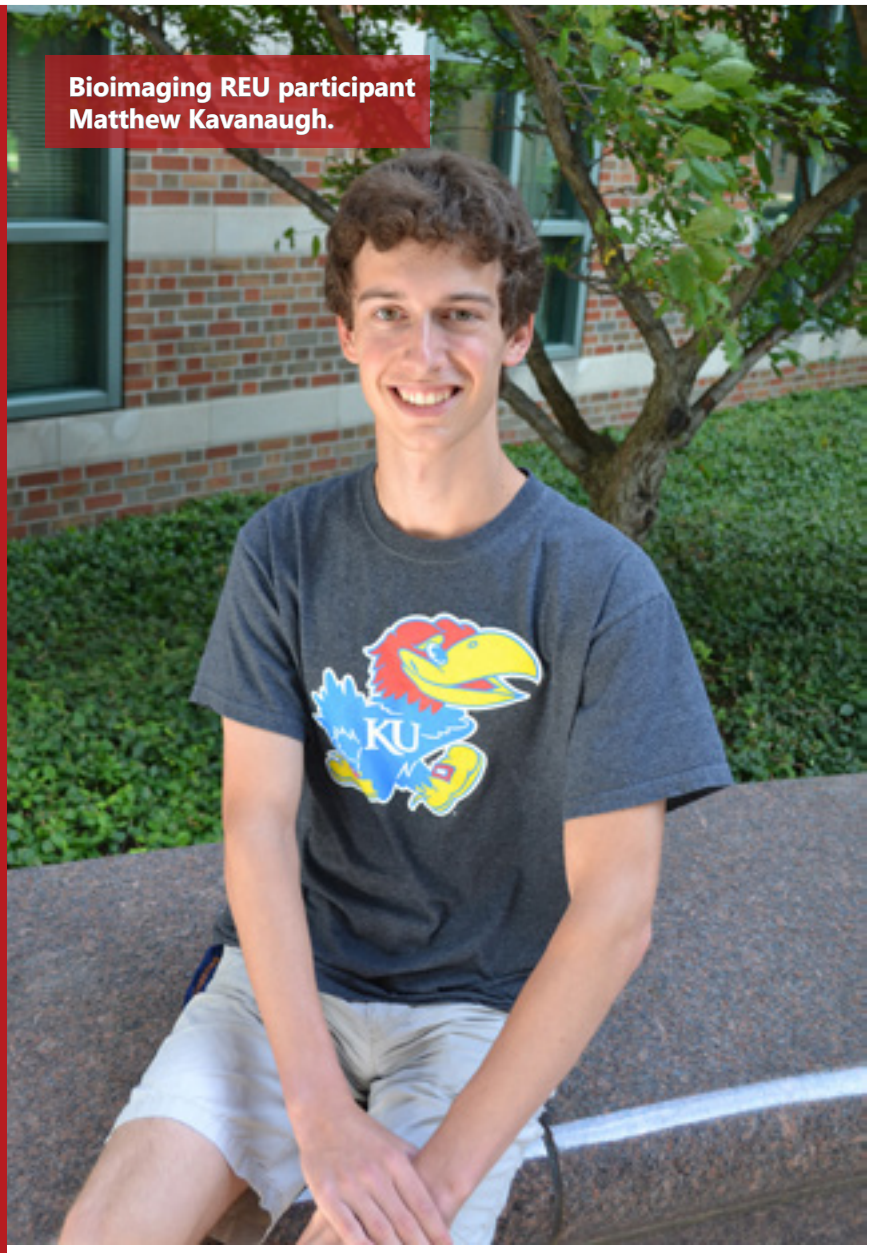
Matt Kavanaugh had originally applied to *Illinois* as an undergraduate, but finances prevented him from coming here. So he matriculated to the University of Kansas, where the rising junior is majoring in Chemical Engineering with a concentration in Biomedical. However, when searching for something productive to do over the summer, he came across the NSF-funded Bioimaging Research Experience for Undergraduates (REU) at *Illinois*. "It caught my attention because it overlapped with my interests," he explains. "And it was a place I liked and had had to decline in the past, but, 'Now I'm here, and it has excellent facilities,' so I came here." And based on his exposure to cutting-edge cancer research in Bioengineering Professor Rohit Bhargava's lab, he may have discovered his future career.

While Kavanaugh has done biomaterials research before at Kansas, he says it was very different from what he did here. Working in Bhargava's lab, he spent his summer training computers to diagnose breast cancer based on certain qualities, such as tumor grade and prognosis.

His goal was "to generate rules, pattern recognition, that the computer follows, and that would be on infrared spectroscopy data. So we scan it, have it analyze all the pixels and, using the rules we gave it, allow it to figure out the sample on its own." Kavanaugh believes the program could be used as a tool that act as a second opinion to pathologists.

Based on his experience this summer, Kavanaugh might be interested in cancer research as a career:

> **"The more I learn about it, the more I see why people are going into it. Cancer is as unique as the person who has it. To try and create general solutions is more challenging than anyone anticipated and is going to require a lot more manpower and individual effort. I can guarantee you that any work I do is going to be of value to someone…cancer is getting up there as a cause of death."**



Bioimaging REU participant Matthew Kavanaugh.

A career in which he can make a difference is important to Kavanaugh:

> **"I think that's the primary criteria of any path that I choose. I have to make a difference and find a personal value in doing so. That would be the most important thing to me."**

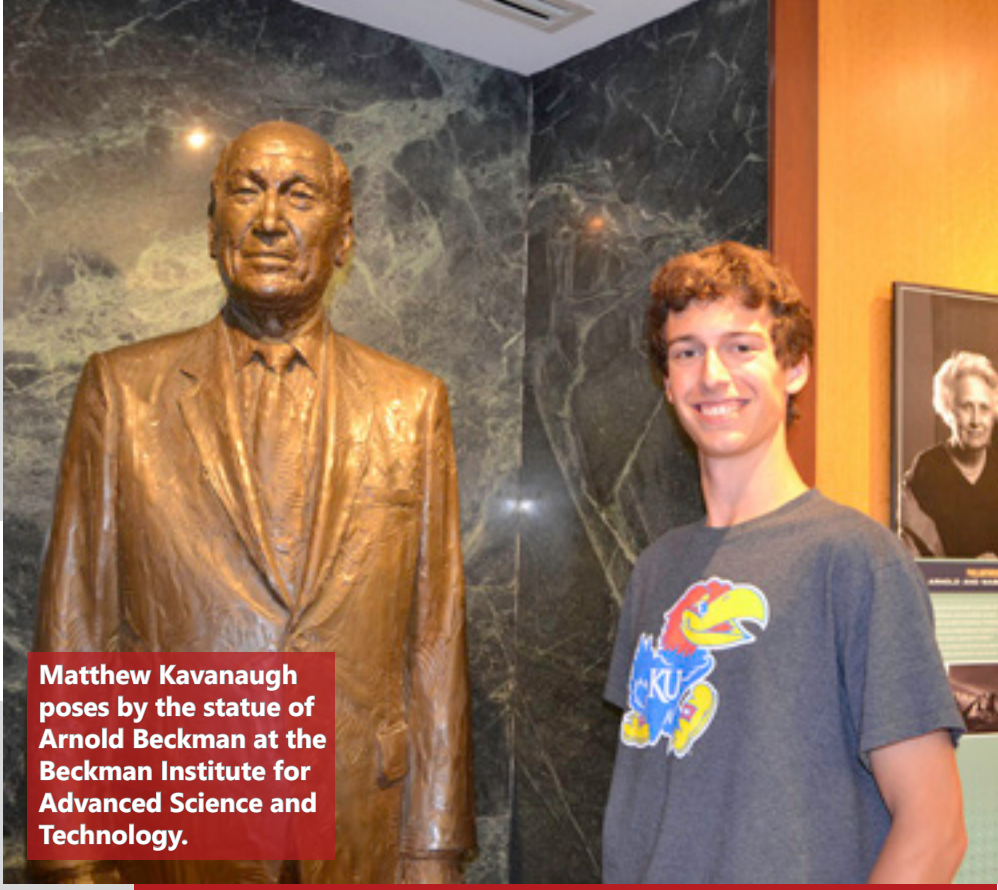
Kavanaugh believes that participating in this REU has had an impact on him in terms of whether graduate school and a career in research might be in his future. "It has definitely made grad school and a future in academia very strong candidates."

Although he's still exploring his options, the summer has had a major impact:

"I really want to spread out and see everything, then narrow in and focus on what I want to do. And this has been one of those major paths that I had to get myself to look at, and it hasn't been disappointing."

In addition to the research skills and knowledge, he also believes the summer has changed him as a student…for the better.

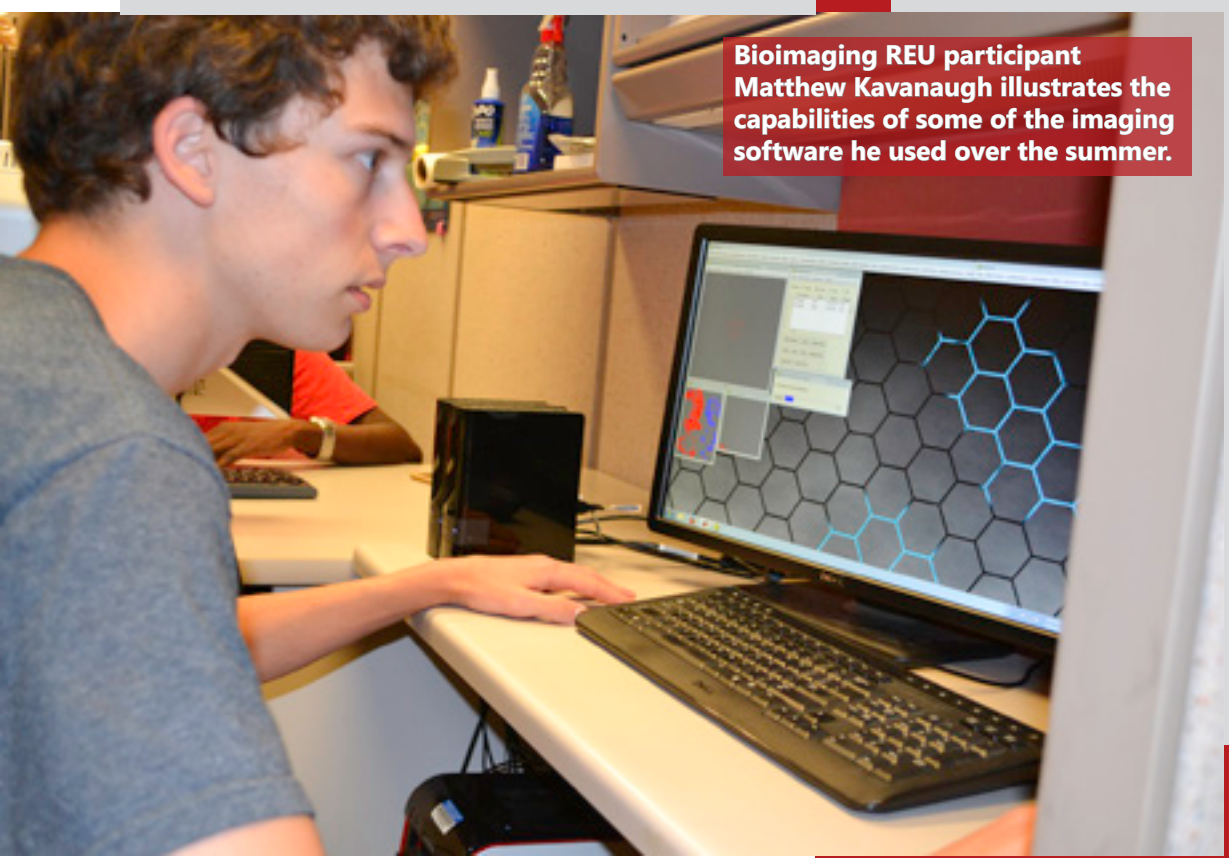
"I think it has definitely improved my discipline and work ethic," he says. "Which I wouldn't say was bad, but definitely not as strong as now. Because when you're working, you aren't doing it for a grade. I could make something to call my own. A lot of the culture I find in research isn't, 'Are you going to sleep? Are you getting three meals a day?' It's more, 'Are you getting it done. Can you stick with it? Is this what you want to do enough to make these other sacrifices to give more of yourself than you thought?'"



Matthew Kavanaugh poses by the statue of Arnold Beckman at the Beckman Institute for Advanced Science and Technology.

Kavanaugh says one challenge he encountered and grew from this summer was learning to use his time and resources effectively:

"With computer applications, there is a lot of loading time and letting it do work," he explains. "And if I were to take the easy route and say, 'Oh, my program is running; I have nothing to do. Time to sit back and relax for 30 minutes,' then it wouldn't be remotely this close to a complete work. And so while this is running, to work on this, and have multiple things on the stove, it makes my time as effective as possible. And this is definitely a big challenge. Its applicable everywhere. The sooner you learn it, the better."



Bioimaging REU participant Matthew Kavanaugh illustrates the capabilities of some of the imaging software he used over the summer.

UNDERGRADS IN BIOIMAGING REU EXPERIENCE WHAT RESEARCH, GRADUATE SCHOOL IS LIKE

July 29, 2016

Ten undergraduate students from around the country participated in the NSF-funded Bioimaging Research Experience for Undergraduates (REU). Working alongside researchers in *Illinois* labs, they discovered the exciting world of bioimaging research, got a taste of what graduate school is like, and some might have discovered what they want to do for the rest of their lives.

Matthew Kavanaugh

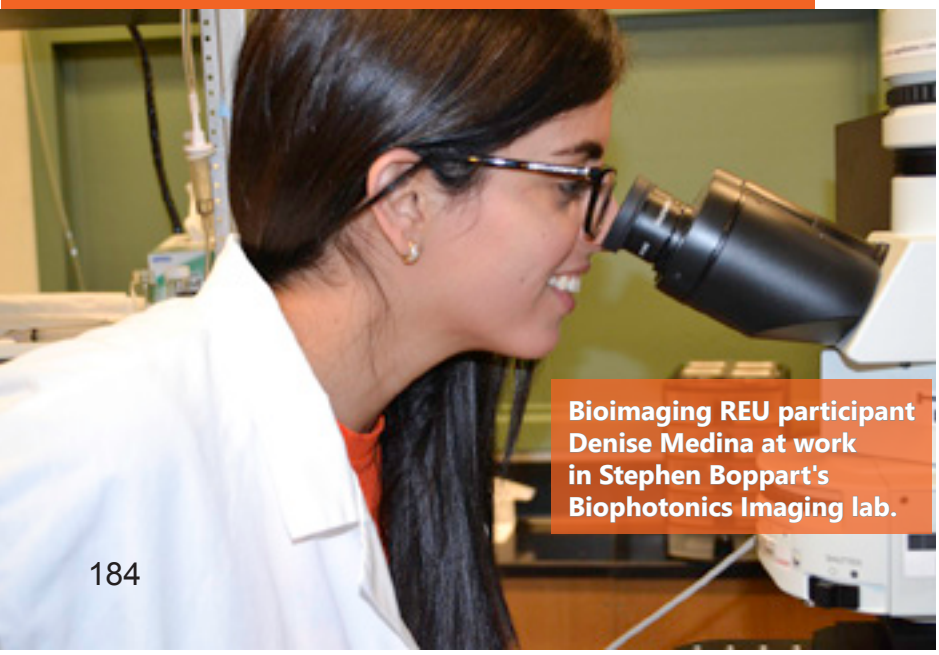
Take Matt Kavanaugh. The rising junior at the University of Kansas is majoring in Chemical Engineering with a concentration in Biomedical. While he has done research before in biomaterials at Kansas, he says it was very different from what he did here. Working in Bioengineering Professor Rohit Bhargava's lab, Kavanaugh spent his summer training computers to diagnose breast cancer based on certain qualities, such as tumor grade and prognosis.

Based on his experience this summer, Kavanaugh feels he might be interested in cancer research as a career: "I can guarantee you that any work I do is going to be of value to someone…cancer is getting up there as a cause of death."

A career in which he can make a difference is important to Kavanaugh: "I think that's the primary criteria of any path that I choose. I have to make a difference and find a personal value in doing so. That would be the most important thing to me."

Bioimaging REU participant Matthew Kavanaugh.

Kavanaugh believes that participating in this REU has had an impact on him in terms of whether graduate school and a career in research might be in his future. "It has definitely made grad school and a future in academia a very strong candidates." Although he's still exploring his options, the summer has had a major impact: "I really want to spread out and see everything, then narrow in and focus on what I want to do. And this has been one of those major paths that I had to get myself to look at, and it hasn't been disappointing."



Bioimaging REU participant Denise Medina at work in Stephen Boppart's Biophotonics Imaging lab.

Denise Medina

Another student making plans for graduate school and possibly even a career in research as a result of participating in the Bioimaging REU is Denise Medina, a rising junior majoring in Biomedical Engineering at Florida International University. Medina first

visited *Illinois* last fall for the MERGE (Multicultural Engineering Recruitment for Graduate Education) program. And because she's involved in research at her school, when she received an email about the Bioimaging REU, she decided she "wanted to go see different labs and different kinds of experiments. That's why I applied. It was worth it."

Working in Stephen Boppart's Biophotonics Imaging Lab over the summer, Medina helped to develop an algorithm on the interconnection between neurons in a network. "We have different types of neurons, so we want to know the strength and connections between them," she explains. "We apply light to the neurons, and we record video, and then we analyze. We can make a relationship and a correlation coefficient between each neuron depending on the intensity of the light."

Medina says she learned a lot about computer algorithm development over the summer. "I had a very basic idea of how to control a program," she says. "I've definitely learned a lot more. I don't feel like I know everything, but I learned a lot."

One source of support for Medina was her grad student mentor, Javier Suárez. "Javier, he's helped me a lot. He taught me a lot. Every time I have a question about my code, he helps me understand and write it. Something that takes me like a day to write; he can help me write it in an hour." She also had a chance to interact with her PI, Professor Stephen Boppart, whom she calls "a very smart and intelligent man."

What other skills has she gained over the summer in addition to those she acquired doing neuron research? For one, Medina says she improved her communication skills—especially regarding how to give presentations that non-scientists could understand. "So people who don't have an understanding in science can understand what I'm doing and saying. It helped me with that. It helped me with communication, with writing."

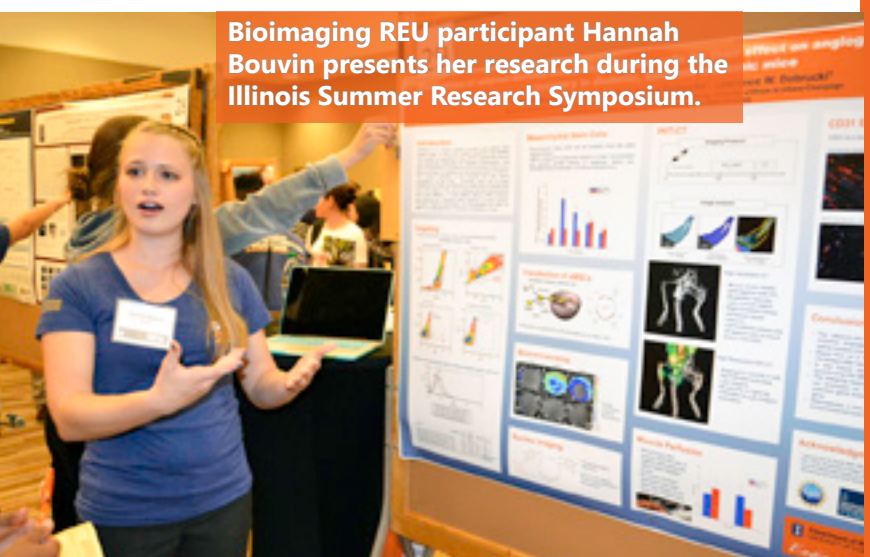
Left to right: Ph.D. student Javier Suárez and Bioimaging REU participant Denise Medina in Stephen Boppart's Biophotonics Imaging lab.

The summer also helped her figure out what she wants to do in grad school. "Now I'm thinking more about doing neuroscience," she admits.

Does Medina think she'll end up in research?

Oh, yeah, I think so," she acknowledges. "Yeah. I like doing research." Because she doesn't really like to teach, she's thinking about industry, although she thinks that maybe after being a TA in grad school, she might like teaching more. "But now, not right now," she admits.

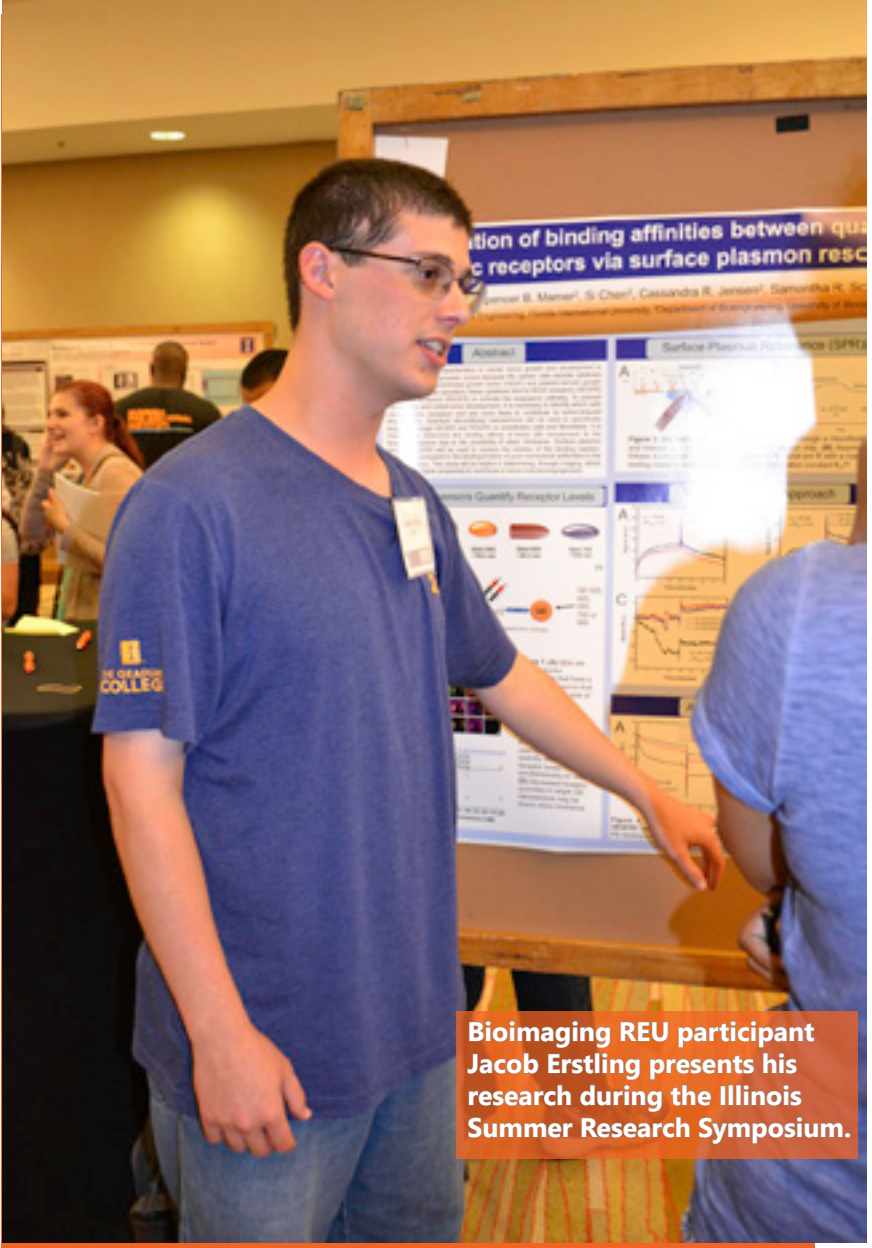
Medina reports that participating in the REU has definitely impacted whether or not she will go to grad school: "I'm really thinking about coming here for grad school now," she admits. "The research here is very good."



Bioimaging REU participant Hannah Bouvin presents her research during the Illinois Summer Research Symposium.

Hannah Bouvin

Like Medina, Hannah Bouvin, also wanted to experience a different kind of research. A junior in Chemical Engineering at Iowa State, Bouvin does biomedical research at her home institution. "I'm interested in research," she says, "and I wanted to know what research was like in a different university." Regarding the summer's impact, she



Bioimaging REU participant Jacob Erstling presents his research during the Illinois Summer Research Symposium.

explains, “I didn’t know anything about bio imaging. I did a lot of different imaging, and learned a bunch of new skills.” She also gained another skill: “I was actually able to do surgeries on mice, which was really exciting!”

Jacob Erstling

A rising senior at Florida International, Jacob Erstling is majoring in Environmental Engineering. His career goal is to go on and get a PhD, become a professor, and “do all that fun stuff.”

Erstling’s research was with quantum dots. “We determined that smaller quantum dot nano sensors were the best option for binding to receptors on cells so that we know which cells can cause tumors,” he explains.

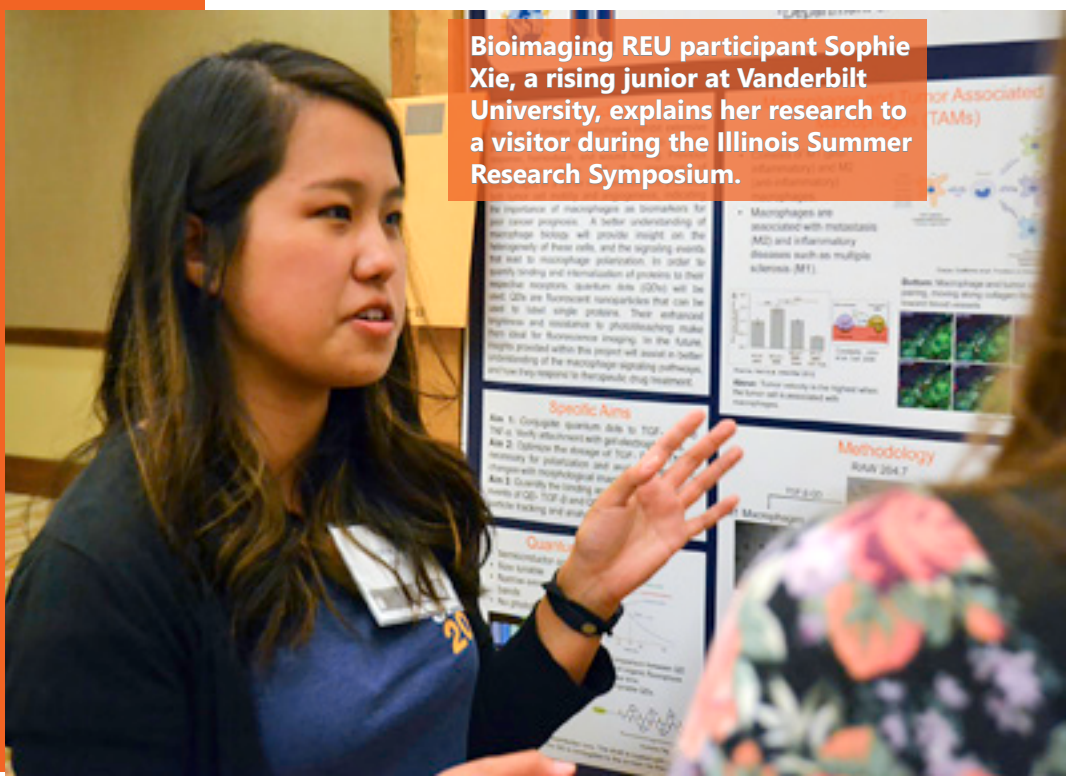
Erstling definitely thinks he’ll end up in research. This summer was not his first research experience. But because the REU he participated in last summer wasn’t about imaging, he says that this summer, he “learned about a whole bunch of new techniques, especially bio imaging…and I learned a lot more about quantum dots as well,” he reports.

Sophie Xie

Sophie Xie is a rising junior at Vanderbilt University where she is majoring in Biomedical Engineering. She participated in the Bioimaging REU because it gave her an opportunity to work full time on a research project. “I work at a lab back at school, but there I have to balance classwork as well as an entire project. This gave me the opportunity to see a project from the beginning to the end. And it’s nice to feel like a grad student over the summer and see the progression of the project, rather than just going to the lab a couple hours a week like at Vanderbilt.”

Xie learned a lot of new lab skills over the summer: how to analyze data and how to approach problems. “There were a lot of road blocks in my project that I had to overcome and try new things. It was interesting to be in that situation to change and communicate with my lab members to figure out what was wrong.”

Xie believes a career in research is definitely a possibility. “I still have two more years, so I will be looking at some industry opportunities as well, but this is definitely a possibility.”



Bioimaging REU participant Sophie Xie, a rising junior at Vanderbilt University, explains her research to a visitor during the Illinois Summer Research Symposium.

She reports that the experience definitely gave her a feel of what grad school is like: “There were some days when I was in the lab till 10 PM. So I think that is a good indication,” she explains.

Wendy Reyes

When rising junior Wendy Reyes spent the summer doing research in Professor Michael Insana’s Ultrasonic Imaging Lab as part of the 2016 Bioimaging REU, she learned a lot. She learned some research skills: how to train software to recognize cancer in the images of breast tissue. She learned some life skills: how to become more organized, to be proactive and not procrastinate, and to overcome her timidity and be bold in seeking assistance. She also learned some things that might be related to her future career: how to apply to grad school, and that she likes research and might want a career in it.

Along with the many skills Reyes learned while participating in the Bioimaging REU this summer, she also learned that she enjoys research.

“At first, I came here to just learn. But now, towards the end, I don’t know what I would do besides research. I like coming up with my own problem and thinking about how to solve it. That aspect I really like about it. If I pursued a PhD, I would also like to teach and help other students find passion in research. I didn’t know a lot about what goes into creating a research project, but now I have a better understanding of it. I want to go into research. I like it, and I think it’s worth it.”

Bioimaging REU participant Wendy Reyes at work in Insana’s Ultrasonic Imaging Lab in Beckman.

WENDY REYES LEARNS LIFE SKILLS—AND TO LIKE RESEARCH—IN BIOIMAGING REU

Left to right: *Illinois* Ph.D. student Cameron Hoerig and his mentee for the summer, Bioimaging REU participan Wendy Reyes.

July 29, 2016

When rising junior Wendy Reyes spent the summer doing research in Professor Michael Insana's Ultrasonic Imaging Lab as part of the 2016 Bioimaging REU, she learned a lot. She learned some research skills: how to train software to recognize cancer in the images of breast tissue. She learned some life skills: how to become more organized, to be proactive and not procrastinate, and to overcome her timidity and be bold in seeking assistance. She also learned some things that might be related to her future career: how to apply to grad school, and that she likes research and might want a career in it.

Wendy Reyes, a rising junior majoring in Biomedical Engineering at Catholic University of America in Washington, DC., spent the summer learning about computational mechanics and ultrasound image processing in Michael Insana's Ultrasonic Imaging Lab. Her project was a machine learning technique that trains artificial neuro networks to learn about properties and distribution of soft tissues. According to her graduate student mentor, Cameron Hoerig, they're not focusing on building a machine, but training software to recognize cancer in images of breast tissue.

Although Reyes did a small research project in high school, she says this was her first research experience in college. One skill she gained here was learning to become organized and proactive about learning; there were "a lot of self-learnings and reading papers," says Reyes. "I didn't know anything about neural networks, so a lot of these things were new to me, and I'm still learning more. I feel a lot more confident than I did at the beginning. I felt overwhelmed at the beginning."

Another skill she learned? How to be bold when asking questions: "So at first, everyone is new to me," she acknowledges, "I didn't know how to approach them, but I learned to do that."

While Reyes says she enjoyed learning about this field, is it something she might want to pursue? "Yes!" she acknowledges "I actually like seeing how things [work]. Before you go to the doctor and you get a 3D imaging done, and you think it's really cool, but you don't know how much work was put into it or the process behind it. So I kind of like knowing that, and I want to use what I learned here for the future. But I do like bioimaging."

Participating in the REU also helped Reyes decide to go into research. "At first, I came here to just learn. But now, towards the end, I don't know what I would do besides research. I like coming up with my own problem and thinking about how to solve it. That aspect I really like about it. If I pursued a PhD, I would also like to teach and help other students find passion in research. I didn't know a lot about what goes into creating a research project, but now I have a better understanding of it. I want to go into research. I like it, and I think it's worth it."

Via the REU and SROP training sessions, Reyes also learned a lot about grad school, for instance, "the application process or what they were looking for," she explains.

Reyes continues, "I learned a lot about it, learned how to show your best. I also met a lot of people going through the same thing. And also they brought in a lot of professors, and seeing how passionate they were about their work helped me decide."

While Cameron Hoerig, Reye's grad student mentor, indicates that all undergrads he's mentored experience a learning curve because of a lack of programming experience, he says Reyes learned it quickly, and even got some results. "I was working on this for 6 months before I even understood what I was doing," he admits, "and she has 9 weeks to figure out what's going on, and make a contribution. But she has learned the necessary material, and definitely pulled out results."

Reyes was able to "help ants learn material properties like stiff and soft. And right now, I'm working to see if they can learn to detect the inclusion without knowing the data."

While mentoring an REU student makes additional work for grad student mentors at the offset, according to Hoerig, there are definitely benefits to having an undergraduate REU student in the lab.

"So a lot of the research is not fun stuff," Hoerig admits. "Basically just clicking buttons and seeing what happens. So it's definitely difficult to train them on how to use so many programs at once. But as far as the summer students go, they can do something to move the project forward. Not the fun part of it, but it definitely moves the project forward. And the results they produce are important. The more difficult part is to explain what the big picture is. I'm not sure how much progress she thinks she made on the project, but she made a tremendous progress on moving it forward. From four months ago to what she has done in the last eight weeks is far more than what I had done before, just because someone else is out there to process the data. And it's just on me to figure out why what happened."

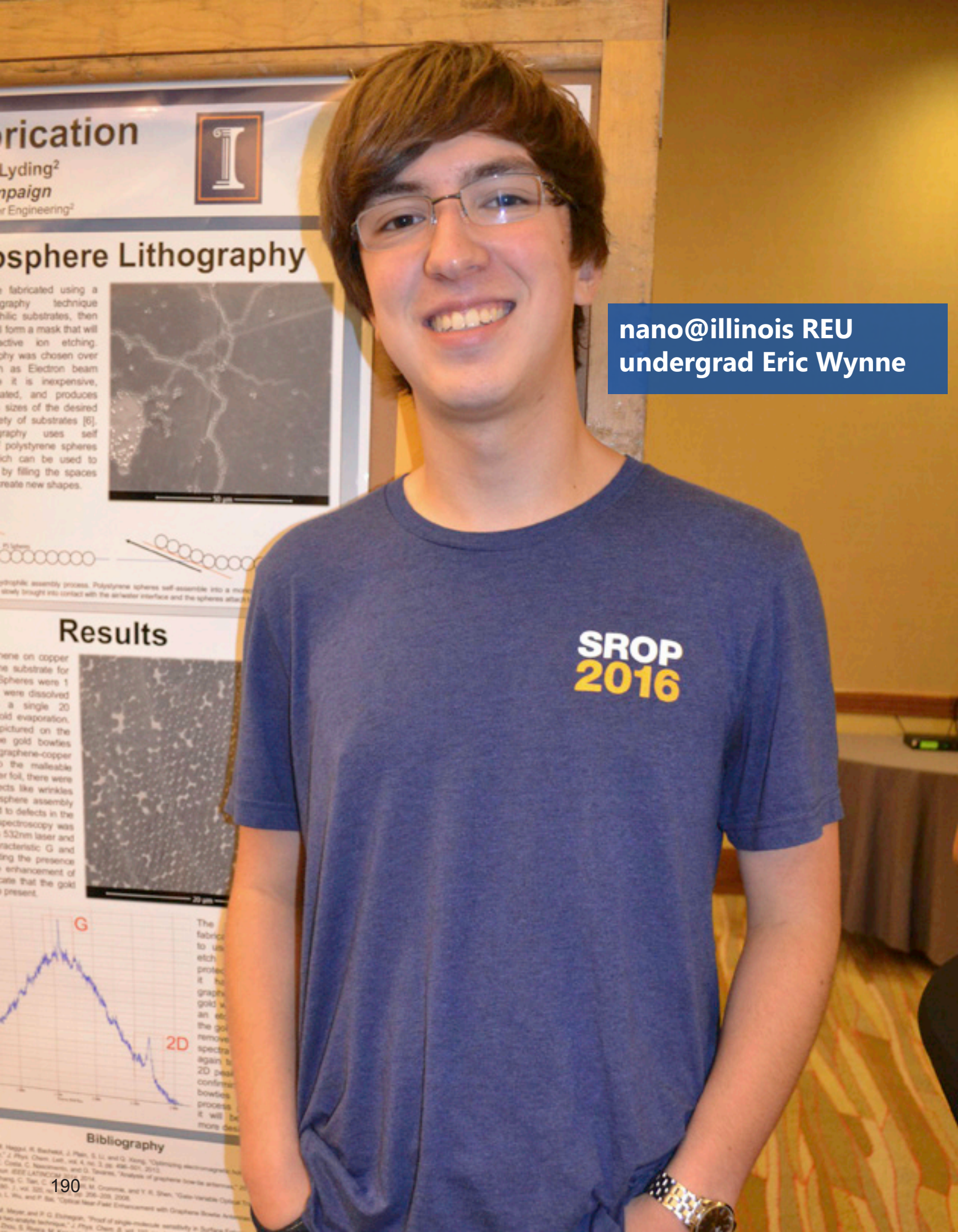
Reyes says she also learned some skills that will be of benefit to her as a student. "I have learned to do things earlier. That has changed my perspective on how I will do things at school. So do things little by little and start work early."

She's also gotten over her fear of approaching professors: "Another thing that has changed is

Illinois Ph.D. student Cameron Hoerig (left) and Bioimaging REU participant Wendy Reyes at work in Insana's Ultrasonic Imaging Lab in Beckman.

learning how to reach out," she admits. "PI's, they are extremely busy. It was a little scary at first, but then I learned how to get in contact with them and email them."

As far as the REU program goes, Hoerig thinks it's a really good experience. "Not many people know what research is like. It's not just doing research and publishing papers all the time, the papers don't show how much incremental work went into the project. And it can be discouraging to people, because it can be worrisome at times, but I think it all pays off at the end. It all makes sense at the end, as the results tie everything together. The REU program shows how it works and how much work goes into it. Especially making the transition from undergrad to grad student, there a lot of self-learning, and you can't just do a google search and find all your answers. And hopefully she found that she likes doing it."



nano@illinois REU undergrad Eric Wynne

UNDERGRADS CONSIDER NANOTECHNOLOGY CAREERS THANKS TO NANO@ILLINOIS REU

August 10, 2016

During the summer of 2016, ten undergraduate students learned about nanotechnology as part of the NSF-funded nano@illinois Research Experience for Undergraduates (REU). While spending the summer performing research in the labs of some of Illinois' premier researchers, the students not only learned a lot about the area in nanotechnology that they were studying; they learned what grad school is like and got some pointers on how to apply. Finally, many of them discovered that they liked research…a lot. In fact, some even decided that the area they researched over the summer was the area they wanted to concentrate on in the future.

Eric Wynne

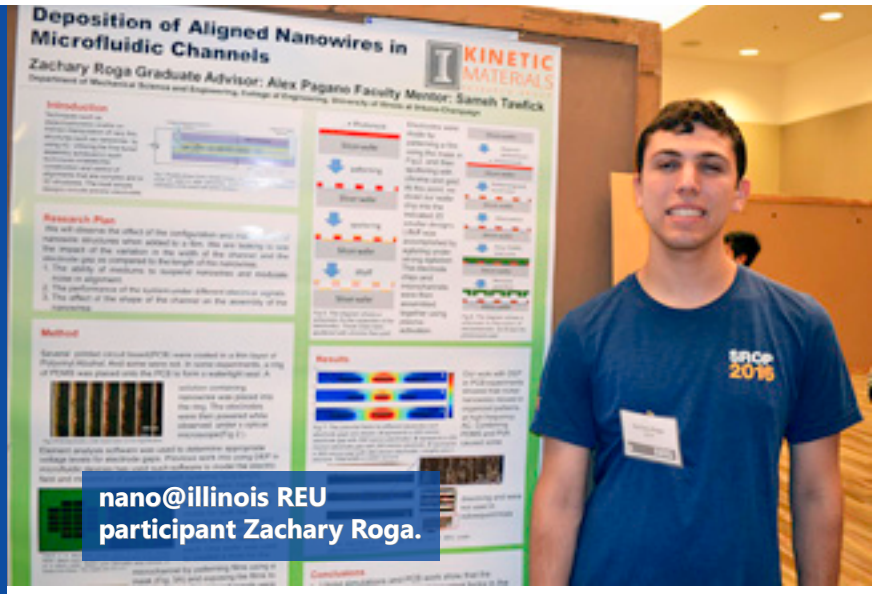
In fact, Eric Wynne, a rising sophomore in Engineering Physics here at Illinois, intends to address the topic he researched sooner, rather than later.

Wynne participated in the nano@illinois REU because he wanted to be in on some ground-breaking research about a nano-material that's been in the news— graphene:

> **"Graphene is a nano material that has gotten a lot of publicity recently; it has a lot of interesting qualities that people have been looking at," says Wynne. "So I was sort of attracted to that because I thought it would be really interesting to work with that, and help discover all the sorts of new things that it can do."**

Did Wynne gain any new skills as a result of spending his summer researching graphene?

"Most definitely," he acknowledges. "Prior to the summer, I hadn't actually worked in a laboratory, so it was really nice to actually be doing things in a lab and designing processes that people have never done before. It's really cool to look at something that nobody else has looked at. I definitely think I've gained a lot of skills."



nano@illinois REU participant Zachary Roga.

In addition to gaining skills, Wynne believes his experience influenced his choice of careers as well.

"I had an interest in nanomaterials before this," he admits, "but I certainly didn't understand the depth of the field, and how many different aspects there were to it. So I definitely think it has made me consider this field a lot more and piqued my interest in it."

In fact, his experience piqued his interest so much that he admits, "I'm actually going to be continuing my research on this topic during the school year. In the same lab. Professor Joseph Lyding's lab."

Zachary Roga

Like Wynne, Zachary Roga believes his experience this summer in Sameh Tawfick's lab will also have a major impact on his career path.

> **"I think this definitely did help me steer more into the nanotech industry," admits Roga. "And I think it could push me further down an academic path."**

A rising junior studying Biological Engineering at Cornell University, Roga says he's been interested in nanotechnology and worked with micrologic devices in the past, so when he had an opportunity to work in a similar area here, he was "pretty excited to take the opportunity and learn more about the process."

Some of the new skills he learned over the summer include microfabrication and photolithography

techniques, silonization, and how to use a mask to expose photoresist.

“I don’t know if this program was a perfect representation of what grad school is like," he explains, "but I definitely understand the research environment better than I have.”

Fatou Cisse

Like Wynne and Roga, Fatou Cisse, a rising sophomore majoring in chemical engineering at the University of Buffalo, also got involved in the nano@illinois REU because of a prior interest in nanotechnology: “I came here because I was interested in nanomaterials and I wanted to learn more about it. I also wanted to learn more about the University of Illinois.”

Although this summer doing research in Arend van der Zande’s lab was her first research experience, she was pretty much convinced that graduate school and research are in her future. Regarding research, she says, “I think it’s great. And I think it’s very useful. And because of that I will consider going to grad school. And I for sure want to go into research.”

Will her research be in nanotechnology? “For right now, Yes,” she says. “Unless I find something else that I find very interesting.”

Regarding any new skills she learned this summer, Cisse indicates that, “Everything I did this summer was new. I learned everything from scratch. Like I learned growing material from scratch. And I learned their applications.”

Boris Djiguemede

Another REU participant who found out what what grad school is like through his research experience was Boris Djiguemede, a junior in bioengineering at the University of Maryland.

“We had a lot of programs that were designed to walk us through the process of going to grad school...” he explains, “the application process and everything. I’m definitely more aware of what I will be doing if I do go to grad school.”

nano@illinois REU participant Fatou Cisse presenting her poster at the Illinois Summer Research Symposium.

Djiguemede recalls his reaction when he first heard about the nano@illlinois REU. “I thought it was tempting, and it looked very cool, so I applied to it.” And the REU lived up to the hype: “It has been very cool so far,” he reports.

Djiguemede has done research before, but “not in an intensive way,” he says. Despite his previous experience in research, he says he definitely gained a lot of new skills in Rohit Bhargava’s lab: “I learned more about a new technique,” he explains, “a new imaging tool that not many people know about, and I was also able to polish my skills on computer design programs and softwares. Yes, I definitely enjoyed the experience.”

Regarding his career aspirations, Djiguemede reports that he’d like to become a doctor/researcher. All along, he’s wanted to go to med school: “But I don’t want to take everything I learn and just become a doctor and look at patients all day,” he admits. “I’ve always wanted to do something with whatever I’m learning right now. I’m still thinking about being a doctor, but I definitely want to do some kind of research that will make me a better doctor.”

Daniel Jacques

Another student who will most likely go into research as a result of his experience this summer is Daniel Jacques, a rising sophomore studying medical engineering at the University of Maryland.

Jacques reports that the nano@illinois REU was his first research experience. What did he think of it? “It’s a lot of work,” he admits, “and it’s really you doing your own thing. You make your own speculation and then you do as many things as possible, as fast as possible. That’s what I’ve learned so far."

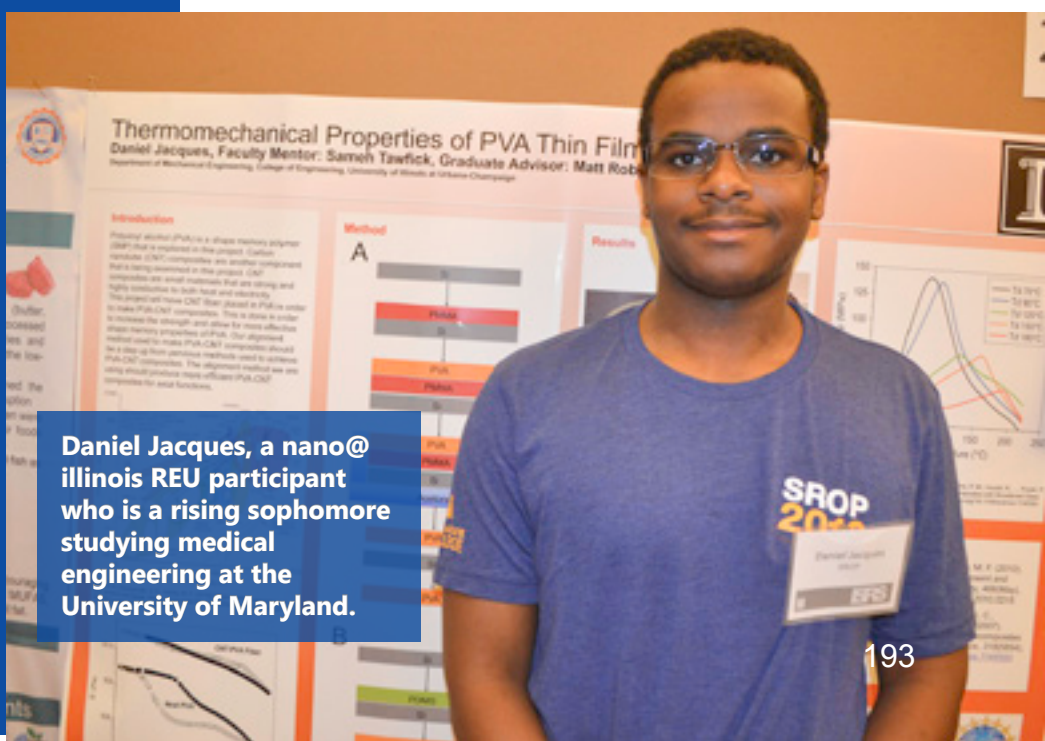
His research this summer in Sameh Tawfick’s lab involved working with carbon nanotubes for shape memory effects. “Shape memory is when I can take a polymer and heat it up to a certain temperature and deform it,” he explains. “Once it cools down, you can change it to whatever you want, and when you heat it back up…" He goes on to explain that it reverts back to the original shape you created, similar to memory metals.

Jacques says he learned a lot more chemistry terms this summer. “I’m a mechanical engineer, so chemistry isn’t my strongest. I took a couple of general chemistry classes so I was able to apply some of my knowledge, but now I’m learning a lot more stuff. Such as stress strain, the thermodynamic properties of stuff. These are all things I will learn later on in my academic career, so I’m just kind of getting a head start on those classes.”

Jacques says there’s a pretty good chance that he’ll go into research. “Especially because my program at my school, they really want people to go out and do an internship over the summer or take classes,” he explains. “And I got this internship. And they really want you to do this; they want people to build their network, their experience, and their knowledge; they really want people to get into graduate school; my program is all about getting people into graduate school.”

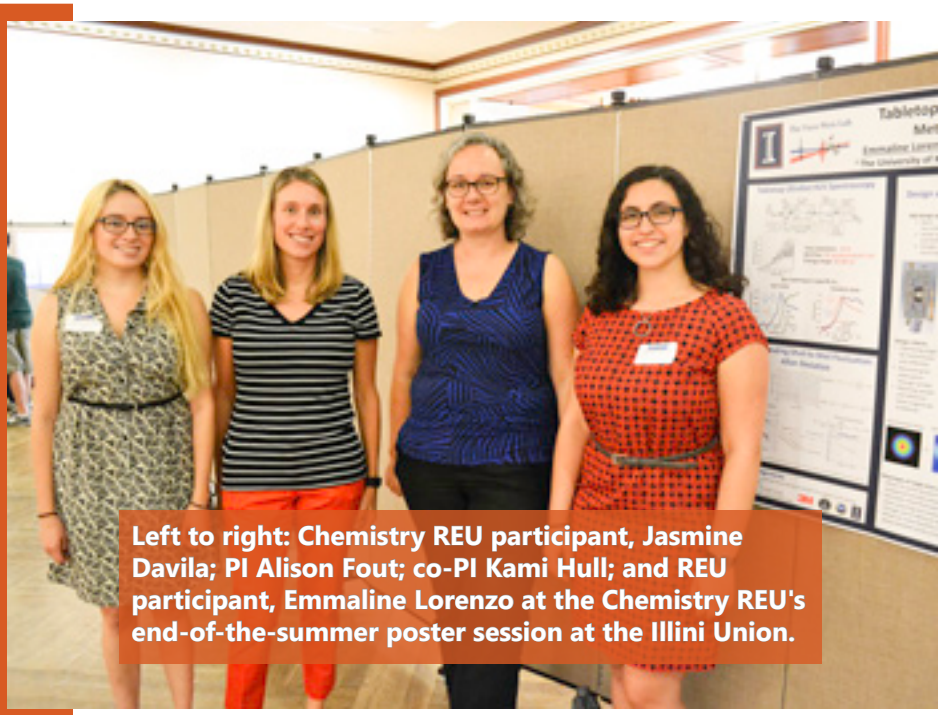
Jacques acquired some new skills this past summer that he says will help him as a student: making PowerPoint presentations in a different sort of way, making a personal statement, and making a CV. “I feel like I can carry that on to my school and other internship positions. And jobs,” he adds.

The PIs of the nano@illinois REU, Catherine Murphy and Umberto Ravaioli, stated in their proposal to the National Science Foundation that the ultimate goal of their REU is "to solidify the students' interest in graduate research and education and contribute to the diversity of the national workforce pipeline..." Based on the number of participants who indicated that they intend to continue on to graduate school in nanotechnology, the project appears to be achieving its goal.



Daniel Jacques, a nano@illinois REU participant who is a rising sophomore studying medical engineering at the University of Maryland.

2016 CHEMISTRY REU OFFERS UNDERGRADUATE STUDENTS A GLIMPSE OF GRAD LIFE



Left to right: Chemistry REU participant, Jasmine Davila; PI Alison Fout; co-PI Kami Hull; and REU participant, Emmaline Lorenzo at the Chemistry REU's end-of-the-summer poster session at the Illini Union.

August 16, 2016

This summer at *Illinois*, five undergraduate students were chosen to be a part of the Chemistry REU (Research Experience for Undergraduates) program to get a glimpse of what research in graduate school looks like. Allison Fout, the PI for this REU, which currently is solely funded by 3M, said that out of 270 applicants, only five were chosen. According to Fout, applicants were selected based upon the following criteria: “Their grades, their letters of recommendation, their experience. (You could really gain experience by coming here)" she adds. Plus, she indicates that the final criteria was: "students that were interested in pursuing chemistry in the future. All of those things were part of what we were looking at.”

In addition, they were looking for underrepresented students. "With 3M, they would like us to target underrepresented minorities" she explains. "That's part of the funding."

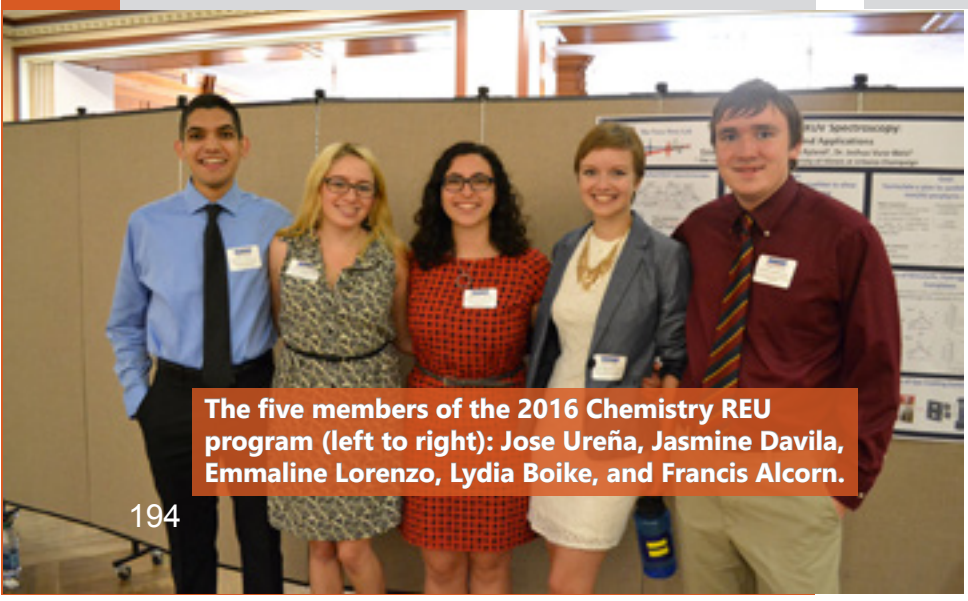
According to Fout, having an REU student in one's lab is beneficial to researchers in a number of ways. For one, the REUs bring a fresh enthusiam:

“Usually they are excited about being there and doing science," Fout explains. "So they bring a vibrant energy (that your lab has), but a new face bringing it and getting excited about the little things."

Fout says it's also a great way to recruit good students for graduate school. "The REU students, when they like it, and like their research, we recruit them for grad school, and we know we are getting a phenomenal student here for grad school."

In addition, Fout says it also lets more people know about the research going on in Chemistry at *Illinois*.

"We’re training them, so when they go back, they talk about their experience. When they go to conferences, they talk about their experiences. So science is getting out to a larger number of people.”

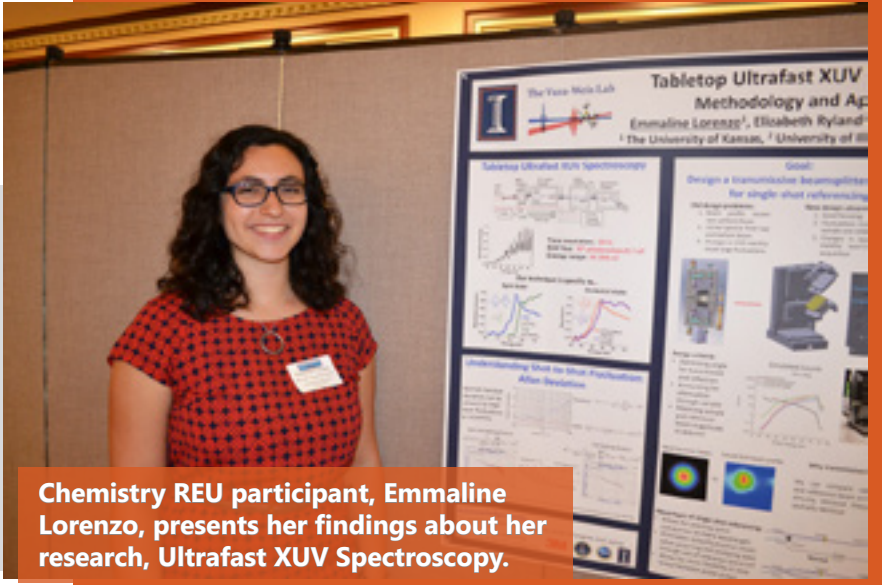


The five members of the 2016 Chemistry REU program (left to right): Jose Ureña, Jasmine Davila, Emmaline Lorenzo, Lydia Boike, and Francis Alcorn.

While the lab and science community benefit from REU students, these students also got a lot out of their experience too. Fout says, “My biggest thing for them to take out is that they experienced scientific research, and they know that if they go to grad school, they know what they’re going to do. And so if you go around and talk to them, I heard 'Grad school,' 'Grad school,' 'Grad school,' and then, 'No, med school!' Now they know what this is about. Earlier they were on the fence; now they know.”

Emmaline Lorenzo

One undergrad who has definitely decided on graduate school is Emmaline Lorenzo, a rising junior at the University of Kansas, who says that this experience, "Confirmed for me that I do want to go to grad school." She indicates that she "got a really good look at what it's like to be in grad school."



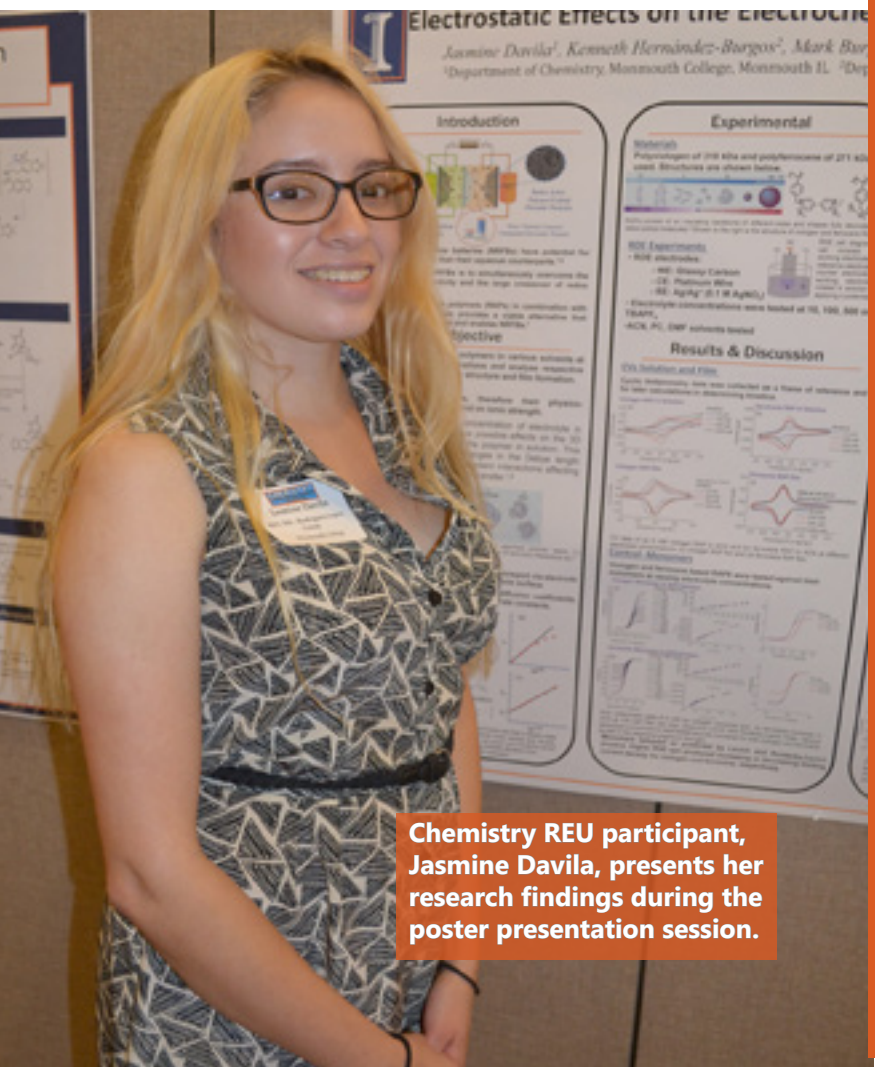
Chemistry REU participant, Emmaline Lorenzo, presents her findings about her research, Ultrafast XUV Spectroscopy.

Lorenzo says she participated in the Chemistry REU in order to learn something new: "I work in a similar group back home," she explains, "but this was an opportunity to go somewhere new and pick up new techniques.

Lorenzo definitely learned some new techniques: "The spectroscopy is a lot different because with extreme ultraviolet, everything has to be under a vacuum. That complication adds another dimension to it."

Finally, deciding on grad school and learning about new spectroscopy techniques weren't the only benefits for Lorenzo.

"I've gained a lot of lab and technical skills," she admits. "I didn't realize in physical chemistry how important design, coding, and computer skills are, so I picked up a lot of that.



Chemistry REU participant, Jasmine Davila, presents her research findings during the poster presentation session.

Jasmine Davila

Lorenzo wasn't the only student to pick up additional skills from the REU, Jasmine Davila, a rising senior at Monmouth College in Illinois, acknowledged that she picked up some practical, personal skills.

"As a student I think I learned a lot about time management. Just because different experiments took a different amount of time, and I wanted to plan it out so I didn't end up missing lunch or dinner. Also just analyzing the data takes a lot of time, on excel even. I got a lot of computer skills out of it and my PowerPoint skills are also sharper. We did group meeting presentations every Friday. My presentation skills are better. I also know how to make a poster."

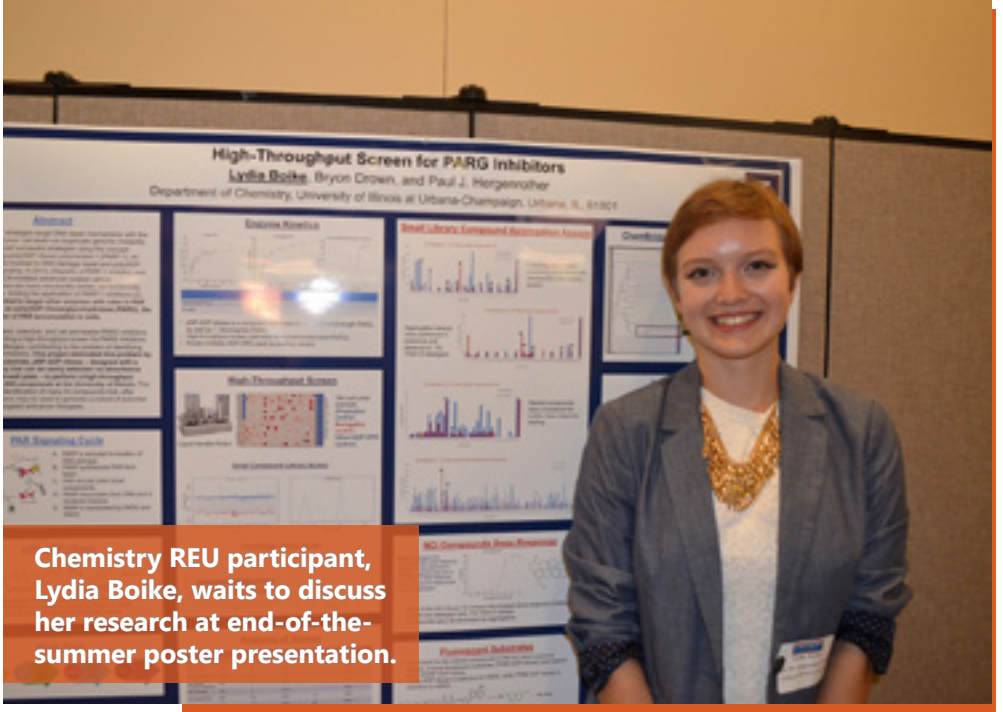
Davila described her research: "It was electrochemically characterizing redox reactive polymers using RDE… We got some pretty good results. A lot of data. Things that are publishable." This REU experience also helped Davila with her plan for the future and admitted "When I came in here over the summer, I wasn't sure if I wanted to do grad school or med school, or MD-PhD, but now I'm definitely thinking med school, but I will apply to some MD-PhD programs."

Lydia Boike

Another student who similarly researched in a medically-based field was rising junior Lydia Boike, who attends the College of William and Mary in Virginia. This summer she was working on an enzyme that could help cure cancer. When asked to describe this enzyme, Boike explains:

"The enzyme I worked with over the summer is called PARGUE. It's a DNA repair enzyme. So in cancer, often times, cancer cells have high rates of mutation and there are enzymes that repair those mutated cells normally, so it just makes sense that if you want to make a drug for cancer that maybe you would want to target an enzyme that repairs damage because if you can get rid of that enzyme then you have a cancer cell that has lots and lots of enzymes, and then the tumor cells will die and that's exactly what you want. Your normal cells don't have such high rates of mutation and isn't necessarily terrible if you are taking a medicine that inhibits this enzyme, but it's bad for your cancer cells that you can't repair all the mutations and then they will die."

In regards to the results of the research, Boike says that "Right now we are at the stage where we are doing this response for our hit compounds, and right now we can't confidently say that we have the compound that is THE compound, but I'm very hopeful that eventually this project will."



Chemistry REU participant, Lydia Boike, waits to discuss her research at end-of-the-summer poster presentation.

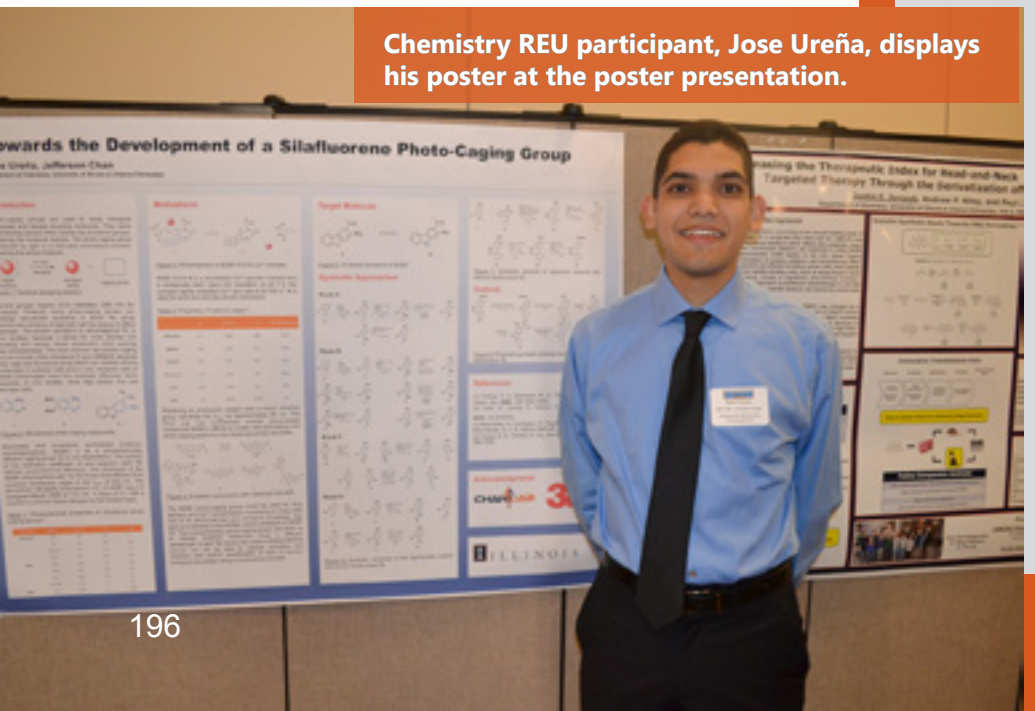
Jose Ureña

Not only did the Chemistry REU offer a glimpse of what research in graduate school would be like, it gave the undergraduate students a glimpse of what it would be like at a highly ranked school such as the University of Illinois. Rising senior Jose Ureña of Millers University in Pennsylvania came to this REU because of this reason.

"The University of Illinois is a top ten school in organic chemistry," he stated, "so I thought I would learn a lot and network and meet a lot of new people."

The REU lived up to his expectations and in response to what he gained from this REU as a student he described:

"I got a really good insight into a top ten grad school. Just the learning environment overall, and then interacting with the PI's, whether they're associate professors or tenured professors. The amount of work you will be doing is just very different than the expectations. I also got the opportunity to network and work on a project all summer that culminates in a presentation. That's very rewarding."



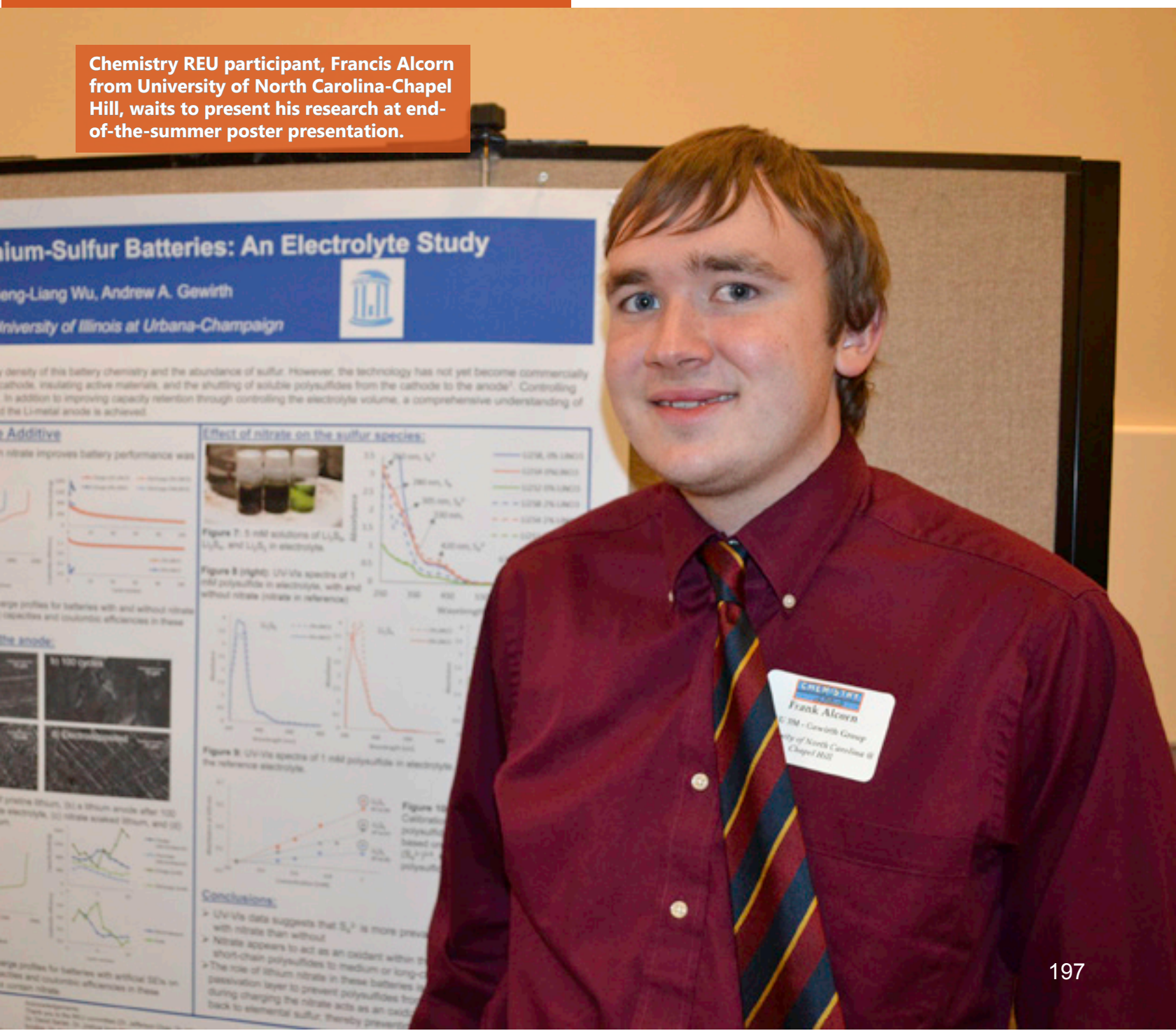
Chemistry REU participant, Jose Ureña, displays his poster at the poster presentation.

Francis Alcorn

Francis Alcorn from University of North Carolina-Chapel Hill also came into the REU with hopes of new experiences. He says he came to the REU this summer "To experience something new, learn some chemistry. Coming in, I didn't know much about electrochemistry, but here I've learned a lot. I don't think it's something I will likely pursue, but maybe I will apply it to other fields of chemistry."

Alcorn describes his research this summer as "Working on lithium silver batteries… It is a promising battery chemistry due to its theoretical capacity which is ten times higher than lithium ion batteries." While Alcorn does not believe he's going to continue down the path of electrochemistry, he is now "hoping to use that knowledge [about electrochemistry] and apply it to other projects."

Because all five Chemistry REU students seemed to have had significant exposure to scientific research and have taken another step toward deciding what they want to do in the future in regards to education, it appears that the Chemistry REU achieved its goal for the program.



Chemistry REU participant, Francis Alcorn from University of North Carolina-Chapel Hill, waits to present his research at end-of-the-summer poster presentation.

POETS REU HELPS ILLINOIS UNDERGRAD SABRINA YIN CHOOSE HER CAREER PATH

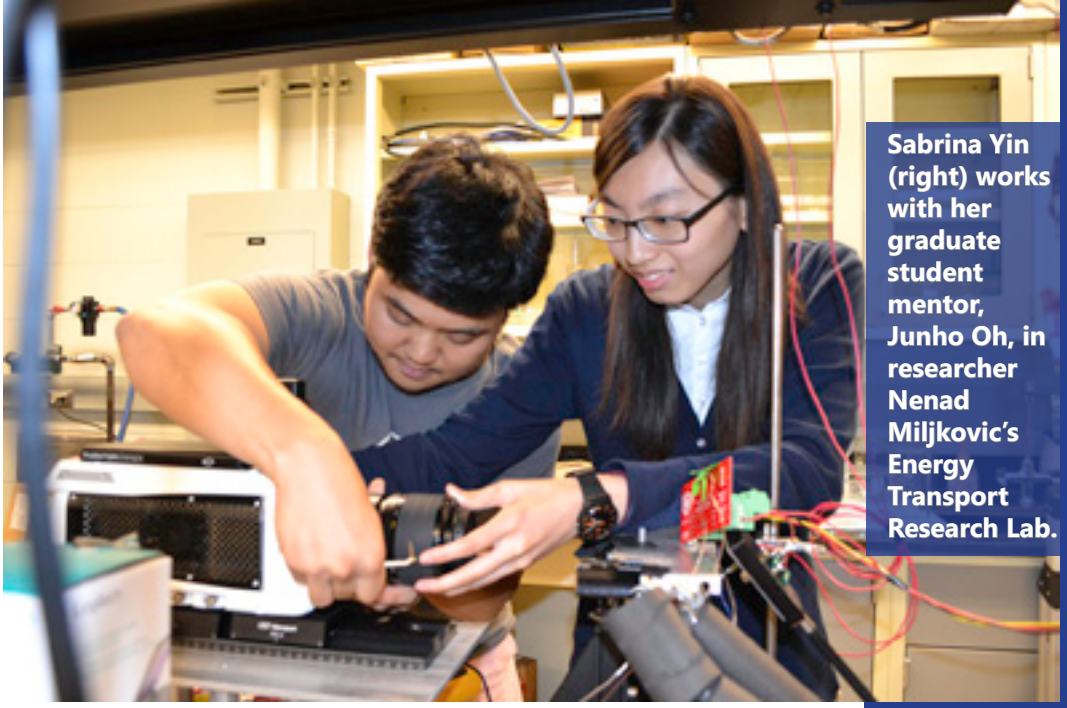
August 22, 2016

Most REU (Research Experience for Undergraduates) participants have an opportunity to conduct research for 8–10 weeks during the summer. Their experience then culminates in a poster session—the highlight of the summer—which gives the undergrad the chance to hone his or her skills while creating a research poster and reporting results. However, POETS REU participant Sabrina Yin, a rising junior majoring in Mechanical Engineering at *Illinois*, is doing more than just a couple of months worth of research in the summer. Yin began working in researcher Nenad Miljkovic's Energy Transport Research Lab in March, participated in the REU this summer, and will continue her research in the lab this fall and beyond. "This research project that I'm working on will run for another two years approximately. So I'll be staying in the lab to help out with the research," she explains.

"This research project that I'm working on will run for another two years approximately. So I'll be staying in the lab to help out with the research," she explains.

One goal of POETS (Power Optimization for Electro-Thermal Systems), an NSF-funded Engineering Research Center, is to contribute to undergraduate retention and to engage underrepresented students via a summer research experiences. However, POETS is also seeking to establish

Sabrina Yin and her mentor, Junho Oh, working in the Energy Transport Research Lab.



Sabrina Yin (right) works with her graduate student mentor, Junho Oh, in researcher Nenad Miljkovic's Energy Transport Research Lab.

a continuing REU program, which would involve campus undergrads in an ongoing, year-long REU experience—similar to Yin's experience in Miljkovic's lab.

Yin says that her research is about "how to utilize jumping droplets condensation on super hydrophobic surfaces to improve thermal cooling for gamma transistors and to achieve higher power density in power electronics." In layman's terms, she's working to provide a solution to keep her (and our) laptop from overheating.

Yin, who has not taken courses on fluid dynamics or heat transfer, says she's definitely learned a lot, and as a user of electronic devices, finds the research to be important.

Yin says, "I just found that application is something that I can relate to very easily. I have a connection with its application. I think it's important to have an effective thermal cooling system in any device that we use, otherwise it would be prone to premature failure. For example, you don't want a laptop that is heating up all the time. I definitely learned a lot."

However, Yin says she plans on taking a course in fluid dynamics next semester. "And since heat transfer is mostly based on fluid dynamics, I'll be taking a heat transfer course later on."

So has POETS changed the direction Yin wants to go with her career?

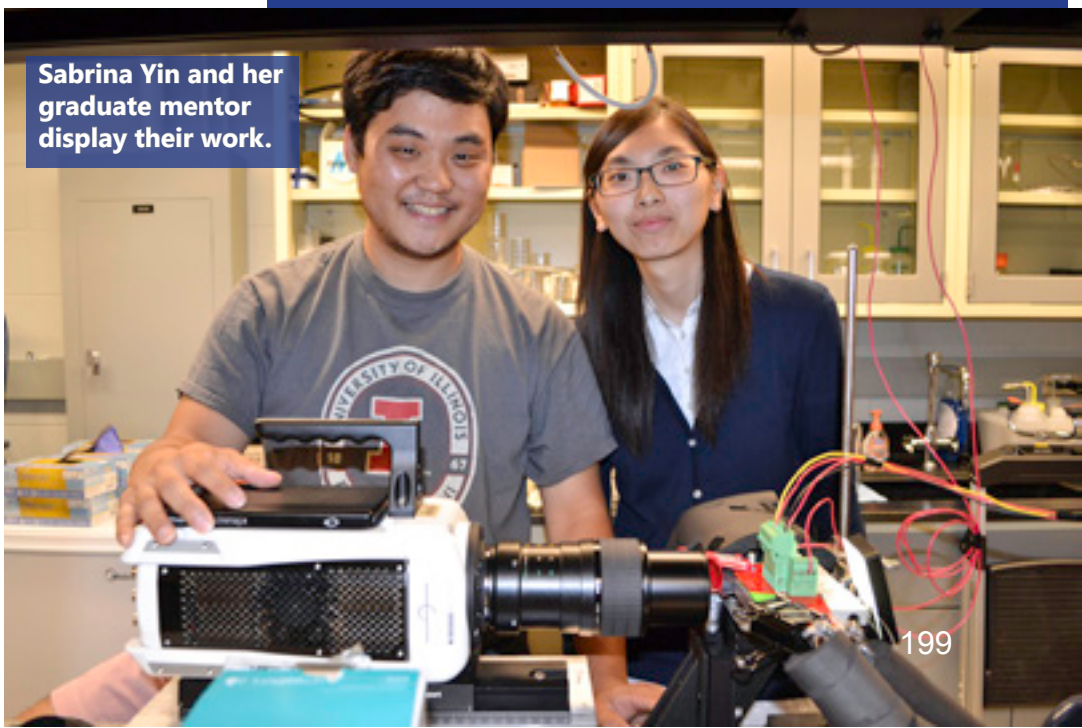
"Probably," she admits. "I think so. Right now, since I've only completed half the ME curriculum, I am still in the process of exploring the area I am interested in, and still looking into the concentration I want to go into for graduate school, so I do think that this research definitely helped me to think about where I should go in the future and career plans as well."

According to Yin, the research has helped her grow as a student, and to improve her problem-solving skills.

"I think the most important thing that fosters us as undergraduate researchers is that it challenged our critical thinking and definitely improves our problem solving skills," acknowledges Yin. "Because we are working along with graduate students to solve something or an issue that has not been solved before. The answer is unknown."

In addition to having her critical thinking and problem-solving skills enhanced, Yin says the experience also prepared her for graduate school.

"Working along with the research team to discover new knowledge, to find new knowledge, it's an unbelievable experience for us to not only get a taste of what graduate school is like, but also to explore the realms that we have not been before."



Sabrina Yin and her graduate mentor display their work.

Kelly Jolley at work in an MNTL lab.

NANO@ILLINOIS RET TEACHERS DISCOVER NANOTECHNOLOGY'S BIG IMPACT—HOPE THEIR STUDENTS WILL TOO

August 31, 2016

This summer, 11 teachers of varying grade levels and backgrounds participated in the nano@*illinois* Research Experience for Teachers (RET) funded by the National Science Foundation. While participating in research in a wide range of areas, these teachers' eyes were opened to the intricate world of nanotechnology and all the possibilities it offers. But while the research is important, that's not the program's only goal. It is expected that these teachers will then take all that they learned through their research on nanotechnology and, with support from staff and other teachers, translate it into lesson modules they can use with their students back home. It is hoped that as they are able to successfully teach their students what they've learned, they'll not only be exposing them to STEM, but some of its cutting-edge possibilities, like nanotechnology, that their students may never been exposed to before because of a variety of factors, including their socioeconomic background.

nano@illinois RET teachers Kala Oglesby (left) and Beth Koplinski at work in an *Illinois* lab (photo courtesy of Kala Oglesby).

During the research experience, which was held from June 13–July 22, 2016, the teachers were able to conduct research in a wide range of research areas, depending on what their interests were, including nanomaterials, systems integration, nano electronics and nano photonics, bio nanotechnology and nano medicine, physics, and chemistry. Then, the second part of the experience, was to take what they had learned and create instructional materials. One challenge teachers encountered was this: their research had been done in a cutting-edge lab using expensive nano machinery; they had to find a way to replicate something similar to that in an inexpensive way in the classroom.

nano@illinois RET teacher John Roach conducts research in the cleanroom (photo courtesy of John Roach).

And while the short-term goal of the RET was to expose these teachers to research, the hoped-for long-term impact was to expose students, especially underserved populations, to nanotechnology research, specifically, and to STEM in general.

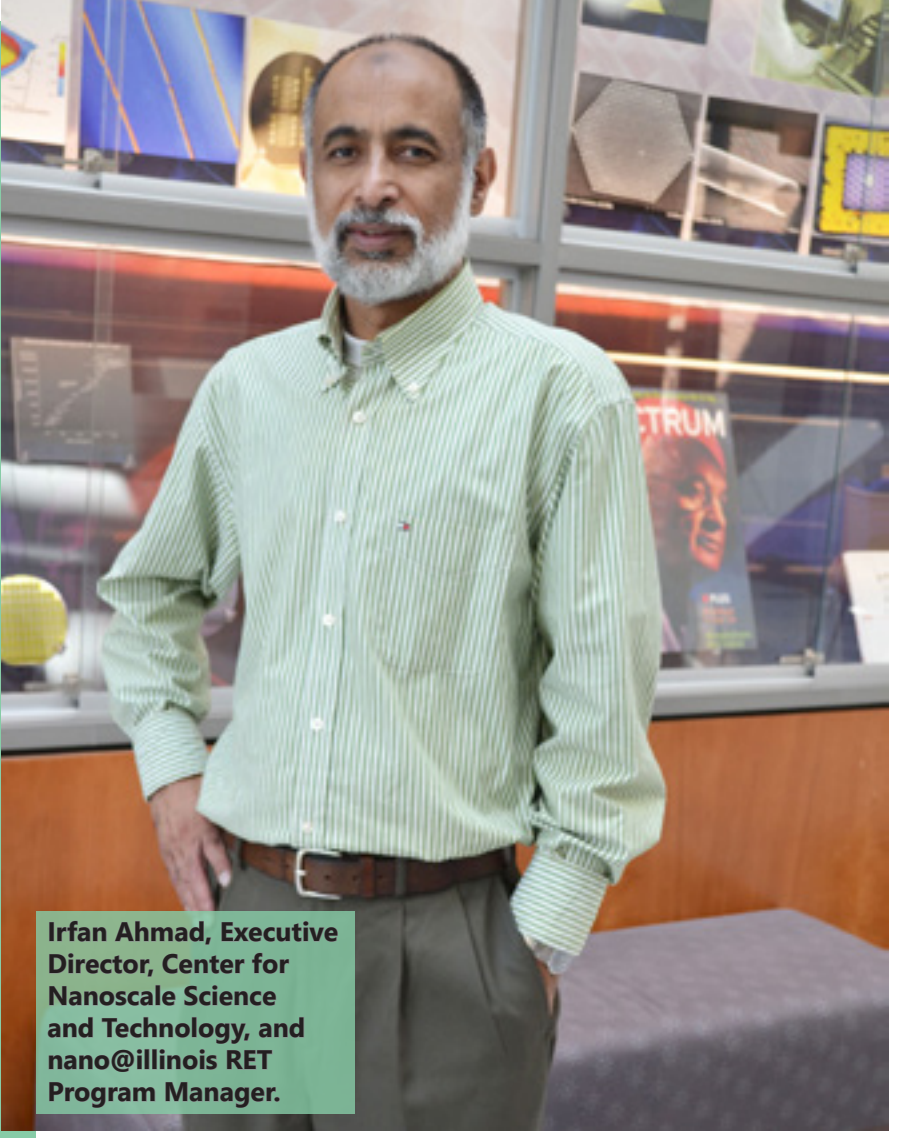
According to Irfan Ahmed, the executive director for the Center of Nanoscale and Science Technology (CNST), "the goal of this program is to have a diverse group of participants" meaning having teachers, including women, "coming from Hispanic teaching schools or schools with large populations of underrepresented minorities." Ahmed states that this "is the biggest gain, so we can stir up this knowledge base and get these kids interested in science and engineering." In the past, the people who make up most STEM fields have been typically homogenous. So one of the goals of nano@*illinois* RET is to help make STEM a much more heterogeneous field.

Lynford Goddard elaborates on how many students could potentially benefit from their teachers participating in this program.

"For each teacher that we train, they will be interacting with—if they have the same students all day—then it's 30 students. If they have different periods, then they'll be interacting with 200 or so students throughout the day." Goddard explains how this wide exposure is another goal of the program.

"Being able to get a little bit of the experience they have here and translating that and sharing their experience with their students is sort of the big goal of the program. [The goal] is to amplify the impact we can have as a university by training the teachers who can then teach the students."

Using Goddard's estimations and a conservative approach to estimate how many kids might be impacted by this program, we would expect a minimum of 330 students to benefit and that's just for one year. This number is an underestimate, since many of the RET teachers interact with many more than 30 students a day. But exposing this many students to nanotechnology and STEM greatly increases the chances that some of these kids will end up in a STEM field and could possibly aid in the creation of the next great scientist.



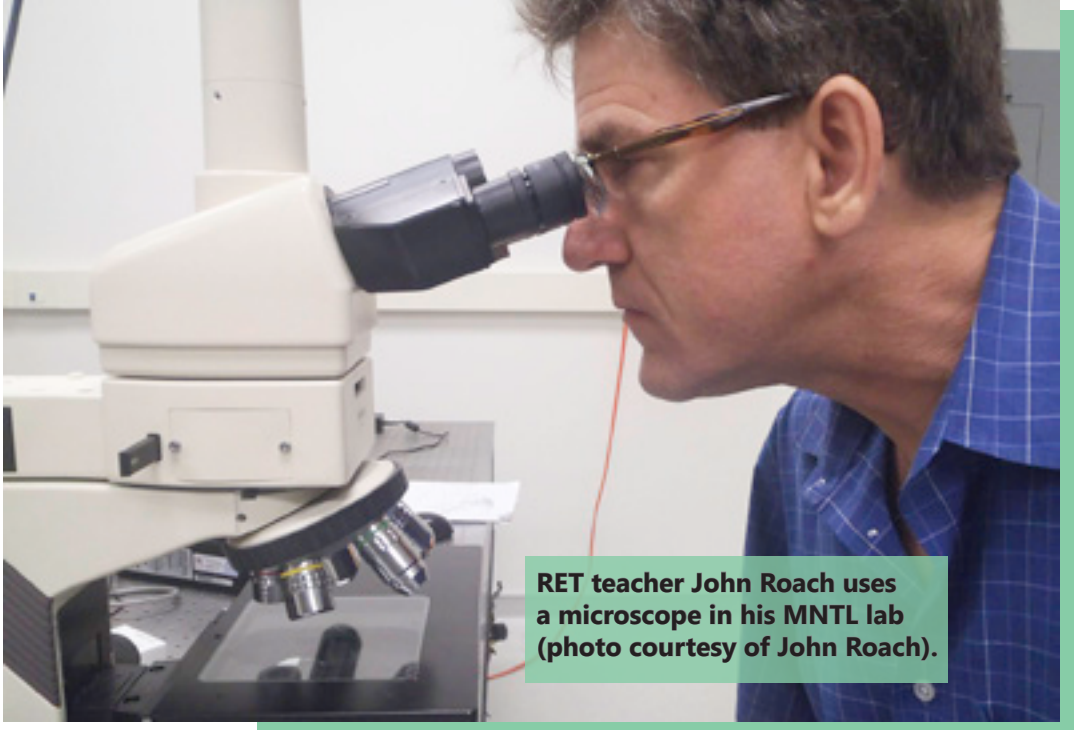
Irfan Ahmad, Executive Director, Center for Nanoscale Science and Technology, and nano@illinois RET Program Manager.

Kelly Jolley

It is also hoped that the program's impact will be amplified even more if participating teachers share with the other teachers at their schools, who then share with their students. Kelly Jolly, who returned to nano@*illinois* for a second year, did exactly that, and describes her experience:

"What we do is, the module that I did for last year, it has a PowerPoint introductory, it has a worksheet for the students, and it has a teacher guide that aligns everything. It gives you background information. It goes through the background, the research is all checked." Also very important—it is aligned with the state's Next Generation Science Standards.

Kelly Jolly presents a poster about her resarch on LEDs.



RET teacher John Roach uses a microscope in his MNTL lab (photo courtesy of John Roach).

"Because if it doesn't match up with the Next Generation Standards, teachers don't have enough time to go dabble in what's new and upcoming… So it's really nice to be able to see those standards. So that's already done for the teacher."

While Jolley may be the only teacher from her district to attend nano@*illinois*, she's been able to make her research versatile, informative, and is very well organized. Thus, it saves other teachers time and allows them to present material to their students that they might not have otherwise had time for . "It's really nice because you can take what you have learned here and fit it in with your curriculum," Jolley explains. "So when you're finished here, what you do is very usable for yourself and other teachers who will be teaching the same material."

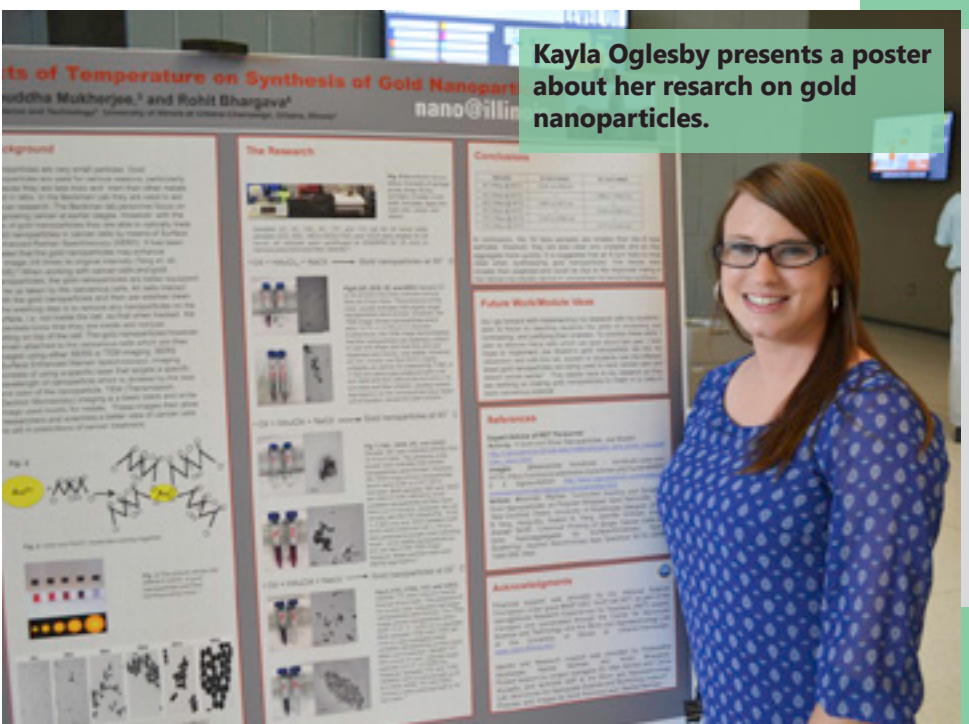
Jolley says nano@*illinois* has helped her stay in the know: "I'm more well versed in what's going on in technology and what some of the changes are and what [the students] can look for in the future," she says, "Which is really important."

Jolley says being up to date on new scientific trends is beneficial for students not only because they'll be learning new things, but because this early exposure could result in their choosing a STEM field (nanotechnology, perhaps?) as a career.

"Because as you look at these technologies, you can tell them about emerging careers. That's why they're in the classroom: to figure out how to build their life and find out what they want to study. If there isn't someone there to pass on the word on what material science is, what nanotechnology is, then they don't know to even consider that for a job field. With these modules, we can really get them hooked."

Kayla Oglesby

Teacher Kayla Oglesby also believes participating in Nano@*illinois* has enriched her students' experience:



Kayla Oglesby presents a poster about her resarch on gold nanoparticles.

"The program benefits my students because I am able to bring back new content, information, and techniques my students have never seen before. I plan to implement 3D printing and the synthesis of gold nanoparticles in my classroom in hopes of getting students more excited about science. I come from a rural, poverty-stricken area, and most of my students have never participated in scientific labs, so I hope to bring this back and show them a different view of science."

Oglesby's students aren't the only ones to benefit from this program, it was also a learning experience for Oglesby herself. She reflected "I believe the experience alone has taught me how to be a student again. It reminded me of the struggles our students often face when learning new information, and so now, I have a better understanding of how my students often feel."

Tatiana Stine presenting her research on graphene.

Tatiana Stine

Another teacher who believes her students will benefit from her nano@*illinois* experience is Tatiana Stine, who's been teaching for 22 years and works with all grades. Stine is also working on Next Generation Science Standards for teachers, which is why she's interested in this program.

"One of the goals of the Next Generation Science Standards is more engineering in the classroom," she explains. "So if they were given more ideas to integrate engineering into a classroom, then it would be done more often in an elementary classroom."

Stine goes on to explain how through her work at nano@*illinois*, she hopes to simplify the process:

"So I've taken each step of my research process and made an elementary application for it. From synthesizing graphene to measuring data with a scaled version, with activities to represent every step. It's taking a lot of these things and putting it into a 5–10-year-old's level. I think that's what I'm going to take back with me. The ideas—how you can do little tweaks and take the world of nano into an elementary classroom. Obviously you can't do the actual size, but you can scale it up and represent the same activities. If you get them hooked early, the kids will think graphene is so cool, and that spark could make them the next big nano scientist."

nano@illinois RET Master Teacher Terry Koker presents his research at the final poster session.

(For more about Stine's RET experience, see: http://www.istem.illinois.edu/news/nanoRET16.stine.html)

Beth Koplinkski

Beth Koplinkski, an elementary school teacher, is also hoping to get her students hooked on science. When asked what she's learned and taking back with her Koplinkski answers "I want to teach my kids about different kinds of mixing. The microfluidic device we had, we actually did a lot of mixing inside the helix of chemicals, and so I want to take that back, and I want to teach my kids a little bit about different types of mixing, different types of flow, that kind of thing.

Koplinski hopes to do more than teach her students about types of mixing. "I also want to talk to them about science careers. I mean, get them excited and elementary school kids about science, do some hands- on things with them, and maybe have some people from the university come over and be good role models for them."

Koplinkski's students aren't the only ones getting a learning experience. Reflecting on her summer experience she explained, "Personally I learned how to measure in the lab because being an elementary major we don't have the technical hands-on science in our programs like a lot of high school teachers who teach science have. So I learned to measure; I learned about different chemicals and how they react with other chemicals; I learned what microfluidics is."

Elementary school teacher Beth Koplinkski presenting her research at the nano@illinois final poster session.

Diana Rodriguez

Koplinkski wasn't the only RET teacher to personally gain a lot through this program. Diana Rodriguez, a teacher for 13 years, described this experience as "Amazing! I learned a lot of things about research and techniques. I learned to experiment and how to keep a lab notebook, participate in lab group meetings." These personal interactions were extremely important for Rodriquez because she's not confident in her English speaking ability. She explains "I decided to come here because I have a problem with my English language, and I wanted to get out of my comfort zone and push me to speak English."

Diana Rodriguez explains her research to nano@illinois co-PI, Lynford Goddard.

Terry Koker

While nano@illinos RET is a great program for educating teachers on nanotechnology and new scientific knowledge, it's important to note that the teachers do have actual cutting-edge research projects they work on while they're in the program. For example, Terry Koker continued the research he began back in 2014 and was actually patented in 2014. He boasts, "My name is on the patent, it's the coolest thing to be able to put it on the wall as a high school teacher and show your students that you are patented."

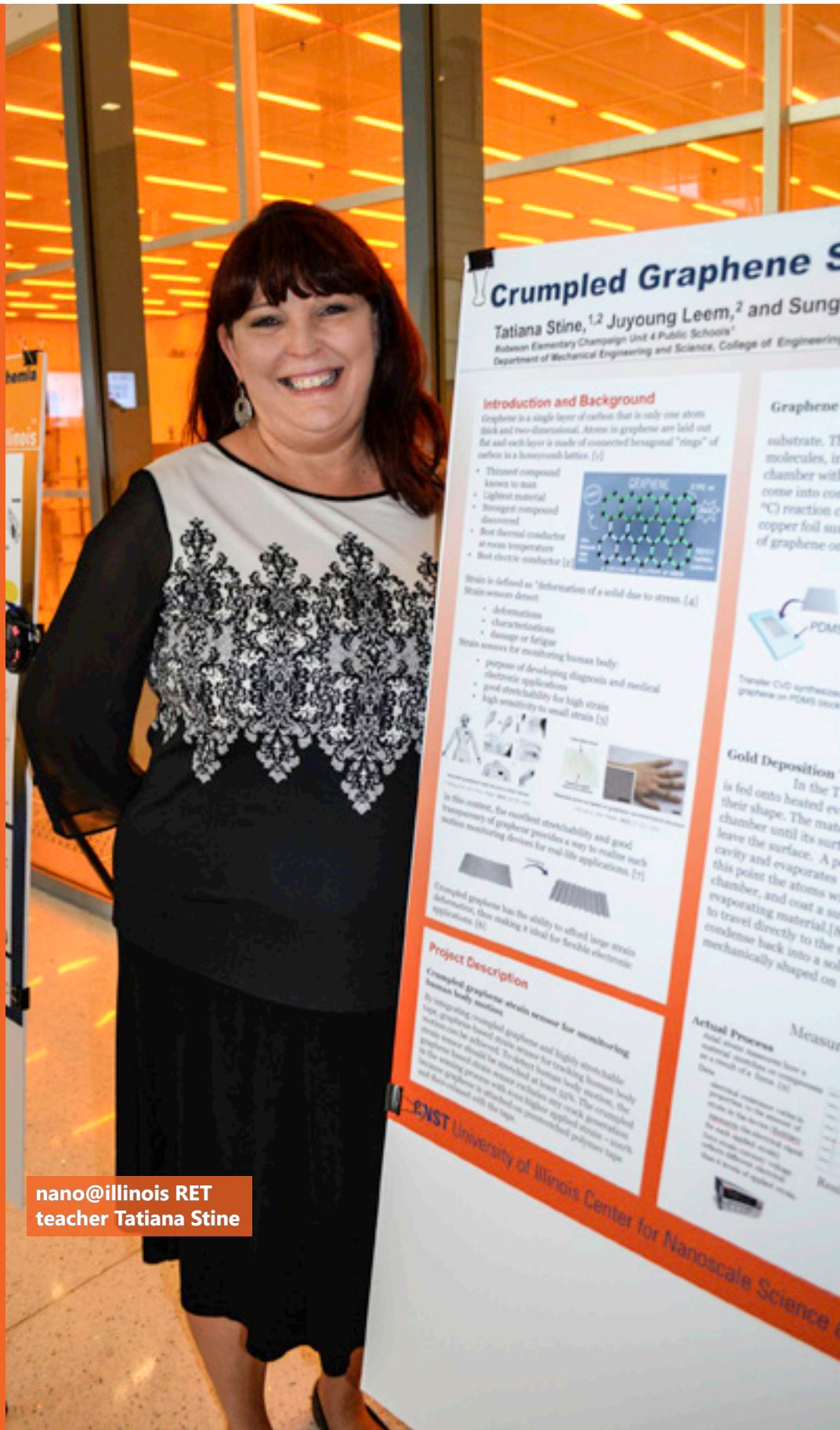
NANO@ILLINOIS RET PARTICIPANT TATIANA STINE HOPES TO HELP EXPOSE YOUNGSTERS TO NANOTECHNOLOGY

September 5, 2016

"If you get them hooked early, the kids will think graphene is so cool, and that spark could make them the next big nano scientist" – Tatiana Stine

An instructional coach at a local school, Tatiana Stine is passionate about helping her teachers implement the Next Generation Science Standards—especially engineering. A participant in the nano@illinois RET program this past summer, she got to work with innovative nanotechnology while conducting research on graphene. And she not only learned a lot of new things, she developed teaching modules she plans to take back to her teachers. And one day, while waiting for gold nanoparticles to deposit on her device, she came up with a fun and novel way to teach youngsters about nanotechology—Gene the Graphene.

Stine, who has been teaching for 22 years, is currently an instructional coach for all grades and teachers at Robeson Elementary School in Champaign. When asked why she participated in the RET, she says, "My dream job in the future is to do science curriculum at a district level, primarily for elementary. Since nanoscience is becoming such a forefront in the academic and science world, you have to become familiar with it; you have to keep growing and learning… If my goal is to eventually be a curriculum director for an entire district, then I have to be



nano@illinois RET teacher Tatiana Stine

Stine at work in the clean room (photo courtesy of Tatiana Stine).

constantly updating my content knowledge to keep up with the changing world of education."

A step towards her dream job is getting to work on the Next Generation Science Standards for her district. "One of the goals for the Next Generation Science Standards is more engineering in the classroom," Stine elaborates, suggesting that if teachers, "can be given practical ideas as of how to integrate engineering into the classroom, then it'd be done more often in elementary classrooms."

So her goal is to give teachers some practical lesson ideas. This is where her work in the RET program came in handy. By having the opportunity to complete research at Illinois, Stine was able to understand nanoscience better and, thus, be able to better translate this interesting, new science to teachers in her district. "So I've taken each step of my research process and made elementary application for it," Stine explains. "So they could basically walk [students] through from synthesizing graphene to measuring data in a scaled-up version, with activities to represent every single step."

Stine says the important thing is to get it down to the kids' level: "It's taking a lot of these things and putting it at a 5 to 10-year-old level, and I think that's the biggest thing that I'm going to take back are the ideas—the little tweaks—and you can take the world of nano into an elementary classroom. Obviously you can't do the actual size, but you can scale it up and represent the same activities easily."

One of Stine's scaled-up activities was created to help explain the effects of strains on graphene circuits. In this activity, the students represent the graphene circuit: "They're going to be passing balls in a circle, but then a strain happens, so you put an arm up because it's deformed. Now what happens to your circuit?" While actively involving students, Stine's activity helps to simplify a fairly complex concept to a level where young students can understand it.

Stine points to the image of Gene the Graphene on her poster at the end-of-the-summer poster session.

Gene the Graphene.

Working with graphene actually sparked another idea: “I was working on graphene," Stine explains, "We were sitting in a room one day waiting for our gold to deposit on our device, and I came up with Gene the Graphene …He’s going to talk about how he’s strong, and he’s flexible, no baths because he’s hydrophobic, all that, and he’s just wondering why nobody can see him, and so at the end of the story he gets discovered.”

Why Gene the Graphene? While piquing kids' interest in science, specifically nanotechnology, she hopes to inspire the next big scientist. “If you get them hooked early, the kids will think graphene is so cool, and that spark could make them the next big nano scientist.”

Gene isn’t alone in his journey, though. Stine depicts, “Gene’s friends in his classroom are like Bucky Ball and Flora Rine, and the teacher’s Mrs. Carbon-Nanotube, so they can all have their own stories eventually.”

Just like Gene, Stine wasn’t alone in this creation process. “A lot of people from the group I worked with want to expand and do more nano friends stories, so it could go places.”

Stories on Gene and friends could be very helpful and educational to give students some background knowledge before learning about those scientific topics in class. Stine knows what it's like to not have the necessary important background knowledge; she experienced that coming into this RET. She reflects, “I was so overwhelmed at the beginning because of the content knowledge, I didn’t know anything about this when I walked in here.”

However, Stine admits that being overwhelmed was an epiphany regarding what students sometimes go through. The overwhelming and helpless feeling she experienced is something that some students encounter routinely; in fact, most can feel like this from time to time, especially with new, unusual material.

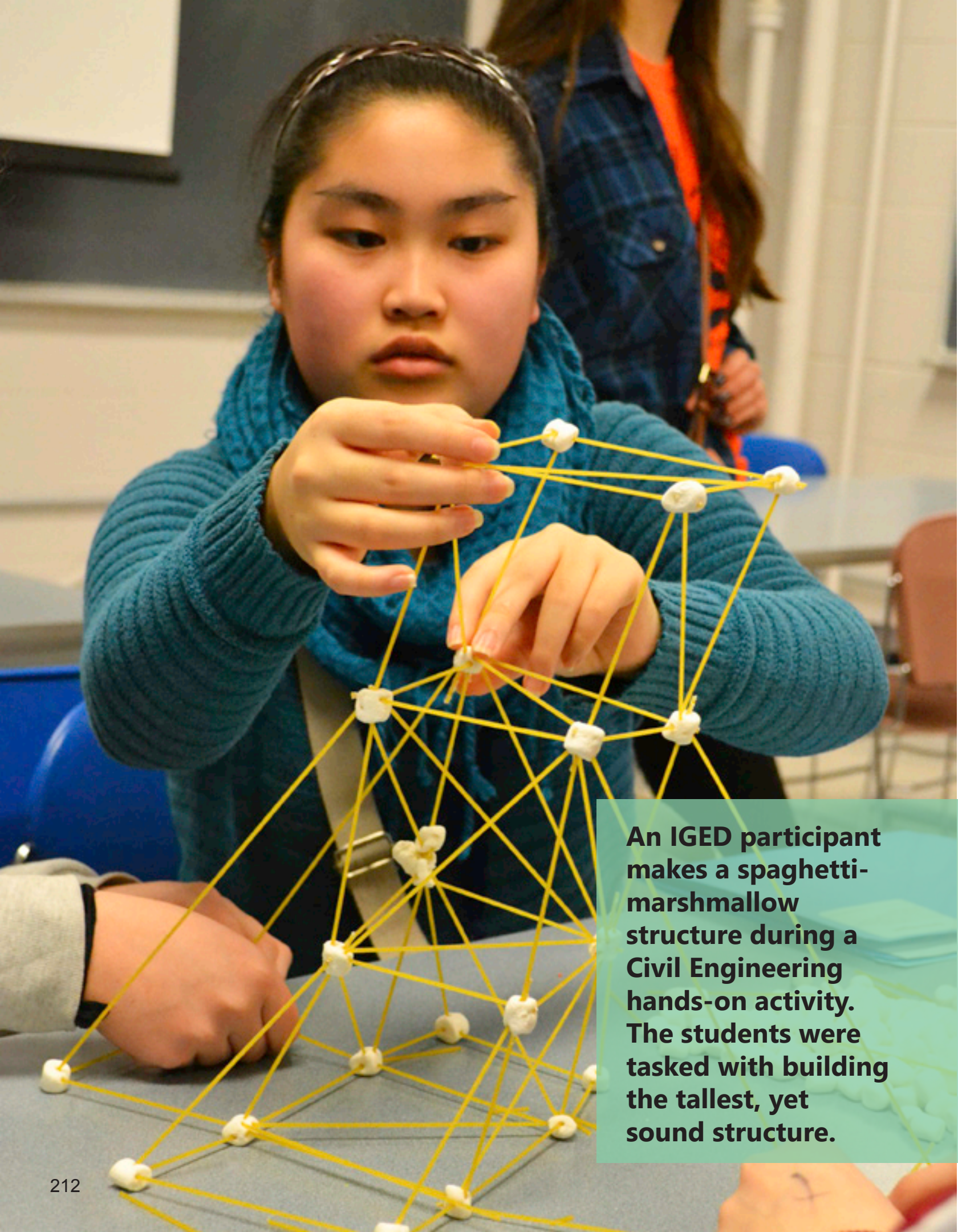
“The biggest lesson I learned is, you’ve got to remember that’s how those kids feel. The way I felt when I was being tossed all this stuff at me is how they feel. It was such a revelation to me, because a lot of times I felt afraid to ask for clarification, even though I didn’t understand what they were saying. Because I didn’t want to look dumb. And all of a sudden, bells are going off in my head, and I’m like, ‘That’s what’s going on with the kids!’ That was a huge take away.”

Stine stresses that it’s important for teachers to realize that all children are different: “You’ve got to go slow; you’ve got to take it into small pieces; don’t assume they all have this background knowledge. A lot of them won’t—specifically with science and specifically lower socioeconomic areas. I think that people assume that all their kids are coming in with the same background knowledge, and they’re not—just like people would assume that because we all have science strengths, we would’ve had this knowledge, and we didn’t. So it was a really good correlation for me to understand the frustration process with the kids as well.”

Stine suited up to enter the clean room (photo courtesy of Tatiana Stine).

ChBE GAMES camper works to extract DNA from strawberries.

OUTSTANDING STEM WOMEN



An IGED participant makes a spaghetti-marshmallow structure during a Civil Engineering hands-on activity. The students were tasked with building the tallest, yet sound structure.

INTRODUCE-A-GIRL-TO-ENGINEERING DAY TELLS GIRLS: "YOU CAN BE AN ENGINEER, CHANGE THE WORLD!"

March 10, 2016

On Saturday, February 20th, SWE's Introduce-a-Girl-to-Engineering Day did just that. Around 150 high school girls (and their parents) who showed up at *Illinois*' Loomis Lab for the day-long outreach were introduced to Engineering at *Illinois* by female engineering students who were excited to get to know the girls and to convey to them this dual message:

1) that they too could become engineers, and

2) that a career in engineering would give them the chance to make a difference. And of course, the Illinois students who helped out hoped to not only woo some of these potential recruits into engineering, but maybe even into their own particular fields.

The third annual Introduce-a-Girl-to-Engineering Day (IGED) at *Illinois*, sponsored by *Illinois*' chapter of Society of Women Engineers (SWE) was part of the national Introduce-a-Girl-to-Engineering Day that corresponds with National Engineers Week. SWE's biggest and most widely attended outreach event of the year, IGED attracted visitors from all over the state. In addition, SWE bussed interested Chicago Public Schools students and their parents to and from Champaign to ensure that lack of transportation wouldn't deter them from participating in the event.

The day began with an introduction by IGED co-chairs Abbie Gerth and Rebecca Ficht, followed by breakout sessions where the girls learned about a number of engineering disciplines via some hands-on activities.

Clair Sullivan, an assistant professor in Nuclear, Plasma, and Radiological Engineering, gave the keynote address, proclaiming that girls can be engineers, too, as she shared some of the successes and the challenges she has encountered as a woman in engineering.

Two high school girls present their design challenge: a plan that enables villagers in third world countries to get electricity from potatoes.

Sullivan wasn't the only one hoping to convince the girls that they could become engineers. IGED co-chair Rebecca Ficht, a junior in bioengineering, says that in addition to exposing the girls to different disciplines of engineering, she got involved "to show them that even if you're a woman, you can still do engineering. I think it's great to inspire girls, especially when they're high schoolers who are just about to pick their majors going into college. We like to show them how awesome engineering is."

While the morning's activities exposed girls to the different types of engineering, the focus of the day's main event, a big design project, was to convince the participants that through careers in engineering they could make a difference—could change the world. So the girls teamed up for a design challenge in the afternoon, where they designed a prototype, created a poster explaining how they their design would solve a problem, then presented their design to the judges (engineering faculty, staff, and graduate students) and to their parents.

Did participating in IGED help the girls learn that careers in engineering would give them a chance to make a difference? Ashley May, one of SWE's outreach coordinators, believes so.

"I think, today, girls can see just the power of engineering in being able to change the world. Because these design challenge are all geared toward real-world problems and major issues in our society, and they managed to come up with

A high school student works on her team's prototype during IGED's Design Challenge.

solutions in 90 minutes. Of course they didn't think of a complete solution," May acknowledges. "They didn't solve the problem, but they're starting to think like that, and they're seeing that engineering is a career where they can change the world and make a difference for society."

The girls showed up for Introduce-a-Girl-to-Engineering Day for a number of reasons—often their parents had a lot to do with it.

For example, one high school sophomore, reports "I'm just here to learn." Admitting that science and math are her weakest subjects, she explains, "So my mom thought it would be a good idea to get me here and have me feel things out and see if I like this type of thing or not." Did she like it? Yes!

"It's really cool actually. When I went to computer engineering, I learned how to do all the technical stuff and how people program computers and video games. It's actually really cool. That would be a backup plan for me other than writing."

Another participant, junior Kristin Winteroff, says she definitely wants to become an engineer. She hasn't picked a discipline, but is looking at a number of them, including Civil.

An IGED participant puts the final touches on her team's Design Challenge poster.

Neither of her parents are engineers, although her dad worked for a highway department for 30 years. However, her parents still encouraged her to attend: "She did really well in math and science," admits Mom, so we told her, 'Let's try this!'"

The girls weren't the only ones to learn about Engineering at *Illinois*; IGED planners scheduled parent workshops about financial aid/scholarships, summer engineering programs, a Talk-with-a-Dean session, and a student panel to help parents discover what being a student at *Illinois* might be like for their daughters. And of course, at the day's end, parents proudly watched their daughters present their project for the design challenge.

Two IGED participants show off their latest creation.

An IGED participant makes a circuit in one of the morning's breakout sessions.

According to Lara Flasch, another of SWE's outreach coordinators, SWE received great feedback from parents: "We also spoke with a lot of parents the day of the event who were very appreciative of and excited about the experience that their daughters were able to get from the day!"

Flasch was also excited about the participants' post-event survey responses, which she called "overwhelmingly positive feedback about the day!"

What were the girls' favorite parts of the day? One had enjoyed solving a real-world problem: "My favorite part was the design challenge, because it was fun to be able to apply myself and my knowledge to the real world!"

Another appreciated working on a team: "The design challenge was my favorite part. I got to work closely with my group for a long time to solve a common problem in the world, and the different prompts didn't make competition stressful."

Another appreciated being exposed to the different engineering disciplines: "Really enjoyed the demonstrations of each discipline in engineering. It broadened my knowledge in engineering."

And finally, a number of girls most enjoyed getting to chat with the female engineering students: "Interacting with other female engineers," "Talking to the students about college life," and "The insight from each member of the engineering program."

Another exciting discovery from the surveys was that a vast majority of the girls didn't have a parent or sibling in engineering.

"So we feel that we targeted a great group of smart girls who may not have been exposed to engineering otherwise!" exults Flasch.

The high school girls and the parents who participated in IGED weren't the only ones to benefit from the outreach. According to Abby Pakeltis, the youngest of the two Pakeltis sisters, both of whom are enrolled in Engineering at *Illinois* and both of whom helped out at the event; whenever she does a SWE outreach, she benefits too.

"The Society of Women Engineers is just a great way to grow as a person through these outreach events where you can share your love of engineering with young girls and inspire them to pursue engineering, where you can change the world," says Pakeltis. "But also it's a great way for me to grow professionally, so it just helps me become a more well-rounded person."

WIE LEAD FOSTERS LEADERSHIP IN ILLINOIS' WOMEN IN ENGINEERING

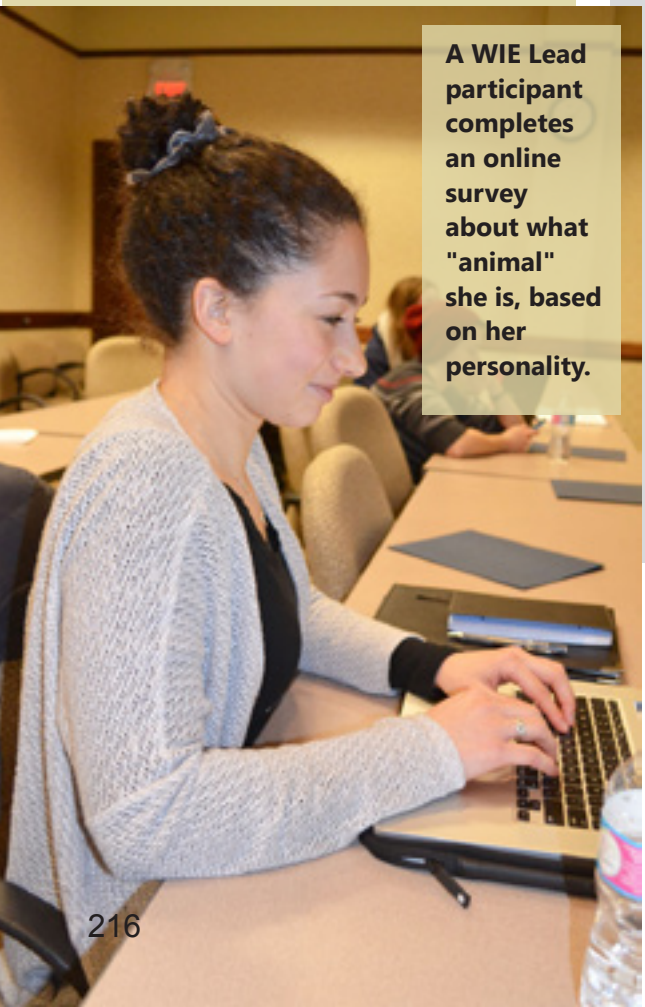
March 22, 2016

"I just want to ensure that these women have a chance to develop these additional personal skills, professional skills, so they feel empowered to be leaders." Angie Wolters

The Women in Engineering (WIE) organization in the College of Engineering prepares women to succeed in engineering. While a major focus of WIE is to help them be successful at *Illinois*, the organization also seeks to help them be successful beyond *Illinois* by providing them with the skills they will need to get ahead in their future careers. So in the 2015–2016 academic year, WIE leaders began a new leadership series called WIE Lead, which features monthly workshops highlighting students, faculty, and alumni who share their stories about how they've grappled with specific leadership principles.

According to Angie Wolters, Associate Director of WIE, some of the leadership qualities they're addressing in the workshops are topics that often don't get talked about in class.

"Our engineers are leaving with extremely strong technical skills, and it's the addition of these kinds of programs that make sure that we've got a balance between those technical skills and the ability to work with others and go in and find those opportunities to be a leader. So I'm excited about this, because I really look at it as a personal, professional kind of development that sometimes students really wouldn't get until they're in the workforce, but we're focusing on it now."



A WIE Lead participant completes an online survey about what "animal" she is, based on her personality.

Engineering alumna Sarah Laken gives a talk about Collaboration.

The WIE Lead series, funded by corporate sponsor Northrop Grumman, is based on the Athena Core 10, developed by Barnard College's Athena Leadership Center, which addresses ten principles of leadership for women. In fall 2015, the topics addressed were vision, ambition, advocacy, and resilience; in spring 2016: collaboration, negotiation, and communication.

For instance, for the February 16th WIE Lead, a former student, Sarah Laken, who currently works as a research scientist at Eli Lilly, returned to give a talk on "Collaboration." Laken, who served as a WIE Orientation leader as a student, and also an officer in SWE, was excited to come back to campus to share some of

what she's learned with *Illinois*' engineering women: “I learned a lot on campus, and it really set me up well for my job, and so I’m really glad to be able to give back to the community that gave a lot to me while I was here.”

During her talk, Laken shared five stages of the collaboration process (Forming, Storming, Norming, Performing, Adjourning), then addressed some challenges she has encountered in her new job related to collaboration with colleagues. She also shared several anecdotes, including one about a colleague who hadn't been extremely cooperative, and some strategies she's developed to remedy the situation. Throughout the talk, she imparted to the students some of the wisdom she's picked up as a result of working through struggles when learning how to collaborate with colleagues.

Two engineering students at WIE Lead practice collaborating during a hands-on activity.

"I have a philosophy that I truly believe in. There's a nice way to say everything. So no matter how harsh it may be, I think there's a nice way to say it. It doesn't always mean you say everything on your mind....So if there is contructive criticism you can give to a group member, you don't necessarily have to bash them, saying, 'You did this wrong, and this wrong, and this wrong!'...but instead, when you give that feedback, have it be true feedback. Say, 'This didn't work well, but I think if we tried it this way next time, it might work better.'"

Another piece of advice? "When giving feedback, avoid the word 'You' as much as possible. If you can avoid it entirely...do it!"

Laken then shared a hypothetical situation illustrating how to deal with conflict using some of the above tips. Suppose one's roommate were, say, leaving her dirty dishes in the sink all the time, what is a nice way to deal with the issue without calling said roommate a slob? Putting a friend on the spot, Laken uses her in the example:

“I’d say, ‘Tara, I don’t like washing the dishes right before I use them, so maybe if we can try to wash the dishes before we go to bed every night, then we can have nice clean dishes when we wake up in the morning, and we don’t have to worry about washing the dishes right before we use them.’”

Laken then stresses that she hadn't used the word "you" at all when confronting her roommate, but had said "I" and "we."

While Laken admits that being an engineer isn’t quite what she had envisioned, she feels she was well-prepared at *Illinois*.

“It’s definitely very different. But I think there are a lot of aspects that I enjoyed in school—the collaboration, the teamwork, and the problem solving—that I definitely do use every day at my job.”

Following Laken’s talk and a question-and-answer period, participants took a short personality test to determine what kind of “animal” they were, based on their personaity characteristics, then did a hands-on activity, which involved teamwork and collaboration: building a spaghetti-marshmallow structure. After the activity, they discussed the successes and challenges encountered while collaborating on the activity.

According to Wolters, around 30–40 students, ranging from freshmen through seniors, have beenattending the workshops. In fact, some upperclassmen who are established leaders have been participating and sharing some of what they've learned with the younger students, contributing a kind of mentoring component to the program.

"It's added to the great dynamic of our own current leaders mentoring some of the younger students," says Wolters.

In essence, the monthly topic has almost become a Women in Engineering mantra for the month. For instance, women who are unable to attend the workshops can still engage with these topics via the tidbits and the stories included in WIE's monthly newsletter sent to all women in the College of Engineering. Also, WIE Advisory Board representatives from WIE's RSO (Registered Student Organization) groups (SWE, Women in Nuclear Engineering, Women in Aerospace, etc.), share the monthly themes with their organizations, who have keyed in on the topics being covered and continued the conversation in their own events, such as TED talks and the speakers and alums that they have coming back to do talks.

Another related leadership initiative WIE has begun is the WIE Leadership Certificate. Female engineering students must attend at least four WIE Lead workshops, plus do StrengthsQuest, an online self-assessment of their characteristics, through the Illinois Leadership Center. StrengthsQuest helps students discover their top five strengths learn more about these strengths, then focus on how to use them to the best of their ability.

Teammates enjoy the hands-on activity building a spaghetti-marshmallow structure during the WIE Lead Collaboration workshop.

"Rather than focusing on anything that you might see as a weakness," says Wolters, "instead, you focus on, 'What are your strengths, and how can you use those in every situation?'"

Students who complete the WIE Leadership Certificate may count it towards earning the campus leadership certificate, a very robust program that includes attending workshops, taking classes, and meeting with a leadership coach. WIE leaders consider the Certificate to be "an introductory program to get our women keyed into the skills and the attributes they need to become leaders," says Wolters. "This is kind of that first stepping stone and that entry level point so they can use campus resources that already exist."

How have Engineering students benefitted from WIE Lead? Jessica Lothridge says, "I think it's a good opportunity to meet other people, first of all. Second of all, to really learn about the things that make a good leader. Honestly, it's really uplifting and inspirational every time I come."

Wolters hopes the program helps students succeed in their careers.

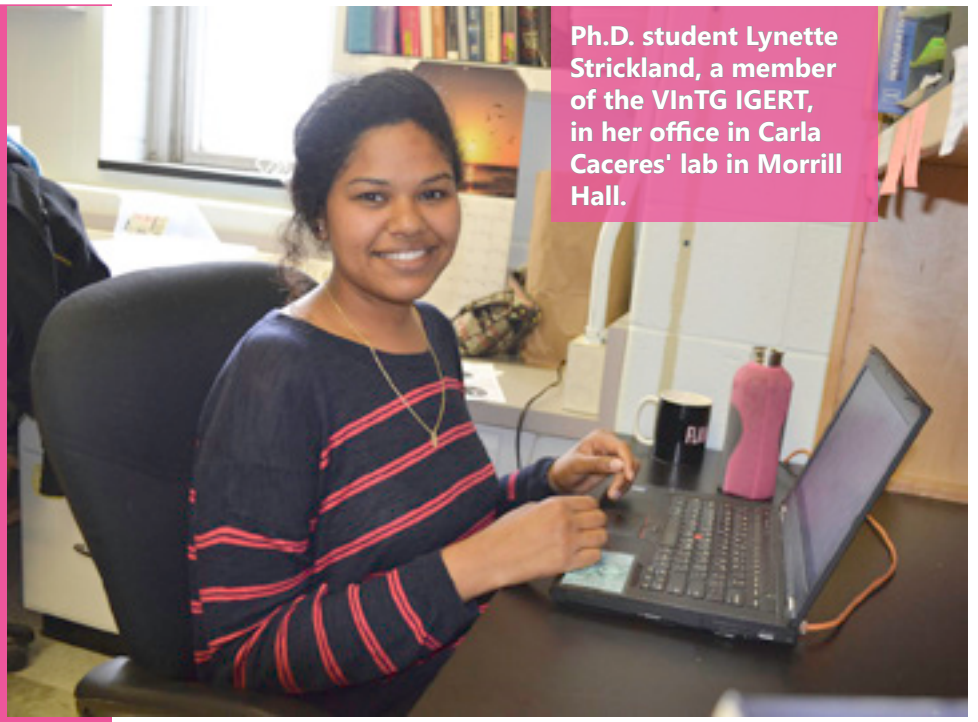
"My hope, is that those who participate are able to have a takeaway of the skillset that they don't have a chance to develop elsewhere, so they're taking away the skills that are going to help them succeed in the workforce. We're a great school, and we do a wonderful job of training our students technically, and I just want to ensure that these women have a chance to develop these additional personal skills, professional skills, so they feel empowered to be leaders."

One of the two teams has their spaghetti-marshmallow tower measured to see if they built the tallest tower and won the competition.

VINTG IGERT INSPIRES PH.D. STUDENT LYNETTE STRICKLAND TO CHOOSE A CAREER IN RESEARCH

May 2, 2016

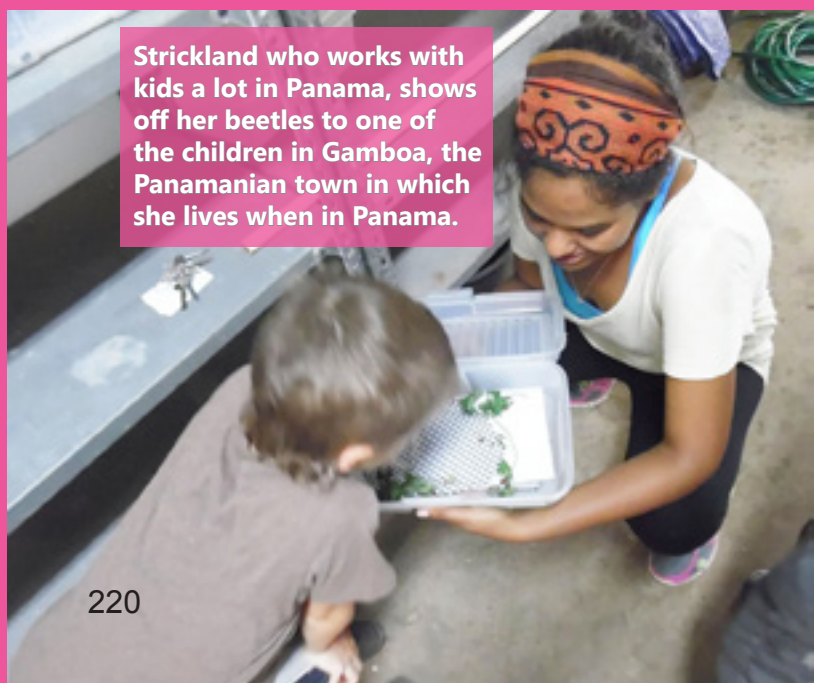
How did a little girl who had never been further than her home state of Texas and dreamed of being a veterinarian end up a researcher at Illinois, who also spends large blocks of time in Panama and is passionate about studying, in particular, the colorful Chelymorpha, or tortoise beetle? Lynette Strickland, an Animal Biology Ph.D. student who works in the lab of Illinois researcher Carla Caceres, credits the NSF-funded VInTG (Vertically Integrated Training with Genomics) IGERT.



Ph.D. student Lynette Strickland, a member of the VInTG IGERT, in her office in Carla Caceres' lab in Morrill Hall.

Even when she was little, Strickland was obsessed with investigating living things. “My mom tells me stories how she would walk me to the bus stop to go to school,” admits Strickland. “We’d have to leave 15 to 20 minutes early because I would have to look at every flower and every butterfly and every ant hill. So I think it’s just something I know I’ve always loved and appreciated.”

In fact, it was her love of biology—animals in particular—that started her on her current career path. How long has she loved living things? “Since I was four years old,” she says. “All my life. Although, I thought I wanted to be a veterinarian for the longest time. I think that’s what got me along the way into college. I knew I had to go to college to be a veterinarian.”



Strickland who works with kids a lot in Panama, shows off her beetles to one of the children in Gamboa, the Panamanian town in which she lives when in Panama.

Knowing how passionate she is about living things, you can imagine how thrilled she was to discover, as an undergraduate student, that she could actually have a career studying them: “It was a couple years into my undergrad,” reports Strickland, “that I found out about graduate school and life as a researcher and that you could actually make a career of studying life. That just blew my mind. At that point, I was like, 'That's what I'm going to do!'”

So Strickland, who grew up in Austin, Texas, and, in fact, had never left Texas before, found herself interviewing at the two graduate schools in the Midwest that she was trying to decide between: Illinois and Indiana. She reports that the many benefits of the VInTG IGERT quickly swayed her towards Illinois. “Ultimately, I was funded better here,” she admits. “IGERT is a really great funding source for the student. Two years fully funded. This is what allows me to work for 6 or 7 months in Panama, when otherwise I would be here teaching.”

So not only is VINTG paying for two years of her Ph.D. program, but it is covering an all-expenses-paid trip—twice—to the steaming jungles of Panama, a hot spot for all kinds of insects.

Strickland says that the first part of the VINTG IGERT was a 4-week course done in Panama.

During the course, students were introduced to approximately 40 staff scientists, plus numerous different interns, fellows, and volunteers. In addition, she and her cohorts visited six or seven different areas around Panama with these staff scientists.

It was there on her first trip to Panama during the spring semester of 2015, that she met the love of her life—the Chelymorpha beetle, commonly known as the tortoise beetle. She explains that she was on a trek through the jungle with Don Windsor, researcher with the Smithsonian Tropical Research Institute who is one of her Panama mentors, when she first spotted the tortoise beetle up close:

> **"We had been hiking maybe at least eight hours. It was about 5 or 6 PM at this point. We started at something like 7:30 AM. He had told me about these beetles, and I was like, 'I really want to see one!' So I finally managed to flip over a leaf on the ground and on the other side of it was this beautiful beetle, and I was taken right away. Right away. Fell in love. That's exactly what happened."**

Strickland says her research is specifically targeting diversity, "how diversity is formed and maintained. I'm using beetles to look at the color variation that they display, and how this color variation is formed and maintained."

This writer recalls a past lesson about natural selection among a certain moth species, where black moths, camouflaged against the bark of the black tree they preferred as a food source avoided detection by birds, while the white moths, who starkly stood out against the tree's bark, were easily picked off by birds, thus decimating the population and causing the color shift to black in the species. Does this sort of thing come into play with her beetles?

"That's one thing I'm looking at with my ecology studies," acknowledges Strickland. "I'm looking at whether predators preferentially eat one of the different phenotypic variants of the beetles, or if they preferentially avoid one of the color variations of the beetles."

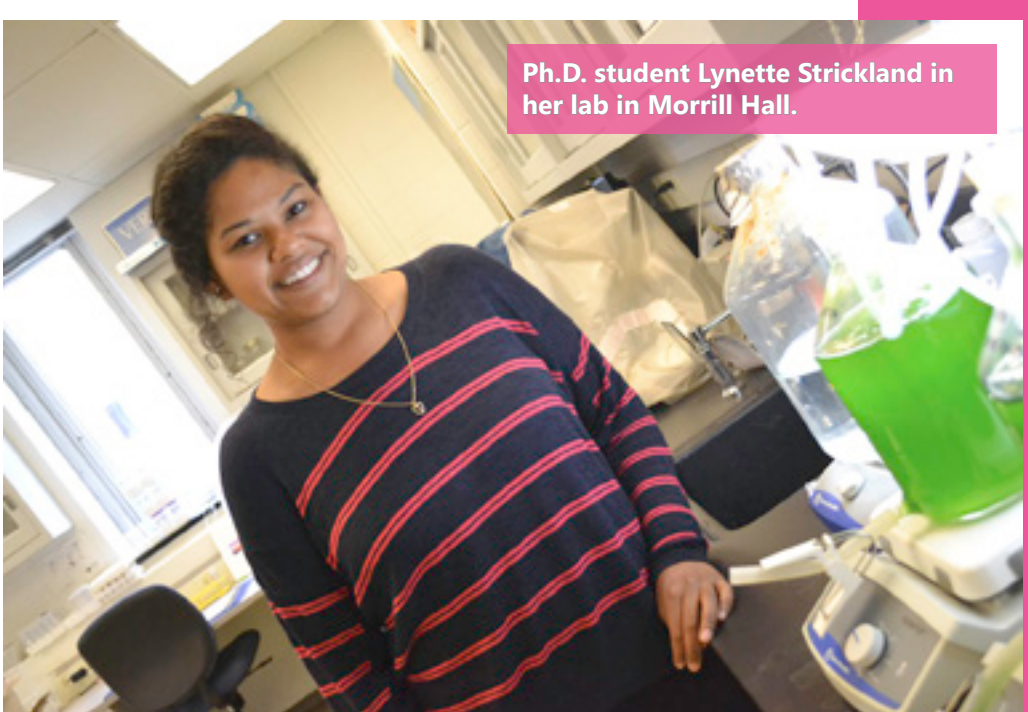
Ironically, while one might assume that brightly colored insects would be more easily picked off by predators, as in the case of the above moths, Strickland says this is not necessarily the case.

"So, especially in the tropics, and with insects, a lot of times they're brightly colored because they're sort of advertising, 'Hey, I'm distasteful or I'm toxic.' So like the poison dart frogs, that's one reason why they're so incredibly colorful is that it's easier for predators to remember them, and say, 'That tastes bad; avoid it!' So it's really cool!"

Knowing that this color-related adaptation exists, she reports, "I'm trying to look at it to see if my beetles get that same response from predators." Her beetles are variations of red, black, and metallic. "So they are gorgeous!" she brags. "They just stand out. You'll see them on a green leaf and they just stand right out."

Strickland isn't just considering the impact of color, but a number of other factors. "What we can learn from this sort of research is how the environment—the ecological factors, predators, other individual beetles, whether there's sexual selection acting on them, whether there's something to do with physiology, if a certain color variant is able to reproduce better in more environments. Taking all of these environmental and ecological factors, and also looking at genomic factors. So what areas of the genome are contributing to the differences in color that we're seeing?"

Strickland adds that, via the VInTG IGERT, she has had access to a diverse team of researchers, both from Illinois and the Smithsonian, who have expertise in all these aspects of



Ph.D. student Lynette Strickland in her lab in Morrill Hall.

her research: “It was really great to have a team that advises me on the ecological aspect, and a team that really advises me on the genomic aspect.”

Strickland’s love affair with the tortoise beetle hasn’t always been smooth sailing. She tried to raise some in the basement of Morrill Hall, but, due to lack of sufficient humidity, they went the way of the fish many of us tried to raise as children. However, according to Strickland, the demise of her subjects has a silver lining…in order to complete her research, she must work for long stretches in Panama, where there is lots of heat and humidity, and, therefore, an abundance of tortoise beetles.

Another silver lining, this summer, her family, none of whom have ever been out of the states, are going to visit her.

“My family is actually going to come visit me in Panama this summer, and it’s going to be the first time that they’ve left the country. To be able to bring this to full circle and have my family come, my mom in particular, means everything to me.”

Ph.D. student Lynette Strickland uses a microscope in her lab in Morrill Hall.

Strickland’s advice to the fam: Take plenty of sunscreen and insect repellent, and wear loose clothing that doesn’t stick to your body because of the heat and humidity.

What are Strickland’s career goals? She wants to work at a university. “I would love, love, love to be at an R1 institution (a Research 1 institution, like the University of Illinois at Urbana-Champaign) somewhere. I really like the advisor aspect. I want to be mentoring students. I really like the teaching aspect. It’s one of my favorite parts—sharing the cool results that you found. And of course, I really love the research aspect. So just, in general, I think an R1 university would be a really great place for me.”

According to Strickland, the opportunities afforded her via the VINTG IGERT have changed her life. What has it meant to her?

“That’s hard to put into words. For me personally, I could never quite put a price on what this has been to me. I came from a low income, single-parent household. I was the first person in my family to go to college. Before I interviewed here and Indiana, those were the first times I ever left Texas. Then, a year later, I was spending seven months in Panama working with the Smithsonian Tropical Research Institute with brilliant staff scientists, and meeting some of the brightest students I’ve ever gotten the chance to talk to.”

Strickland also acknowledges that the interactions with people she’s gotten to work with as part of the VInTG IGERT have shaped who she is as a researcher and essentially determined her career path:

“We just had such diverse interests—everything from people, to insects, to mammals, to manatees. Just so many different things, and so many different conversations that I was able to have, has just done so much to really form me over the past couple years. To really form my research interests, who I want to be as a scientist and a researcher, who I want to represent. This IGERT fellowship has meant the world to me.”

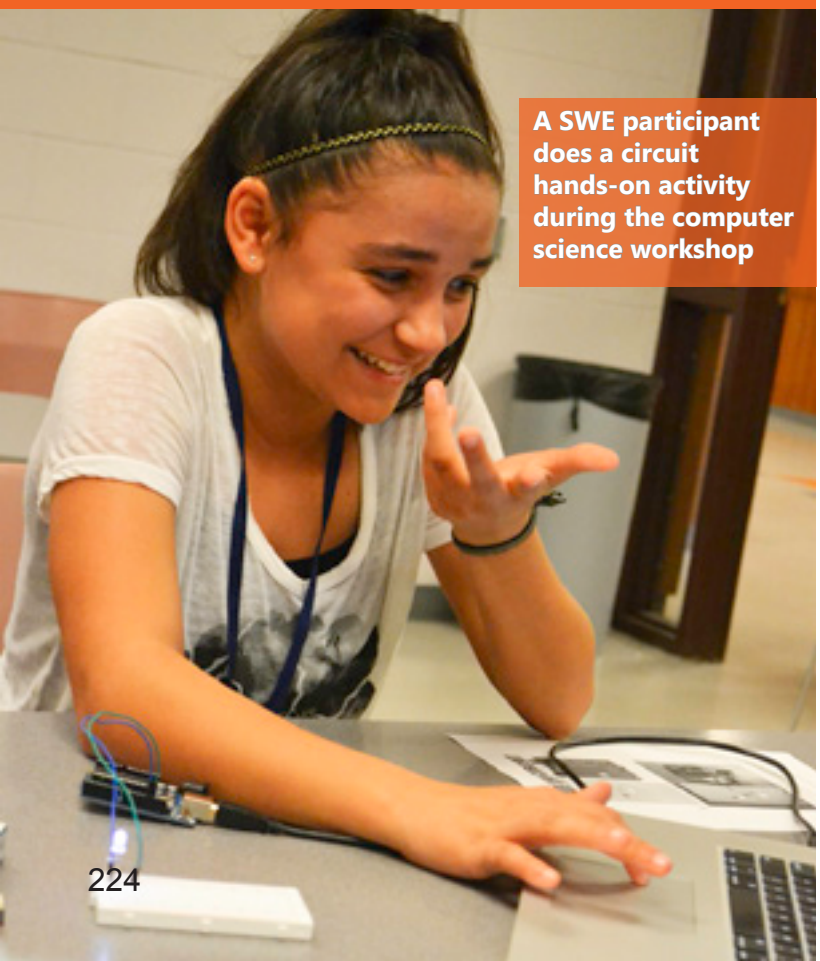
Lynette Strickland exhitbits a photo of Chelymorpha, or tortoise beetles.

SWE'S SAVE THE WORLD WITH ENGINEERING OUTREACH TARGETS MIDDLE SCHOOL GIRLS

May 16, 2016

Up to date on current research about STEM outreach, the Society of Women Engineers (SWE) at *Illinois* is aware that middle school is the crucial age to expose youngsters to STEM, and also that today's young people want careers in which they can make a difference. So on April 16th, 2016, SWE held its first-ever SWE (Save the World with Engineering) event, an outreach that both targeted middle school girls and showed them that through careers in engineering, they can change the world.

During the brand-new event with its fun, superhero theme, 30 or so middle school students participated in hands-on activities that gave them a chance to explore a number of different engineering disciplines as they rotated from workshop to workshop during the five-hour event. Probably just as important, the middle schoolers also got to interact with *Illinois*' female engineering students who served as role models while acting as instructors for the event, demonstrating that girls can be engineers too. Fun activities were even planned for the parents.



A SWE participant does a circuit hands-on activity during the computer science workshop

Middle school students learn about computer engineering during *Save the World with Engineering*.

Bioengineering senior Emily Matchevich explains why targeting middle school students is so important.

> **"Middle school is the time when girls are starting to find interest in certain subjects," she explains "But sometimes, by the time they get to high school, they've already narrowed down what their favorite subjects are. So middle school is a great time to capture that. They're young enough that they're still energetic and outgoing, but while they're in elementary school, they're starting to mature, so they can appreciate the science activities we have for them. It's just a really great balance and a really great time to spark their interest in engineering."**

Ashley Williams, the SWE President for 2015–2016 and a Bioengineering senior, admits that she too was excited about participating in the event because of the new age group SWE was targeting:

"I came so I could help middle school girls be introduced to engineering. This was our first big middle school event that we've ever done, and it's really exciting. I definitely wanted to be a part of it. I love doing different outreach events with our section."

A middle school girl launches the glider she designed during SWE's Aeronautical Engineering workshop.

Did Williams see any girls who might be future engineers? "I saw quite a few," she admits. "I am very excited to see where they're going to go. A lot of them are on the cusp of high school, so this is when they really start deciding for themselves where they want to go and what they're going to do. I saw budding curiosity in all of them. They asked such good questions, and they're all really into it. That's such a great thing to see before they go into high school."

Quyen Ngyen, a Chemical Engineering freshman, says she wanted to be a part of the in to give youngsters something she didn't have at their age—a grasp of what the different engineering disciplines are.

"I really like the outreach because I remember when I was in middle school," she acknowledges, "and I didn't really know about what type of engineering there was. So this really exposes girls to what type of engineering it is or gives them a tangible example of what engineering is. I asked one of the girls and she said that chemical engineering was just pouring a bunch of things together!

Ngyen also says she encountered some future engineers at the event. "I definitely saw some when I asked them if they knew what distillation was and they were like, 'Oh yeah, we did an example in class last week.' and I was like, 'I never did examples of what distillation is!' I actually just did a distillation thing in lab last week, so they're ahead of us!"

According to Ashley May, one of SWE's co-Outreach Coordinators for 2015–2016, *Save the World with Engineering* can be a wake-up call for many of these young girls career-wise. She hopes that it might cause them to consider engineering careers and provides the incentive to take the high school courses necessary to achieve their goals.

A middle school girl is enjoying herself despite having issues with the concoction she's making during SWE's Bioengineering workshop.

A middle school student makes a circuit during SWE's Computer Science workshop.

"I think this is probably the first time girls of this age get to see anything relating to the field of engineering," acknowledges May, "because a lot of times you don't really start thinking about college majors like engineering until high school. I think this is really going to be an eye-opening experience for them to see that this is a career path, because you don't really take any engineering-related classes in middle school. So this is something for them to look forward to that might help them decide what kind of classes they want to take in high school and start shaping their dreams for the future."

Ashley Williams, SWE President for 2015–2016, helping teach the Chemical Engineering workshop.

ILLINOIS MATH WOMEN SEEK TO KEEP KIDS, ESPECIALLY GIRLS, IN THE STEM PIPELINE

June 3, 2016

University of Illinois Mathematics PhD students Michelle Delcourt, Melinda Lanius, and Claire Merriman are passionate about sharing research level mathematics with the local community and encouraging area kids to study mathematics. All three are actively involved in organizing mathematics outreach events through the *Illinois* Geometry Lab (IGL) and the *Illinois* chapter of the Association of Women in Mathematics (AWM). Events include Sonia Math Day, Summer *Illinois* Math (SIM) Camp, and Girls Engaged in Math and Science (GEMS).

A national organization, AWM's mission is to support women; it's open to anyone who believes women should be involved in math. While *Illinois*' chapter, which is primarily comprised of graduate student women, has around 20 members who regularly come to events, both male and female math students participate in many of the outreaches and coed social events they hold.

Delcourt, Lanius, and Merriman have all been graduate student leaders of the *Illinois* Geometry Lab. Additionally Delcourt and Lanius are currently members of AWM's executive board and its three committees: Outreach, Academic, and Social. And each is integrally involved in many of math's outreach activities.

Merriman explains the philosophy behind their outreach events: "The math that you see in schools is very useful, but this more creative and discovery-driven process that's more driven by questions than by answers is closer to how mathematicians actually work. We're hoping that if we show kids this early, then they will actually be excited about studying math." So this is the philosophy behind the activities for AWM's major outreach events, such as Sonia Math Day.

In its fourth year, Sonia Math Day is an outreach for 8th–12th grade girls held in both the fall and the spring. At the spring 2016 event on Saturday, April 23rd, nine girls spent the day with *Illinois* math students, playing math games and discovering that math is fun...and that it's not just for guys.

To help the participants feel comfortable working with the leaders and each other, the day's events began with an icebreaker. Then the workshop leaders introduced the girls to important women in math, such as Sonia Kovalevsky, and explained why there's a day named after her. The girls also learned about Maryam Mirzakhani, a winner of the 2014 Fields Medal. Mirzakhani was the first woman ever to win the prestigious award—the highest award a mathematician can receive.

"We want these young girls to know, 'You can be a mathematician, and there are a lot of very successful women who are mathematicians!'" exclaims Lanius.

Many of the day's activities involved math games centered around the torus (which is like a hollow doughnut). While classified as "hands-on," the games actually involved the entire body, as girls played Simon Says, Tic Tac Toe, and Twister, all adapted to the torus.

Melinda Lanius, (right) 4th year Math PH.D. student, during Sonia Math Day activities.

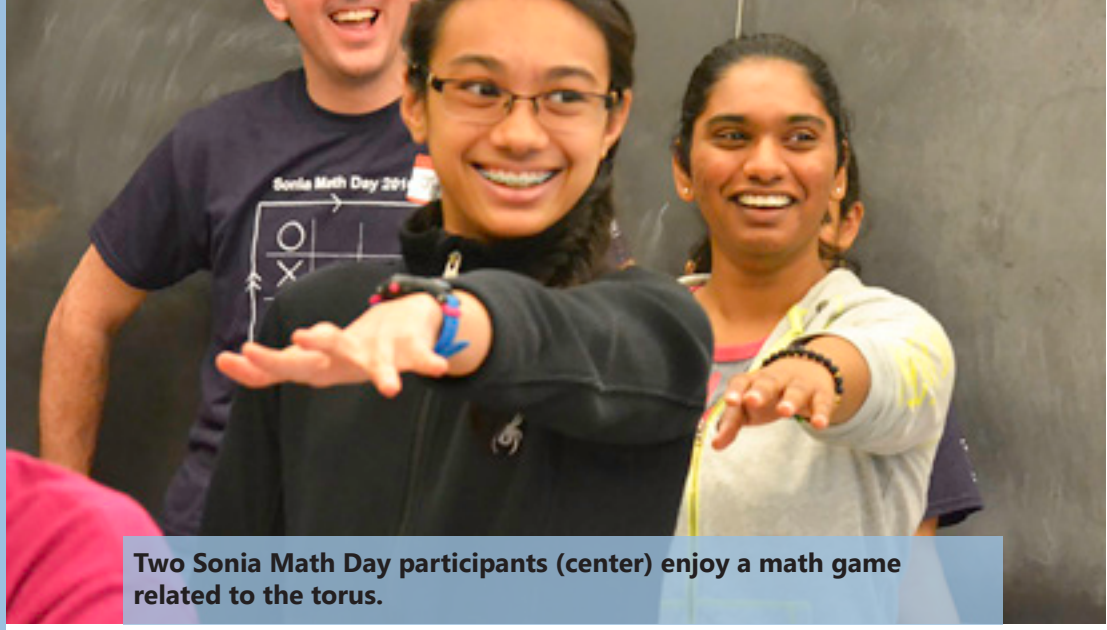
"By grounding the math in games that a lot of people are familiar with," explains Lanius, who does outreach for both IGL and AWM, "they're really going to get familiar with this doughnut concept. They're playing a game; it's a lot of fun. It's great for everyone involved."

Some of the math principles the girls learned dealt with low dimensional topology. Lanius explains that the students learned they could "build these objects using what we call 'pairs of pants,' or cobordisms. So if you imagine taking this kind of hollow doughnut and slicing it a certain way, you get what looks like a pair of pants.

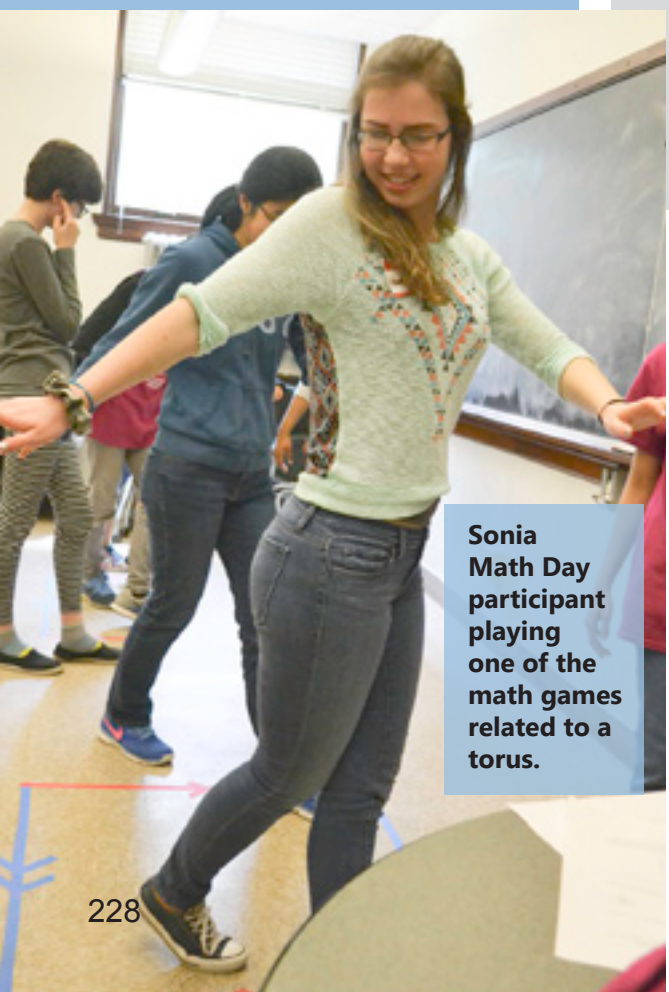
So imagine a pair of pants. There are two holes where your feet go through, and a hole for your waist. It's a fun fact that all of these surfaces that I've described have what we call these pants decompositions. You can use the pants to assemble them."

Lanius, the AWM Outreach Committee Chair for 2016–2017, reports that the kids have difficulty grasping the idea that they are actually learning math while playing fun games.

"It's always amazing each year when that student has that 'aha!' moment—when they're like, 'Wow, this counts as mathematics?'" she explains. "They think memorizing the quadratic formula and executing it is math, but that really isn't the type of mathematics that we do as researchers. Our practice as mathematicians is extremely creative, and we think about things, like the hollow donut—that counts as mathematics."



Two Sonia Math Day participants (center) enjoy a math game related to the torus.



Sonia Math Day participant playing one of the math games related to a torus.

She goes on to explain that part of their motivation is to show kids that they shouldn't put math in a box:

"There's a place in mathematics for every kind of person," acknowledges Lanius. "There's an area of mathematics for artists who like to visualize putting things together, and there's things in mathematics for people who really like paying attention to close details and working things out."

"Or want to work on real-world problems," adds Merriman.

"We're just trying to open up that scope for them," Lanius continues. "They really think that math is just memorizing things. We're trying to show them that there's this vast world and there's a place there for you."

In its second year, Summer *Illinois* Math (SIM) Camp is a free day camp run by female math students. Lanius shares an anecdote about how the camp came to be:

"Claire and I were at a conference in Texas. We were just chatting over coffee and were like, 'You know what would be an awesome thing? We really enjoyed camps when we were kids!' And Claire recognized that we have a lot of outreach through AWM for women in high school, but we had nothing for both genders at the high school levels. And we don't have anything in the summers. So we thought it would be so much fun to do this. Two weeks later, she went and started asking for money, and she made it happen."

"I had a vision," Lanius continued, "and Claire executed it!"

They applied for a public engagement grant to fund the camp. Claire recalls going to Michelle Delcourt who at that time was the president of AWM and the other outreach manager in the *Illinois* Geometry Lab (IGL). "I told her, 'We don't have anything in the summer!' and she was like, 'Here's a grant to apply for.'" The Math Department also helped fund the camp. The 2016 SIM Camp is funded by the above two, as well as a number of other agencies, including the National Science Foundation.

"We're truly lucky at *Illinois* to have all of these opportunities and all of this support," acknowledges Michelle Delcourt. "Our department

Two math grad students participate in an activity during Sonia Math Day.

in particular has been very generous, as well as the Office of Public Engagement as far as funding and supporting these programs and these initiatives, and we hope to continue this into the future."

While 23 kids 9th–12th grade attended the first SIM camp in 2015, the summer 2016 camp is expanding, with more students and a larger age range. There will be two camps with about 20–25 students attending each:

- **SIM Camp Delta** from July 18–22 will be for middle schoolers (8th and 9th grade).
- **SIM Camp Epsilon** from July 25–29 will be for high school students (9th–12th grade).

Evidently an inside joke only mathematicians can appreciate, the names of the camps, Epsilon and Delta, are common Greek letters used in mathematical proofs. "So that's why it's cute," admits Merriman, who acknowledges that those of us who are not mathematicians don't get it, and relates that among the blank stares she gets from folks upon hearing the camp names, "There'll be the random mathematician who goes, 'Oh, that's so cute!' says Lanius, then adds, "I was talking with people from the department over the weekend, and they all appreciated it a lot!"

Because it's free, the SIM camps specifically target kids who normally might not have an opportunity to go to one because they're so expensive:

"So it's important that it's free and accessible for the communities that couldn't normally afford this," explains Merriman, "for students who don't normally have these opportunities to be able to apply. The kids who have opportunities are welcome as well. Certainly, we won't let the financial aspect be a problem."

In fact, the ladies are particularly targeting Champaign County schools and are working with the principals to make sure the kids know about it, and that, "We really want them to apply," says Lanius.

Another AWM outreach for girls is GEMS (Girls Engaged in Math and Science), a math workshop for 6th–9th grade girls. Fall 2015's GEMS: Adventures in Geometry was held for three Saturdays in October at the Orpheum Children's Science Museum and addressed Conic Sections, Ruled Surfaces, and Surfaces of Revolution.

The AWM doesn't just do outreach. In addition to the Outreach Committee, AWM also has two others: Academic, and Social.

As the chair of the Social Committee in 2015–2016, Lanius' goal was "Making sure we're bonding and staying connected," she explains. Some social activities, usually coed, included Casual Coffee ("Every couple of weeks, we had this casual coffee, where we could all support one another, hear what's going on," explains Lanius), and Study Breaks (snacks and an activity). To get into the Christmas spirit, they took a trip to a Reindeer Ranch in December. In early April 2016, they held a spring luncheon. ("That's an important

Left to right: Math Ph.D. students Lanius and Claire Merriman

event where the younger students get to meet the older students, and the faculty come in and they share and support us, so there's kind of that mentoring aspect.") As Social Chair, Lanius also instituted a Buddy System in Fall 2015, where incoming first year grad students signed up to have a mentor (this was for everybody; it wasn't based on gender or only women who are AWM members).

AWM has also organized a Graduate Student Colloquium series, which is the responsibility of the Academic Chair, which is three or four times a semester. "That has become quite popular," says Lanius. "Faculty are coming to it."

Girls participating in Sonia Math Day play Simon Says on a torus.

While Delcourt, Lanius, and Merriman are extremely busy Ph.D. students, they make time in their schedules for outreach, hoping to do something about the bad rap math gets. Besides showing youngsters of both genders that math is fun and that they can do it, they especially hope to be role models for girls, to let them know that they can be good at it too.

For example, Michelle Delcourt, currently a manager for IGL, who has held positions in AWM ranging from president to outreach director, explains that she wants to make sure today's youngsters discover that math is fun.

"These are truly the programs that I would have liked to have done as a young girl," she admits. "There are so many students that when I say that I like math or do math, the first thing that they say is either "You must be really smart!" or "I hate math!"

Children do not hate math; they love patterns and games and symmetries. But the school systems think math is memorizing formulas and derivatives and that sort of thing, which it's not. It's a creative process, and I think if you can show younger students that math is fun from a young age, they won't develop these preconceived notions."

Lanius and Merriman's goal is simple: "Keep kids in the pipeline!" exclaims Lanius. "Keep kids in the pipeline!" echoes Merriman.

"A lot of people drop out of the pipeline," explains Lanius, "and don't even think that this is an option for them. Particularly, it happens before they get to see this. We're trying to make sure the options are open and that they can make meaningful decisions."

So did the three see some mathematicians among the Sonia Day participants? "Yes, I hope so," says Delcourt. "A number of the girls were actually saying that they love math and biology and that they want to do biomathematics which is also a big field. Hopefully some of them will apply to do the SIM camp this summer as well, where we're doing a session on math biology.

When asked what impact she hoped Sonia Day had had, Delcourt's response would no doubt be echoed by both Lanius and Merriman and applicable to all of AWM's outreach events:

"I hope it's encouraging young girls to pursue careers in math or science, or further education at the very least. Ideally, we would have the next famous mathematician—the next Sonia."

The nine girls who participated in Sonia Math Day (center) and the math grad students/staff who helped at the event.

HIGHSCHOOLERS EXPERIENCE CHEMICAL AND BIOMOLECULAR ENGINEERING AT GAMES CAMP

A ChBE GAMES camper learns how to use the lab equipment during the Pumps experiment.

June 28, 2016

Twenty-four high school girls from all over the country converged on the *Illinois* campus the week of June 19th–25th for the Chemical and Biomolecular Engineering (ChBE) GAMES camp. During the 2016 edition, they not only learned about chemical and biomolecular engineering, but got to try their hand at it. After hearing about a variety of interesting aspects related to chemical engineering, they got to do fun, hands-on activities related to them—including some geared toward things that might appeal to girls—like foaming face wash and shower gel. Plus, during field trips, girls got to see first-hand what a career in chemical engineering might be like.

In its fourth year, the 2016 ChBE GAMES camp for girls from 9th grade to 12th grade, drew not only local girls, but a few from Chicago, and one each from Texas and Nevada. In charge of the camp this year was Ricky Greer, a ChBE instructor, who reports that he does the camp every year to give the girls the chance to explore their career options…and to possibly recruit a few to *Illinois*.

"I just have a passion for community outreach," he admits. "Reaching out to young people and having them being able to explore different concepts, ideas, career fields—and hopefully get students to come to the University of Illinois."

Most of the week's mornings and afternoons started with a lecture by a faculty member, followed by an activity that corresponded to that lecture, led by the faculty member and his grad students. For instance, on Monday morning, ChBE Assistant Professor Diwakar Sukla gave a lecture about Computation, followed by a game reiterating the lesson material. Other lessons during the week included Catalysis, Surface Science, and Materials Synthesis by Dr. Flaherty; Polymers and Recycling led by ChBE Assistant Professors Charles Sing and Damien Guironnet; Bio Transportation plus a Hydrogel activity by ChBE Associate Professor Hyunjoon Kong; and "Crystals All Around Us," a crystal-making activity by CBE Assistant Professor Ying Diao.

A camper extracting some DNA.

Evidently Diao's crystal-making activity was pivotal in getting the girls excited about the subject matter. When reporting on how the camp was going, ChBE Lecturer Jerrod Henderson, who began the camp back in 2103, says, "So far so good. Started off kind of slow, but today (Wednesday) I think they kind of

had their break-through moment. They were making crystals out of chocolate. So that livened them up!"

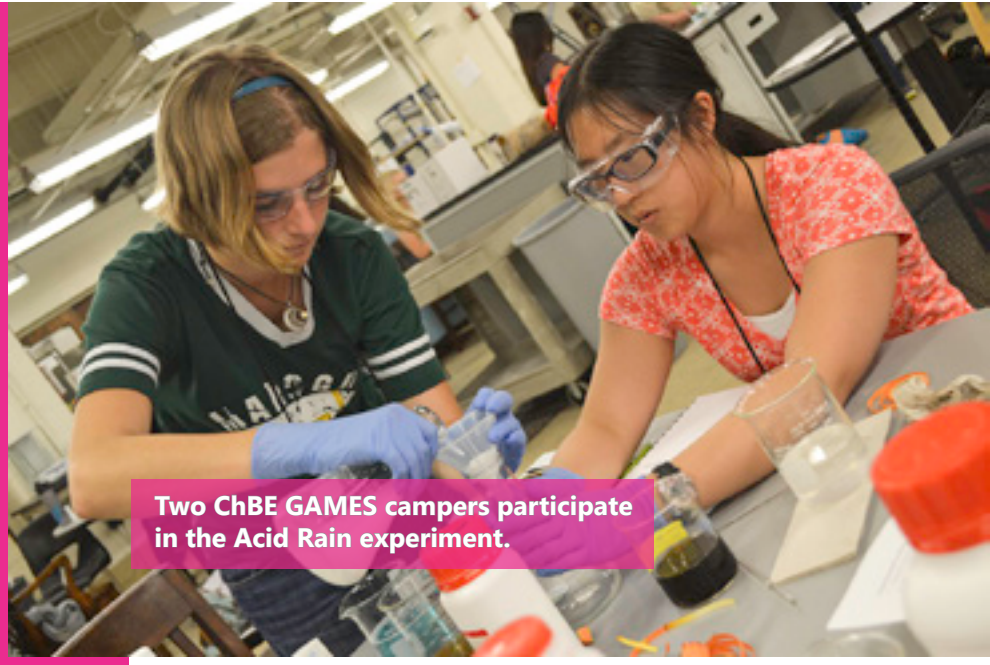
To give students additional hands-on experiences, students rotated through a set of six basic operations, many of which allowed the students to learn about and use the machines in the lab. The experiments included:

1. Pumps
2. DNA Extraction
3. Polymer Extruder
4. Enzymatic Cleaning
5. Batch Distillation
6. Acid Rain

According to Henderson, the pumps experiment was new for 2016. "So the ladies are looking at how different fluids flow in pipes, and how they're pumped. They're looking at water, and something that's more viscous, liquid clorox too."

To give the girls additional exposure to what a career in Chemical Engineering might be like, several field trips to Illinois businesses were scheduled during the week. For example, the campers visited the Tuscola ethanol plant of Lyondell Basell, one of the world's largest plastics, chemical, and refining companies, with 55 sites in 18 countries. They also traveled to Chicago on Thursday to tour a research and development lab of Abbott, a global healthcare company.

According to Henderson, who accompanied one of the groups on Tuesday's visit to Lyondell Basell, the girls appreciated the field trip immensely.



Two ChBE GAMES campers participate in the Acid Rain experiment.

"They had some awesome questions about engineering. Shows that they were thinking about college and beyond. They were asking a lot of questions, like, 'What is work life like for chemical engineers?' and, 'Am I going to be on call?' and, 'How did you make the decision to really stick in the field?' These young ladies over there mentioned it, the opportunity to see a plant as a high school student. They thought that was valuable."

Also, should the girls be considering a career in chemical and biomolecular engineering but need additional information, a Prospective Student Q&A session was scheduled with Kay Moran, Assistant to the Head of the ChBE Department, to answer any questions the girls might have about how to apply to ChBE at *Illinois*.

Did any of the girls decide on a career in chemical engineering as a result of the introduction to the field during GAMES? Greer believes some might be interested. "I think the overall goal is to allow the girls to explore the field," he reports. "So I'll give them the opportunity to see what the industry looks like…And we also show them the side of academia. And we also talk about other fields such as field industry, cosmetics, and things like that."

In addition to the faculty members who taught sessions during GAMES, several ChBE

Two campers participating in the Enzymatic Cleaning experiment examine stained cloths to determine which got the cleanest.

students served as lab assistants to teach the students about the equipment and guide them during the experiments…and also to serve as role models to show the girls that a woman can be a Chemical Engineer.

For example, in charge of the Polymer Extruder experiment was lab assistant, Kendra Yean, a rising sophomore in Chemical Engineering who hopes for a career in Research and Development. Yean says she participated in the camp to help the girls understand that they too could become chemical engineers: “It is a pleasure to expose the interesting side of chemical engineering to the girls and strengthen their confidence in this field,” she explains. According to Yean, the girls were very enthusiastic in learning. “They paid attention to every detail explained and also asked a lot of questions throughout the week."

A ChBE GAMES camper operates the machine during the Polymer Extruder experiment.

Yean believes some of the girls might be headed into Chemical Engineering: “I can see all of them are very passionate about Chemical Engineering, if not engineering or STEM itself. There was a day when there were no experiments for the girls, as we invited a comedian to perform, and the girls turned out to be really disappointed. I’m glad that the girls were so eager to learn new things every day.”

Yean encourages students who think they might be interested in chemical engineering as a career to attend the camp: “This camp is really eye opening to chemical engineering, and I highly recommend anyone who has a slight interest in chemical engineering to participate, as I believe your interest will boost up after the camp.”

Illinois junior Yolanda Bradshaw, an Animal Sciences major in charge of the Acid Rain experiment, wanted to participate in the camp to help steer girls into STEM…plus she attended GAMES camp herself when she was younger and wanted to have a similar impact on the girls:

“I myself was a GAMES participant when I was in middle school. Being able to give back and have an impact on young girls going into a STEM field is a very rewarding experience.”

Does Bradshaw think any of the girls are headed into Chemical Engineering, or at least engineering or STEM?

“Of course!” she says. “These girls are definitely headed into engineering. Their faces lit up during every lab and they had a lot of great questions.”

ECE grad student Lorna Edwards (right) works with a camper during the session on building their radio phones.

GIRLS EXPERIENCE ELECTRICAL ENGINEERING FIRST-HAND AT THE 2016 GLEE GAMES CAMP

GLEE campers hard at work building radio phones.

July 6, 2016

During the 2016 edition of the GLEE (Girls Learning Electrical Engineering) G.A.M.E.S. (Girls' Adventures in Mathematics, Engineering, and Science) camp, the week of June 19th–25th, 19 campers from across the US (and even one international student) not only got their heads around what Electrical and Computer Engineering (ECE) is like...they got their hands around it too. First they learned about a range of things related to ECE, like circuits, signal processing, imaging, optics, antennas, etc., then implemented what they had learned in the classroom via some hands-on projects. The idea of the camp was to expose the girls to a variety of activities that would give them a taste of what Electrical and Computer Engineering is all about.

First offered the summer of 2010, GLEE, run by Electrical and Computer Engineering (ECE) professor Lynford Goddard, was in its seventh year. The 19 participants were mostly from around the state of Illinois, along with several from California, one each from Tennessee, New York, and even one from Taiwan. According to Goddard, this year's girls had "a wide variety of interests and background, in terms of the courses that they have taken."

A number of the camp's activities were related to something most teenage girls are never without… their cell phones. The activities were designed to help them understand some of the principles that make cell phones work. For example, the girls built a "radio phone" (an FM transmitter circuit), which included learning to solder. In the circuit the girls built, they learned about how one's voice gets transmitted into a voltage signal, gets amplified, then gets radiated through the antenna. The girls also built an LED (light-emitting) calculator that can add numbers as high as 3 + 3…and display it with light.

Illinois sophomore, Elaine Houha (center) helping out with GLEE GAMES camp examines the work of one of the campers.

Some of the classes in which the girls participated involved a broad range of subjects: power and energy, optics, algorithms,

nanotechnology, and solar cells, which included a lab during which the girls tested some solar cells.

In addition, the girls toured some key university buildings: during a tour of MNTL (the Micro Nanotechology Lab) they got to experience its cleanroom lab; plus they did a tour of Beckman Institute.

Why does Goddard run a camp for teenage girls every summer? He says he wants to pay it forward:

“So I think it’s mainly thinking about the opportunities I had when I was going through undergraduate and graduate school, and the people who were influential in my decision to choose a career in engineering and science. So being able to give that back to the next generation is important to me.”

Did Goddard see any future engineers? “Oh, of course…They’re definitely motivated and just kind of seeing what they are interested in, and tailoring activities to match their interests is an important part. But, yea, I definitely do see people who are going to be very strong engineers in the future.”

Goddard is quick to acknowledge the students and colleagues who helped with GLEE.

"This camp couldn’t have been put on without the help and the support from the department; the college; women in engineering, who are handling all of the logistics for the dorms and the activities and so forth; and also the camp staff. We have two counselors, two grad assistants, four lab assistants who help out with all our programs.” He also praised the ECE folks who helped with the camp: Yu-ting Chen, who gave a lecture on Digital Circuits; Xiuling Li, who talked about nanotechnology; and Dane Sievers, who gave the girls a tour of the cleanroom lab, to name a few.

One GLEE lab assistant was Elaine Houha, a rising sophomore in Computer Engineering, who was on hand to help the campers with soldering, wiring, and debugging their projects. Like Goddard, Houha also wanted to "pay it forward." A three-time GAMES alumnus, she hoped to possibly influence some of the girls just as she was when she participated in GAMES:

"When I was in high school I did the Civil, Computer Science, and Aerospace GAMES camps. I wanted to give back and hopefully give the campers the same experience I had when I went to GAMES."

A 2016 GLEE GAMES camper testing her radio phone.

Houha was also excited to expose the girls to some of the cool things in her field and to make the week a memorable experience for them:

"I believe the camp had a positive impact on the campers because they got to see various labs, hear about some of the amazing research being done in Electrical Engineering. Being able to live on campus and use the equipment many students use during the year to build their own projects is something that stays a memory for a long time."

Like Goddard, Houha also thinks there were some future engineers...who may end up studying at *Illinois*:

"I would love to see any of the campers become an engineering student either at *Illinois* or another engineering school. I didn't solidify my career path as an engineer until the middle of junior year of high school, despite attending the

camp three times. A lot of the campers were very curious about their possible chances of getting into the engineering college, so I think a decent number will probably apply and pursue the path of becoming engineers. They all asked questions during lab, and were genuinely curious to how certain chips or parts worked beyond the explanation that was given. That's the mark of a future engineer, the ability to question and wonder—in my mind at least."

Also helping out as a lab assistant was ECE MS/PhD candidate Lonna Edwards. Edwards helped the girls understand fundamental concepts taught during the week and was also on hand to help them troubleshoot issues that they faced during experiments.

Edwards says she participated in GLEE hoping to recruit more girls into her field. "I am always interested in encouraging students who are underrepresented in a particular field, such as ECE, to 'give it a shot.' Many times, students avoid majors that society deems as difficult because they don't believe that they have the skills to do well in that area. I want the girls to understand that the ability to become an engineer isn't really a question of whether they are intelligent enough to do so, but rather a question of whether engineering interests them enough to ignite a desire to stick to it."

GLEE camp Coordinator, Lynford Goddard (left), works with a camper building her circuit.

Edwards believes the girls, besides having fun, experienced a sense of accomplishment. "I think that GLEE camp helped the girls see that although electrical engineering involves difficult concepts, it can be fun to learn, especially when the hard work pays off and an experiment works. I think that GLEE camp also helped them learn the importance of perseverance."

Did Edwards see some future engineers? "I am not certain whether they will all become engineers," she adds. "However, I do think that the girls realize that becoming an engineer is an option, if they really want it."

One BioE G.A.M.E.S. camper takes another's blood pressure during a hands-on activity.

A camper examines a cell through a microscope during a cell culture activity.

G.A.M.E.S. CAMPERS LEARN ABOUT BIOENGINEERING WHILE BREAKING DOWN STEREOTYPES

July 20, 2016

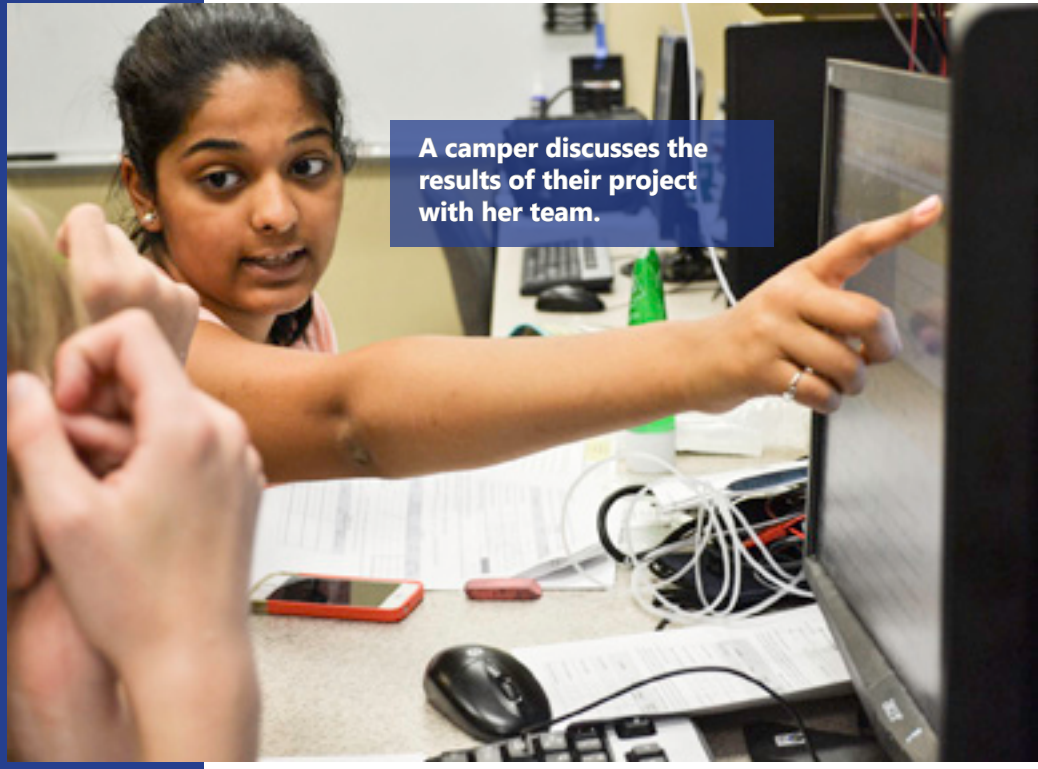
For one week this summer, 31 high school girls were exposed to the world of bioengineering (BIOE) at the Bioengineering G.A.M.E.S. camp (July 10th–15th). They learned about many aspects of bioengineering research, such as cell culture, health disparity, biometrics and 3D printing, MRIs, ethnography, synthetic biology, and much more. While the camp focuses on BIOE material, co-directors Jenny Amos and Olivia Cangellaris strive to "help [the girls] realize everything they can do as an engineer, not necessarily sticking with BIOE, but opening up their eyes to what it means to be an engineer [and] to create things to help transform the world in different ways."

This ideology is what brings these two co-directors back every year.

"Seeing the girls who come out of the camp who are just convinced they've discovered where they're supposed to be and what they're supposed to be doing… it's always great to say that you in some small way could have impacted helping them find their direction."

A Bioengineering G.A.M.E.S. camper performs a cell culture.

Jenny Amos shows campers how to take an accurate blood pressure reading during one of BIOE G.A.M.E.S. camp's activities.



A camper discusses the results of their project with her team.

Amos also adds to this by saying "Year after year, we have fun doing it because we're just us, you know—having a good time teaching the girls—but also why the girls are comfortable talking to us, following up with us, sending us notes, and then they end up coming here." Their closeness with girls and the way they keep in contact over time is astounding, and you can truly tell the impact the camp has on girls since "It's at least a handful [of the campers] that come to Illinois, whether or not they come to the one they studied or other majors."

The girls aren't the only ones benefiting from this camp, though. Cangellaris says, "I've learned a lot. I've picked up things about curricula and how you tailor things to students with different backgrounds in terms of what they know. The nice thing about G.A.M.E.S. is that it's very refreshing. It's the same with teaching in general. Every year you get a group of new people that refresh your excitement for what it is you're doing."

Amos adds to this by saying,"I benefit from it in my career; some research papers have gone out about G.A.M.E.S. camp. We try to have a lot of fun with it, but it's also helpful for us career wise, personal development wise. It's just kind of beneficial to everyone." them find their direction."

When asked what their favorite BIOE G.A.M.E.S. event was this year, Amos and Cangellaris couldn't decide since, "They're all good." When pressured more and asked which event the girls seem to have the most fun at, Cangellaris stepped up and said going to JUMP Simulation Education Center in Peoria, IL. Amos described it as "a simulation and training center for doctors in training so they learn to practice life-saving techniques or inserting IV

An *Illinois* grad student teaches BIOE GAMES campers how to perform a cell culture.

lines, things like that." Cangellaris said that this was "only the second time we've done it, but last year it was really exciting." This all-day field trip is "a very novel experience, and it's a way for them to see how bioengineering affects medicine."

G.A.M.E.S. camp isn't just teaching these high school girls about bioengineering research techniques, it's also teaching them to go out in the world and do whatever they want, no matter how society views it. G.AM.E.S. camp inspires the campers through their strong, relatable, female co-directors.

"It's incredibly important to have role models of all genders, and all ethnicities, and all kinds of backgrounds. Because it's very difficult to envision yourself doing something if you can't see someone like you doing that," Cangellaris states. That's why the BIOE G.A.M.E.S. camp is so important to these high school girls.

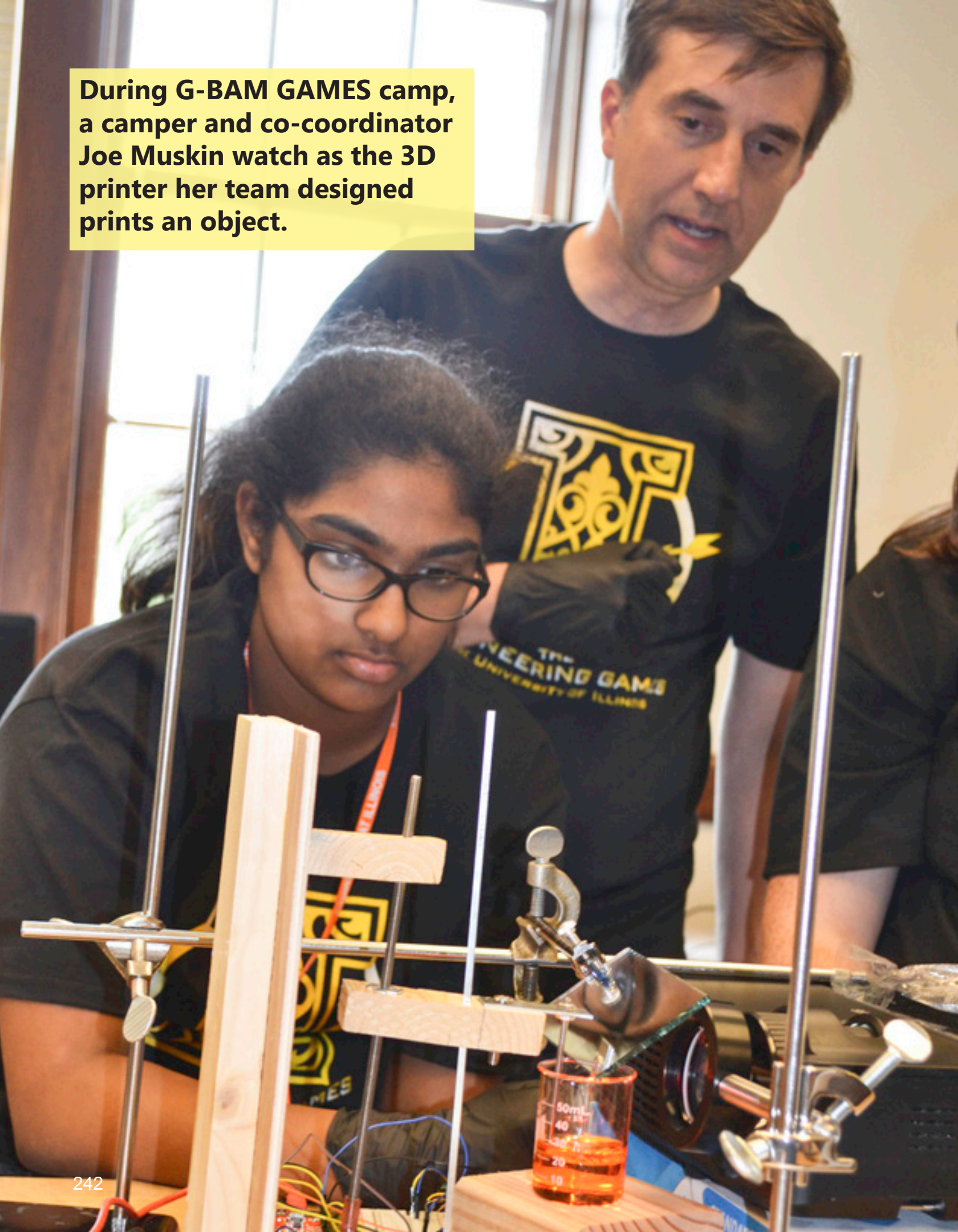
"Being able to see strong women in STEM—whether it be engineering, mathematics, or life sciences—it really helps you visualize and say, 'I can be like that person!' And being able to show you're passionate about something that in some ways people consider to be like a boys' club and maintain your own identity and have that become a part of your identity is very important," continues Cangellaris.

That's what the BIOE G.A.M.E.S. camps do; they create a warm and welcoming environment for these high school girls and expose them to many different science techniques, all while being led by two funny, friendly role models (Amos and Cangellaris) that give these young, developing minds the push to believe in themselves and that they can succeed in a stereotypical male field.

Cangellaris expands on this idea by relating it to how she personally grew up: "Growing up, I never felt that there were stereotypes I had to break away from in order to pursue a career in a STEM field, because that was never part of the conversation within our family dynamic, and their faith in me is the basis of my courage to look and work beyond (or I suppose in spite of) those stereotypes in my undergraduate career and beyond."

Now, at this camp, Amos and Cangellaris are in charge of instilling faith in these developing girls so that they can believe in themselves and pursue whatever major they want without being held back by gender norms.

A Bioengineering G.A.M.E.S. camper practices newly learned skills.



During G-BAM GAMES camp, a camper and co-coordinator Joe Muskin watch as the 3D printer her team designed prints an object.

G-BAM GIRLS LEARN TO MAKE A DIFFERENCE VIA ENGINEERING

Professor Amy LaViers (right) goes over a team of campers' choreography for the robot.

July 22, 2016

Many of today's young people want careers that allow them to make a difference in other people's lives. During the 2016 G-BAM (Girls Building Awesome Machines) G.A.M.E.S. (Girls' Adventures in Mathematics, Engineering, and Science) camp, the 24 high school girls who participated from June 19th–25th not only did high-tech, hands-on activities, such as building a 3D printer and using CAD to design and 3D print a key chain, and fun stuff, such as writing a program for a robot, then watching it do the dance moves they had designed. During other activities, like building a prosthetic device and a field trip to Intelliwheels (a start-up which designs wheels for wheelchairs), they discovered that a career in engineering could allow them to impact others' lives...for the better.

For MechSE's 2016 G-BAM GAMES camp, co-directors Associate Professor Matt West, Assistant Professor Elif Ertekin, and Education Coordinator Joe Muskin revamped the curriculum, implementing a number of exciting new activities. For instance, for the main project of the week, students designed then built their own 3D printers...then were actually able to print tiny models on them.

Two of LaViers' grad students work with the RAD Lab's robot.

One new activity that was a hit with the participants (and this reporter) was led by MechSE Assistant Professor Amy LaViers and several students from her RAD Lab (Robotics, Automation, and Dance) which uses dance to design systems that control robots. During this activity, first the teams of girls choreographed a dance move routine, then the routine was programmed into the robot. At the end of the session, amidst lots of smiles and spontaneous laughter, each team gathered around the robot and did the dance moves with it.

On a more serious note, to remind the girls of the important role engineering can play in making a difference in people's lives, students were given a scenario about a young female amputee and asked to custom design a prosthetic device for her.

In addition, students visited a cleanroom, made a key chain they had designed with CAD (computer-aided design), and learned about copper tape and programming arduinos, material testing, and microfluidics.

Students also took a couple of relevant field trips to *Illinois*' Research Park to visit Caterpillar, where they did hands-on activities and got some fun freebies—baseball caps with the Caterpillar logo. They also paid a visit to a new startup, Intelliwheels, whose co-founder and CEO Scott Daigle got both his BS and MS degrees at *Illinois*. While on campus, he designed a wheelchair with gear-shifting technology similar to a bicycle, and

now his company, IntelliWheels, designs wheels to improve the efficiency and usability of manual wheelchairs. Daigle introduced visiting students to his engineering philosophy which involves really listening to clients in order to create products to help solve their specific problems.

One "hands-on" activity campers enjoyed while at Intelliwheels was a wheel chair relay involving two different wheelchairs—a low-end wheelchair and a high-end one featuring some of Intelliwheels' high-tech wheels. While lots of fun, students also learned some things, as they not only experienced the differences in the usability of different types of chairs, but also challenges persons in wheelchairs regularly encounter, such as uneven pavement, ramps, and how to navigate differences in height between streets and sidewalks—exactly the kinds of things an engineer would need to consider when designing a product that would meet the client's needs.

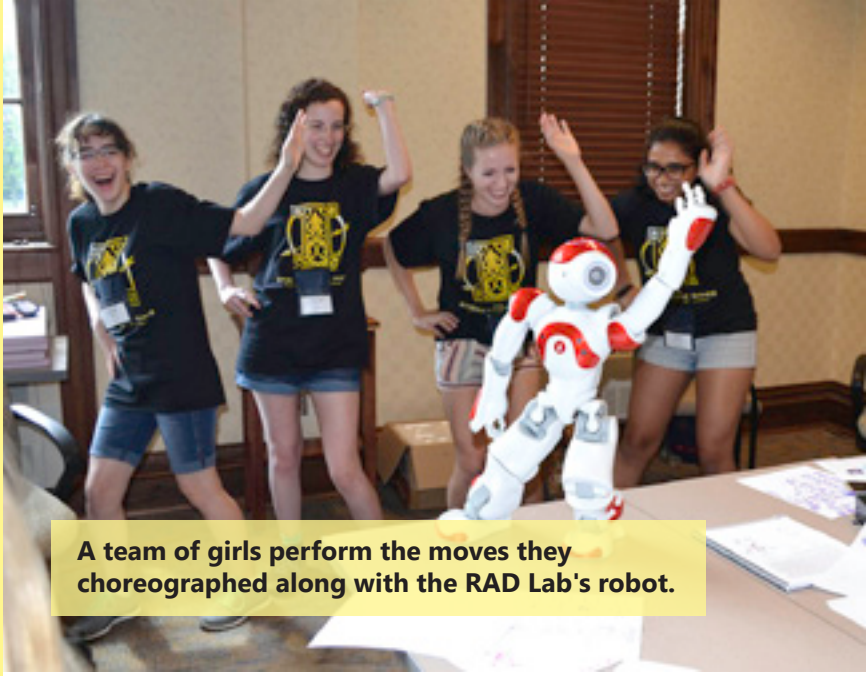
Most of the 2016 G-BAM GAMES campers, who came from Illinois, with a few from other states, participated in the camp because they were interested in engineering. For instance, rising senior Carolyn Simon, from Highland Park, Illinois, came to camp because she's interested in finding out more about *Illinois*.

"Well, my parents heard about it because we were interested in the University of Illinois, and it sounded like fun."

"Does Simon think she'll become an engineer? "Yea, I think so," she says.

Bryce Marin, another rising senior who goes to school at MICDS (Mary Institute and St. Louis Country Day School) in Missouri, says she too will

A team of girls waits for their 3D printer to print out their image.



A team of girls perform the moves they choreographed along with the RAD Lab's robot.

probably become an engineer. Will she choose mechanical engineering? "Probably, I guess," she says. "I'm keeping my options open, but it seems really fun so far."

Marin says her favorite part was the biomechanical activities, "Except the coding part was pretty fun, too, and building the 3D printer. So yea, they're both fields of mechanical engineering."

While the campers might hope that they've got the right stuff to one day become engineers, co-coordinator Matt West, who knows what it takes to become an excellent engineering student, says he definitely saw some future engineers in this year's crop of campers:

"We have seen a lot of good creative thinking, really good problem solving," he acknowledges. "I've seen people really excited about the idea of doing engineering, and using engineering to help people."

West explains that that aspect of engineering, being able to help people, was really important to the G-BAM campers.

"A message that really resonates with a lot of the girls is being able to get out there and actually make a difference by building new things, solving things for people."

He goes on to describe the field trip earlier in the week to Intelliwheels. "That story, I think, really resonated with the girls," he adds.

"So if you want to actually help somebody who is disabled, for example, with engineering you can actually make a difference in their life."

West also calls the new 3D printing activity "a really nice and noble project…Very slow, and they can print very small things," he qualifies. "But to go from nothing to a functional 3D printer is astounding. Absolutely."

West was pleased to have *Illinois* undergrad and GAMES camp alumn Abby Pakeltis serve as a counselor for both MechSE's GAMES and WYSE camps. Pakeltis was excited about participating in the camps because of the impact GAMES camp had on her in high school. In fact, it had such a great impact that she is currently a student in Mechanical Science and Engineering. So she hopes to play a small part in the camps having that same kind of impact on this year's crop of campers.

"I wanted to be a counselor for the camps this summer because I have experienced the fun and excitement of GAMES camp when I was in high school. Now, as a student at UIUC, I still connect with the counselors that I had as a camper. Having real engineering students to ask questions of and simply have fun with is a unique opportunity that these camps provide. Because I made friendships with my counselors that continued into college, I was eager to come back to camp as a counselor for this year's campers."

As a GAMES alumnus, what was it like being on the counselor end of things?

Pakeltis reports that "Being the counselor for these camps gave me the chance to see the campers find their passion in engineering with activities that I participated in as a camper. I loved watching the campers become so excited to participate in these activities." She found it particularly rewarding to "be able to relate to them stories of when I went to camp."

Pakeltis was particularly impressed by the campers' dedication and drive to finish their projects.

"Each day, the campers did not want to leave their projects. They would have been happy to keep building and perfecting their machines all day—which made me smile."

Pakeltis believes the camps allowed students to do activities related to what might become their future careers: "Each week, I watched as the students with a variety of experience in engineering participated in the activities. Whether the campers were familiar with certain topics or were learning them for the first time, they all spent the week realizing their passion for learning and creating. During the camps, I would ask the students if they knew what they wanted to design or develop as engineers… Many of them had a chance to build or experience these possible future careers."

G-BAM campers and one of Professor LaViers' grad students (right) enjoy watching the robot perform dance moves the campers choreographed

Aerospace GAMES campers react to the flight of one of their fellow camper's model aircrafts.

AERO GAMES CAMPERS SOAR WITH NEW AEROSPACE KNOWLEDGE

July 26, 2016

From July 10th–16th, 30 girls from *Illinois* and a few other Midwestern states attended Aerospace G.A.M.E.S. (Girls' Adventures in Mathematics, Engineering, and Science) camp. Besides learning about the diversity of an aerospace engineering degree, they also had what was most likely another new experience for most of them—being with a large group of girls who have a similar interest in STEM. Plus, as the pièce de résistance, after spending the week learning about aeronautics, they designed, built, then got to actually launch a glider and a rocket. Based on the week's activities, the girls got a taste of what college life at Illinois is like, and many are considering Aerospace Engineering at Illinois. And if camp director Brian Woodard has his way, “Hopefully we can recruit them,” he admits.

Aerospace GAMES camper, Veronica Lee, shows off the glider she designed and built

Most days the girls had class and labs on aerospace topics, such as astronautics and aeronautics design, rocket propulsion, aerodynamics, wind tunnel lab, orbits, and structures and materials. They also had some out-of-classroom experiences by going to the University of *Illinois* Observatory, where they learned about astronomy, and a field trip to Willard Airport, where they learned about all the different opportunities an aerospace engineer has at an airport. At the end of every day, the girls had about two hours to work on their own gliders and rockets that were going to be launched during competitions on the last day of camp. For the glider competion, the winner would be the one with the longest flight time. For the rockets, there was an added dimension:

“They’re launching rockets with an egg in it," explains camp director Brian Woodard, "and it has a little piece of electronics that measures the height based on air pressure. And so the competition is the highest egg that comes back intact."

Woodard explains why he serves as director of the camp every year:

Camper Sara Pietrzak celebrates an awesome flight by her model

“I just love to get out here and encourage all these people who maybe wouldn’t realize what aerospace is all about, and how fun it is. We build rockets and airplanes for this particular thing, but we show them how diverse aerospace is and show them that they can do so many things with an aerospace degree.”

And most of the camp's participants were definitely considering engineering—possibly aerospace. For instance, Melanie Wasson, an upcoming junior at Harlem High School in northern *Illinois*, showed up at Aero GAMES

Two Aerospace GAMES campers watch the flight of one of their fellow camper's gliders.

camp because her aunt, “found this camp online and suggested that I go to this because she knew I was interested in Engineering, and she had been to this school.” Wasson says this was the first camp she’s ever gone to.

When asked what she learned from the camp, Wasson admits, “a lot about aerodynamics and a lot of aerospace stuff that I didn’t know before.” She’s “70% sure [she’ll] do aerospace” at *Illinois*. “There are still other things to look at,” she adds, “but this is high on the list.”

How’d she do at the camp? Her rocket reached 800 feet in the air and her egg didn’t break, even though the parachute didn’t deploy.

Veronica Lee, a rising senior at Downers Grove North High School in *Illinois*, also came to Aero G.A.M.E.S. to find out more about Aerospace Engineering. She admits, “I came to this camp because I’ve always been interested in engineering in general, and U of I is my number one choice. I want to be a mechanical engineer, but aerospace is also something that I’m interested in. This is my first GAMES camp, and I’ve had a lot of fun. It’s really cool.”

Lee says she “learned more about the theory side and how generally it’s applied about aerodynamics.” She indicates that she “also learned more aerodynamics and fluids, and how weight is really important in general” and while she “wasn’t good at physics, [she] liked the challenge of it.”

Her favorite activity of the week was the visit to the airport: “That was really cool!” she reports. “We went up to the control tower. We didn’t get to fly a plane—the weather was kind of bad this year so they couldn’t do it. Just thinking of all the jobs in the airport and how it all works and comes together is really cool.”

Lee found the Aero GAMES camp to be a great preview of college: “I definitely think I got a feel for more of a college environment,” she reports, “kind of squeezing all this material into a week and seeing how everything is applied and works.”

Lee reports the camp did a good job of providing real-life, practical applications to theoretical learning she’s gotten in school; however, what she sometimes found challenging was “trying to separate what I’ve already learned and what I’ve newly learned and to try and make sense of it all. Because you go through all these things and theories, and then you come here and see how it actually works. This is how it works in real life, and this is the math behind it.”

Lee definitely appreciated being with a bunch of other girls who were also passionate about STEM: “I think also trying to see more people interested in the same thing is really cool. Because I don’t usually get people who are all interested in science in the same place. It’s really cool.”

Lee highly recommends this camp to any girl who’s interested in engineering: “I really think GAMES camp should be for everyone. I don’t think the price should deter anyone, and I really think that if you apply it, and this is what you’re really into, then it’s a great place to bring minorities and women and girls all together who love STEM.”

Like Lee, Nidhi Kadiwala, an upcoming junior at Main East High School in the Chicago suburbs is also interested in engineering, and that's why

she attended: "I was really interested in Engineering and I wanted to try something new," she says.

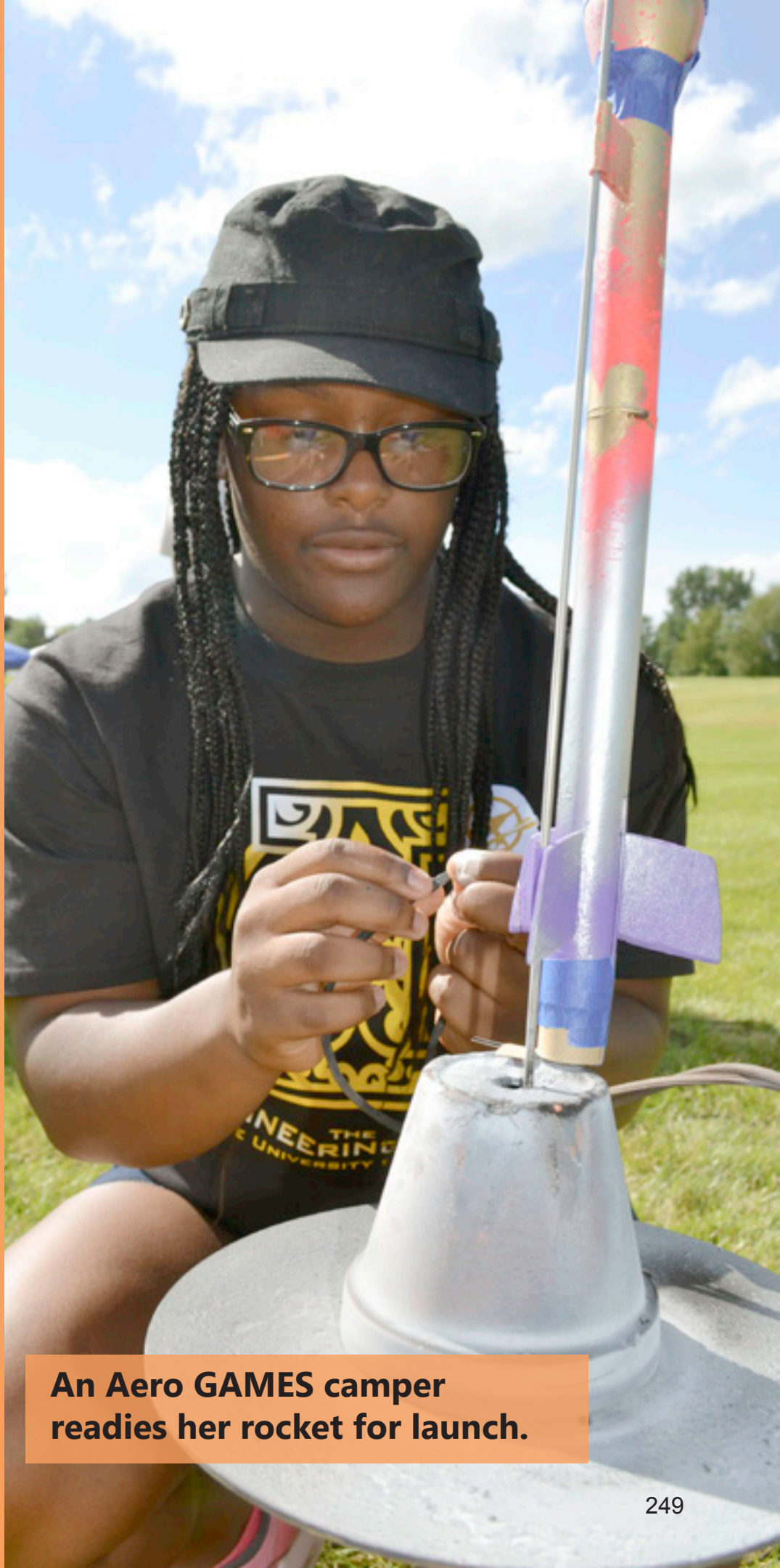
Although her dad is an engineer, she says he never pushed her into the field. In fact, this was her first camp. Nadiwala says she really liked it.

"It was very informative, and I learned a lot of stuff. My dad's an engineer, so I wanted to go into something similar. And I really liked physics, so I thought this would be cool."

Like Lee, Kadiwala also learned a bit about what college is like: "I definitely learned how classrooms work in college. There's a lot of walking."

While most Aero G.A.M.E.S. campers weren't settled on what their major in college will be, many were definitely considering Aerospace Engineering. When asked about it, Kadiwala replied "Definitely one of the things I'm considering. Haven't pinpointed it exactly, but, yes, definitely considering it," and Lee admits, it's "something I'm interested in." Many girls attending this camp were also strongly considering attending University of *Illinois*, Urbana-Champaign, and camp director Woodard acknowledges, "Hopefully we can recruit them." He adds an interesting statistic that speaks to the success of the Aero GAMES:

"We here at *Illinois* have been increasing the number of women in Aerospace the last four years, and hopefully we can keep that going with these camps."



An Aero GAMES camper readies her rocket for launch.

GAMES CAMPERS PASSIONATE ABOUT SAVING THE PLANET LEARN ABOUT ENVIRONMENTAL ENGINEERING

Two Environmental Engineering GAMES campers test water quality at Boneyard Creek.

August 4, 2016

The 2016 Environmental Engineering and Sustainability G.A.M.E.S. Camp was a perfect experience for 20 high school girls who have a passion for saving the planet. This one-week camp addressed many facets of Civil and Environmental Engineering (CEE), ranging from water quality, air quality, renewable energy, and sustainability, and gave the girls some exposure to what a career in environmental engineering might be like.

The 2016 Environmental Engineering and Sustainability G.A.M.E.S. Camp was in its sixth year of operation led by the creator and co-director of the camp, Sotiria Koloutsou-Vakakis, who was originally inspired to start the camp because of her daughter's positive experiences at G.A.M.E.S. camps years ago. Koloutsou-Vakakis says she keeps on doing it because she loves teaching: "I do games camp because I love working with students of all ages."

Environmental Engineering GAMES campers analyzing results of water quality at Boneyard Creek

One of several graduate students who helped out with this year's camp was Mary Foltz, a CEE graduate student in Environmental Engineering whose research focuses on nitrogen cycling in agricultural fields. According to Foltz, because the camp's activities touched on a wide range of environmental engineering issue, this dovetailed with the girls' wide spectrum of interests.

"Some really enjoyed the outdoors lab where we tested water quality at Boneyard Creek. Others were really interested in computer modeling and mapping software we utilized throughout the camp. Still others liked the tour of Abbott Power Plant and learning about how interrelated water and energy are. Luckily, there was something for everyone with the large variety of topics we covered."

Like Koloutsou-Vakakis, Foltz indicates that she also got involved with the camp because of her love of teaching.

"I participated in the GAMES camp mostly because I love teaching," he admits. "Before coming to graduate school, I spent a year teaching science at an alternative high school outside Chicago. Although I love the classes and research I am involved in here at UIUC, I really missed interacting with students and being a positive role model for them. GAMES gave me the opportunity to share my love of environmental engineering and science with the girls."

Environmental Engineering GAMES camper works on tidal wave project.

Foltz was also motivated by the desire to do a little recruiting—she wanted to "hopefully encourage them to consider engineering and UIUC for their future."

Did she also hope some of them would end up in CEE? Foltz indicates that many of the participants discovered that environmental engineering is the field for them. "I know several of the girls will end up in civil and environmental engineering. Many of the girls came in wondering what exactly we do as engineers and what their future could possibly look like going this route. After learning about the diverse areas you can get involved with through civil and environmental engineering, many girls realized this was the field for them."

Foltz indicates that having some of the girls discover that engineering or CEE was not the field for them was equally important: "The camp was still beneficial for those who determined that this field wasn't for them after all, because at least they figured that out now rather than three years into their college studies like some students these days do."

Like Foltz, Koloutsou-Vakakis reports that she too definitely saw some future engineers in the group—and possibly some in her own field—and also hopes they end up at Illinois. "Most of these students this year, they chose this camp intentionally. It was their first choice. That's what they told us. And they're planning a career in sciences or engineering. We hope they come to the civil engineering and environmental engineering."

According to Koloutsou-Vakakis, because the group was comprised of mostly juniors and seniors this year, they were hoping for some input regarding CEE as a career. "So they're definitely looking for their future major and career," she explains. "We also have some sophomores who are just exploring."

Of the group of mostly juniors and seniors, Foltz also believes many of the girls got some help regarding their decision making about their future career:

"The most important impact I think the camp made was helping the girls decide if engineering, and more specifically environmental or civil engineering, was for them. They came in with so many questions and uncertainty and left with a good sense of direction."

GAMES camper measures & analyzes the output of her wind turbine.

Devon Goszkowicz (right) watches as a GLAM camper makes an adjustment while 3D printing an object.

GIRLS LEARN ABOUT MATERIALS SCIENCE AT THE 2016 GLAM GAMES CAMP

August 9, 2016

As its name implies, during the 2016 edition of GLAM (Girls Learning About Materials) G.A.M.E.S. camp, 19 high school girls did just that. From July 10th–16th, the girls learned about a wide variety of materials, ranging from polymers, to biomaterials, to a material that's a favorite of girls everywhere— chocolate. Plus, and probably more importantly, the girls were exposed to numerous female role models in materials engineering.

In its sixth year, the Material Science and Engineering (MatSE) Department's GLAM GAMES (Girls' Adventures in Mathematics, Engineering, and Science) camp featured numerous hands-on activities. They learned about 3D printing with polymers while 3D printing some tiny figures to take home. They discovered the intriguing properties of non-Newtonian fluids; they experimented with composites, such as memory metal; and they not only got their hands on several kinds of chocolate as they learned about its material properties, but they got to taste them—all in the name of science.

Two of the many role models the participants were exposed to all week long were GLAM's co-coordinators: MatSE Ph.D. student Kaitlin Tyler, whose research involves working on manipulating eutectic material microstructures for optical applications, and MatSE Assistant Professor Jessica Krogstad, whose research focuses on material performance in extreme environments (like gas turbine engines and nuclear reactors). While 2016 was Krogstad's first year as GLAM coordinator, she's not new to GAMES; she served as a GAMES counselor as an *Illinois* undergrad when she got her BS degree in MatSE in 2007.

When asked why she got involved GLAM, Jessica answered

"I was also a camp counselor for the overall GAMES program as an undergraduate and I saw first hand how much the campers enjoyed it. So when I ended up back here at *Illinois* as a faculty member, I knew that I had to find a way to get involved again."

MatSE Ph.D. student (left) holds the tiny figure this team of GLAM campers has just 3D printed.

Jessica assisted the students with many of the activities they worked on this summer. According to Jessica some of the favorites activities were Biolectronics, fracture behavior of chocolate, Casting, and their new design project using every-day materials.

Kaitlin Tyler has been serving as the coordinator of the GLAM camp for four years. She takes a week out of her summer to do this camp every year in hopes of passing on some of her excitement about engineering to the campers:

> **"Because I love interacting with the students," she acknowledges. "I love seeing them getting excited about engineering and sharing something I am obviously passionate about, as I am a graduate student in Materials Science. I obviously enjoy it. And being able to spark that passion into other people is really fun. I like it."**

One person in whom Tyler definitely sparked that passion is MatSE undergrad Devon Goszkowicz, who has worked as a lab assistant in GLAM twice now—both last summer and again this past summer. According to Tyler, Devon was a GLAM camper her first year as coordinator. Then, a year

Left to right: A GLAM GAMES camper makes an adjustment while 3D printing an object as MatSE junior Devon Goszkowicz watches.

later, Tyler served as Devon's TA when she was an *Illinois* freshman taking the "Intro to Materials Science" class.

Goszkowicz, who will be a junior in MatSE this fall, indicates that it was because of the impact that GLAM GAMES had on her personally that she has been participating.

"I got involved with GAMES this summer because I went to GLAM Camp as a high schooler. Going to this camp is what made me realize I wanted to study Material Science, so I wanted to help out as a college student."

According to Goszkowicz, who spent a lot of time interacting with the girls during various labs, says one activity the girls particularly enjoyed this summer was casting, during which the campers make molds out of silicone, then cast an object into those molds. She reports that another was vat polymerization—a form of 3D printing where a UV light was used to cure a liquid polymer.

In addition, Goszkowicz was also the Summer Manager for MakerGirl this year, and was on hand when the GAMES campers visited MakerGirl as one of the camp's evening activities.

As it did with her, Goszkowicz believes that GLAM GAMES camp is having an extremely positive impact on the girls who attend. "At the end of the week," she says, "the girls visually appear more excited about engineering and have loved each activity introducing them to it."

In terms of its long-term impact, she also believes that "many of the girls will go into engineering after attending the camp." In fact, she reports seeing some of the girls who participated in last year's GLAM on campus.

"I have seen quite of a few of them at *Illinois*, and in MatSE here at the university," she says. In fact, I chose MatSE at *Illinois* partially due to the exposure I had to the program during my time at GLAM Camp."

Krogstad also has high hopes that many of these young girls will pursue a career in Engineering after their summer experience. Recalling the impact that the camp has on their students, she stated:

The campers always go home smiling. I recently spoke with our incoming class of MatSE freshmen women only to see some familiar faces in the audience! I've only been working with the camp for two years, and to already see those same students in my classes is awesome! GAMES has some great statistics about the matriculation of former campers into engineering programs. Our survey results from this year show that 89% of our campers are highly likely to apply to an engineering program.

A GLAM GAMES camper prepares to taste some chocolate during a hands-on activity about it.

CINDY AND STEPHANIE RICHARTZ — KEEPING IT IN THE ILLINOIS ENGINEERING FAMILY

Cindy and Stephanie Richartz, keynote speakers at this year's WIE Orientation.

September 1, 2016

Mother-daughter duo Cindy and Stephanie Richartz, the keynote speakers at the 2016 WIE Orientation (August 16–18), are both *Illinois* graduates. Both majored in industrial engineering. One major difference? While mother Cindy has been in industry and at Abbott for a while, Stephanie just recently graduated (May, 2015) and began her journey in industrial engineering. However, despite the difference in number of years in engineering, both were delighted to come back to their Alma Mater to share about their respective journeys—Cindy's years of experience as a woman engineer in industry, Stephanie's more recent experience at *Illinois* and finding a job. Both are also committed to giving back to *Illinois*, especially the Women in Engineering (WIE) program, to ensure that Engineering keeps producing a steadily increasing flow of bright young women engineers through the *Illinois* pipeline.

For both of the Richartz, though, getting to where they are today was quite a process. Even with no pressure from Mom, Stephanie was considering Engineering at *Illinois*. Torn between that and business, she shares about the deciding factors.

Stephanie Richartz (left) and her mother, Cindy, during their address to several hundred *Illinois* freshmen during this year's WIE Orientation.

"I think the way my decision was made was more my passion for math and science," she admits. Then, when you're looking at what opportunities those could bring you, I was trying to decide between business and engineering. I just really liked the more concrete answers with engineering as opposed to the more philosophical and fake structure of business in that sense."

While Cindy stayed admirably neutral during the decision-making process between engineering and business, she definitely supported and helped her daughter once Stephanie chose engineering. Since engineering is such a large field with many different disciplines, it can be overwhelming to pick only one with little knowledge about the differences between disciplines.

But once Stephanie had chosen engineering, Mom gave her a big nudge toward Industrial, right? Stephanie says no.

"I don't think that she pushed me in that direction." Stephanie goes on to describe her decision-making process: "Once I decided I wanted to be an engineer, I needed to figure out what kind was most interesting to me. So that's where I went through the different disciplines and looked at the courses that they study, and then also what positions I would potentially have after school, and kind of found that I would enjoy either industrial, general, or mechanical."

So to help Stephanie with this decision-making process, Cindy held an impromptu “Take Your Daughter to Work Day.”

“I gave her an opportunity to come into work and meet with a number of different engineers just for the day. I think she met with a chemical engineer, a mechanical engineer, and maybe an electrical engineer, just to kind of learn about what they do in industry,” explains Cindy. “Because she was trying to make this decision on what she wanted to do, and I think that at least helped her understand what they do.”

Cindy admits that figuring out the different jobs that engineers in specific fields do can be an issue. “I think the biggest challenge that a lot of kids have is, ‘Okay I have a degree, but what do you do when you work in this field?’ So that, at least, gave her a first-hand look at what some of our engineers do at Abbott and different areas.”

However, while it was extremely beneficial to Stephanie that her mom could offer this opportunity, not every parent can help their child make their decision in this manner.

“The other thing Stephanie had brought to my attention is, not everybody has parents who are engineers,” Cindy reflects. “Not everybody has parents who work in industry, who have the kind of experience I have.”

Cindy Richartz shows off the WIE Champion award she received during this year's Orientation.

But while Cindy can’t take everyone’s daughter in to work with her to help them figure out which engineering discipline to go with, she can provide support to women through a couple of different avenues: for instance, through her outreach-minded company, Abbott, which is serving as a corporate sponsor for WIE, and by all of her work with Women in Engineering, for which she received the prestigious “WIE Champion” award during the Orientation.

“I’m fortunate to work for a company that really supports STEM in a lot of different ways,” Cindy explains, “and because of that I’ve been able to continue really my passion for outreach and helping encourage women into the technical STEM fields."

Cindy also hopes some of her work with WIE might make a difference in terms of retention of women in engineering. “If I can help share some of that information and guidance with other students who maybe haven’t heard it, then maybe that will make a difference for them. Because we do know that a lot of women come into engineering too, but then a certain amount may change majors or shift course, and if we could keep them here, that’s really better probably.”

Cindy was extremely excited about serving as a co-keynote speaker with her daughter during this year’s WIE Orientation and getting to speak to a large number of the women in this year’s freshman class.

“So the opportunity here was that I could come with my daughter, who’s a more recent grad and has more recent experience, and hopefully provide some little nuggets of advice and information.” Cindy's hope is that, in the future, “if they’re going through a challenge here while at the university, they think back and say, ‘Oh, maybe I shouldn’t panic, or maybe there’s other resources I can use.’”

For a part of their talk, Stephanie candidly shared with the group about one semester in her sophomore year at *Illinois*, where she was doing badly in several courses. In fact, someone had even suggested that she might want to change majors. But through encouragement from Mama and help from a number of resources, she turned things around, learned from her mistakes, and made it through with flying colors.

Cindy was hopeful that by sharing with the girls some of Stephanie’s struggles, and how she dealt with them, the two of them could “help them understand that engineering is just an incredible career and not to let those little bumps in the road detour them from that ultimate goal of becoming an engineer.”

Some of those "little nuggets of advice" from Cindy are: "If you hit a bump in the road, don't give up. Don't change majors or do something if you really like engineering and feel that's kind of where you want to be. Look for the resources that are available to help you through that challenging period of time so that you can first of all learn from that situation and second of all recover from it and get back on track to keep moving forward through the engineering education process."

Stephanie also has some advice for students going through difficulties:

"My favorite little mantra or saying (and it can be a little bit harsh sometimes) is,

'I hate to ruin the ending for you, but everything is gonna' be ok.' That's something that my teammates used to say to me, something that I used to share with my friends. When you feel like the world is ending, you just have to realize that, at the end of the day, it's gonna' be ok. So you have to just keep on keepin' on."

Stephanie also has a piece of advice for women regarding finding their niche in engineering:

"Try anything and everything. Like try it all. If there's something that you see that sounds interesting and it's completely out of your realm of normalcy, then try it! Because the worst that'll happen is that if you apply for something maybe you don't get the position. Or if you try it and maybe you don't like it, or maybe you love it, or in the process, you learn something about your character, then you can take each of those pieces and form them into a career that you want and that will make you happy for a very long time."

Not only does this mother-daughter pair share the same major, but they also share the same love for their Alma Mater, and they want other women to love it too. A very teary Stephanie professes that *Illinois* made her who she is today:

"I love *Illinois*, and I love—gosh—the person that *Illinois* has made me. And I just want to be able to give that to everyone else because I want them to love it as much as I do. It's so recent for me still. My mom went to school a while ago, so she has like years'-worth of career and other experience that maybe give her a different perspective. But for me, *Illinois* is the most recent thing that shaped me into who I am."

She also hopes that women who end up in Engineering at *Illinois* will have the same passion for the place that she does. "I loved everything about my experience. Obviously there are little things you would want to change perhaps, here and there, but I just want all the students to be able to fall in love with this place, and this campus, and this education, like I did, so that they can project that in their lives afterwards because I think that sense of community is so important."

While Cindy may be far removed from her years at *Illinois*, she says her engineering degree from *Illinois* is still opening doors for her. "Something I've learned, especially being out in industry," she admits, "is the prestige of having an engineering education from *Illinois*. I can go to an industry conference, and when people find out I went to *Illinois*, there's a certain level of respect that you generate."

Cindy adds that, as an alumnus, she's also committed to keeping the reputation strong. "We have the top students from the top schools, and they're really the future of this institution—they're our future success. So anything we can do as alumni to help make sure they're plotting a strong course for success, I think, is part of what we should all try and aspire to."

Cindy and Stephanie Richartz outside of the new ECE building, site of this year's WIE Orientation.

LAVIERS' RAD LAB USES ROBOTS/DANCE TO STUDY MOVEMENT, PROVIDE AUTOMATION

Young robotics aficionados express their appreciattion when NAO does something we humans do without even thinking, but which is a major feat for the little guy...sitting down.

September 8, 2016

Surrounded by a crowd of laughing, cheering GAMES campers, NAO, an adorable little white and red robot, strutted its stuff, doing the moves the girls had choreographed and which it had been programmed to do. Then, like a chorus line, the team of high schoolers who had developed the routine lined up behind NAO and performed it along with the robot, amid gales of laughter.

“People think it’s so cute!” admits Mechanical Science and Engineering Assistant Professor Amy LaViers, referring to NAO, the autonomous, programmable, humanoid robot her RAD (Robotics, Automation, and Dance) Lab uses in its research. Exhibiting the tendency people have to anthropomorphize robots, this reporter, who kept calling NAO “him," asked if they thought of NAO as a "him" or a "her."

“We prefer not to use a gender," LaViers stresses. "It is a machine. And we try to educate people about the fact that it is a machine. And the coolest thing about it is that you can design its movement!”

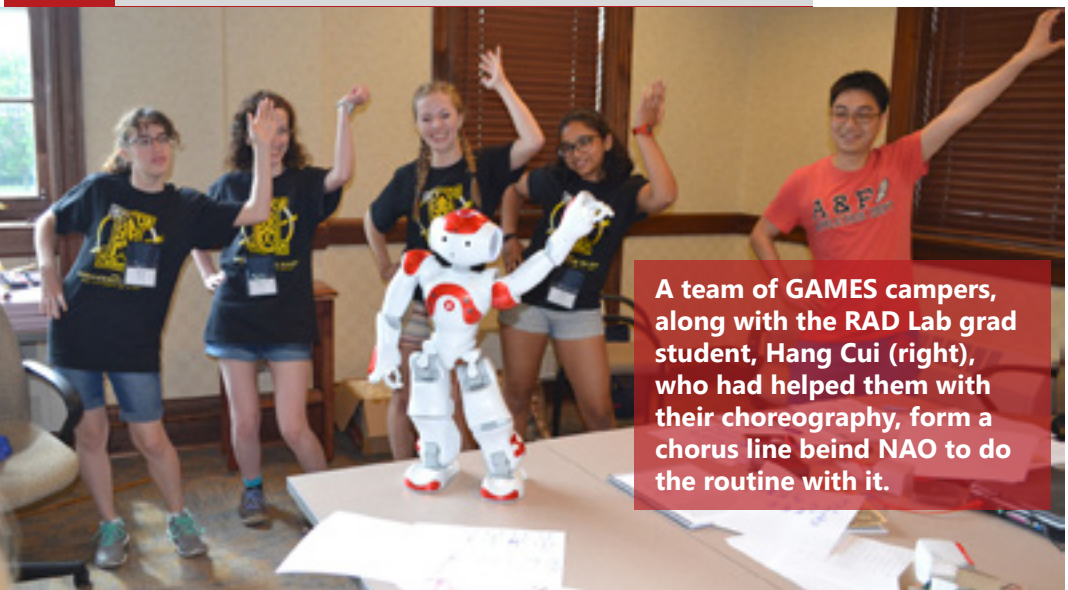
The fact that this little robot is programmable is what makes it valuable to LaVier’s lab. She says, “The GAMES camp activity was a little more interactive, and people could really see, “Yea, I can decide what it does. And that’s the power of robotics to me.”

NAO’s "older brother,” Baxter, RAD Lab’s other robot, is not quite so endearing. Rather than legs, the much larger, more imposing robot, is attached to a pedestal with wheels. Rather than a “face,” it has a monitor (which I understand can be programmed with a sort of face, though). However, like NAO, because it’s a robot, it’s still intriguing to us humans. For instance, during RAD Lab’s recent open house on August 19th, visitors were tickled to be able to control both of the robots’ movement simultaneously using a wand-like controller.

“It’s surprising how interesting it is to watch them now,” LaViers says, regarding our fascination with robots, “because its movement is so much simpler than ours. It has so many fewer degrees of freedom and so much less control of the dynamic quality of movement. But, yes, people find it very interesting to watch. “

Because of this fascination with robots, RAD Lab’s research lends itself to outreach activities quite naturally. In addition to the GAMES camp, the RAD Lab students did another outreach over the summer, where they demonstrated NAO’s capabilities to a group of robotics enthusiasts at a camp run by Ctrl-Z, one of FIRST’s local robotics clubs for 8th–12 graders.

While the robots themselves are enough to pique one’s interest, another integral part of the lab is dance. Says LaViers, “I think there



A team of GAMES campers, along with the RAD Lab grad student, Hang Cui (right), who had helped them with their choreography, form a chorus line beind NAO to do the routine with it.

is a very natural connection between what we were just talking about, which is, 'I get to decide how this machine moves,' and 'What do we do in dance? We decide how other people should move." What she's referring to is the fact that in many types of dance, such as ballet, modern dance, even ballroom dancing, someone else often choreographs the movements of the dancer.

What interests LaVier is the process: "How a person might articulate a desired movement pattern or how we might transfer an existing process movement in a person to a very different platform—the simple robots that we have."

And while their robots can currently do some standard moves based on the standard software that came in the box, the goal of LaViers' research is to improve the software, to enable the robots to perform more complex moves. Her mission? To "design algorithms for robotic control" says LaViers, to "leverage existing tools in order to create high-level, supervisory controllers that define more complex behavior."

LaViers says her lab uses use a number of tools—mathematics, supervisory control, optimal control, and information theory—to conduct their research on movement, But one of the main tools they use to describe movement is a taxonomy called Laban-Bartenieff studies, which she describes as "a very compact and descriptive and qualitative language that people use to describe and analyze movement. It's a formalized version of a choreographer's language."

According to LaViers, Laban was a choreographer and Bartenieff was both a dancer and a physical therapist who worked with polio patients and people who were losing capabilities in movement.

MechSE Assistant Professor Amy LaViers

Understanding that a robot can do nothing without the software that controls it, the Ctrl-Z campers crowd around to get a peek.

Bartenieff also worked with folks who had similar patterns of tension and limitations that were a result of their own training—ballerinas.

During the activity she and her students did with the GAMES campers, they taught the girls some Laban-Bartenieff taxonomy so they could use it to describe the movements they wanted the robot to make.

"The activity is much richer if you don't just say, 'I want you to make up a movement phase, but I want you to name, and describe, and think about what is each movement, so that you can start to specify," LaViers explains.

To further elucidate what she's talking about regarding her research, she instructs me to make a movement by raising my arm up from my side to make a fist.

"The robot can't do just what you did," she continues, "So we have to make choices about what is important. So that's really where that training and that dance background that I have really pushed me into this direction. So hopefully people who do this outreach with us get a little taste of being conscious about what movements are."

It makes sense that LaViers would incorporate dance into her research. She's been dancing practically her whole life. She started dancing when she was three, and for most of her life has had at least one dance class a week, or been in companies which practiced several days a week.

She was even involved with dance as an undergrad and during grad school. What kind of dance? You name it, she's done it: ballet, tap, even modern dance and contemporary dance. "It was just always there," she says. "It was just a natural connection with the work I was doing in robotics."

So what is the connection between robots and dance? She and her team's goal "isn't to have dancing robots, although we would take that!" she admits. "But we are interested in creating lots of movement so that we don't have a robot that does the same thing over and over again."

Amidst a frenzy of photo-taking, NAO struts his (whoops! its) stuff for the GAMES campers.

Like robots in factories. "If you want to see a cool robot, go to a factory, right? We can make lots of cool things; we can control them. But they do the same things over and over again." While she acknowledges that that's the goal of a factory robot—"We are interested in that precision, because we want every MacBook to look the same"—she hopes to be able to program robots to do more complex movement. "But when we move those robots out of a factory for a human-facing scenario, the world changes more frequently. It's more dynamic, and we need a lot more diverse movement capabilities that we can quickly access."

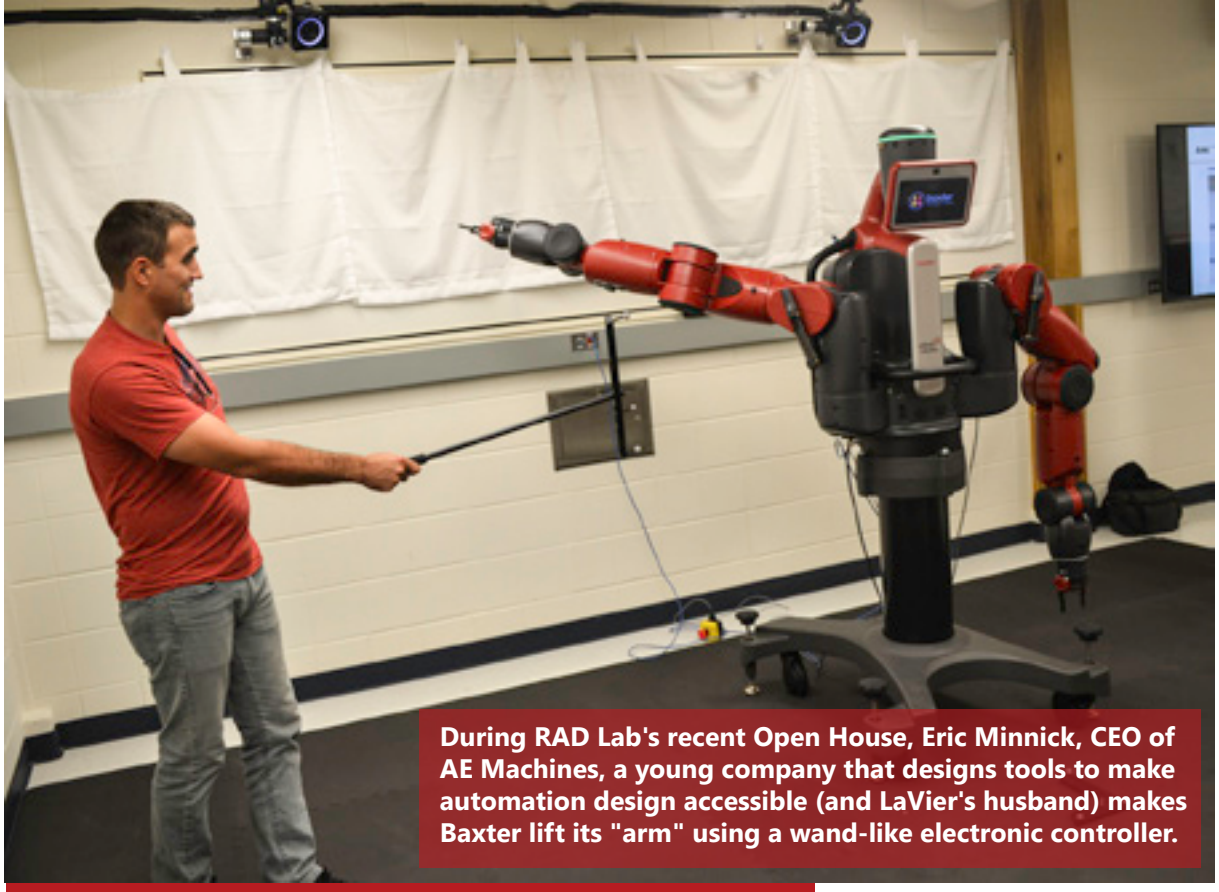
What are some real-world applications for her research? LaViers says one is manufacturing. She describes a couple of scenarios. The first is a BMW car factory, where "Every car is the same, and they make, let's say, 10 million cars that are exactly the same. They are constantly in motion, twenty-four hours a day making these cars." But what about a different kind of factory, where an order comes in from a customer who needs fifty cars that look a certain way, and then a month later, a different guy needs a different shape? "So there is a big nationwide push to move towards bringing automation into small-batch manufacturing."

LaViers says another application would be in coal mining or industrial cleaning, where every job is a little different. She says robots could be used to clean chemical plants, which are dangerous for people, and where there's a lot of variability. For instance, these plants might come in different shapes and sizes, and the chemical buildup isn't the same everywhere. There are many variables that come in to play.

"It probably won't be fully automated in the near future, in my opinion," says LaViers, "but we can make them to assist the cleaners."

LaViers says the Baxter robot would work in small-batch scenarios. Whenever a manufacturer wants automated or mechanical help in a complex way, a robot could be brought in and automated to do the job. However, she calls creating the specific programming "a fairly work-intensive process" that requires a lot of new tools.

NAO waits in the wings to be presented at Ctrl-Z's robotics camp for local youngsters.



During RAD Lab's recent Open House, Eric Minnick, CEO of AE Machines, a young company that designs tools to make automation design accessible (and LaVier's husband) makes Baxter lift its "arm" using a wand-like electronic controller.

Why are LaViers and her students involved in outreach? “Outreach is a very natural thing for the lab to do,” she says. In fact, she feels it’s her responsibility to do so, in order for the public to experience what “their” robots can do.

“We have really started reminding ourselves who buys our equipment and who funds the research in the lab. In nearly every case, it is from taxpayer dollars…So I think about the burden we have to take care of the equipment and also the burden to try and share it with the people who it’s for, and who own it.”

LaViers admits that she and her team are also involved with outreach to recruit others into their field.

“We need people to be interested in studying this area, because we need more and more people—hopefully more and more diverse people that study this area.”

And LaViers believes her research on robotics and movement is a great recruiting vehicle. She says it provides “an unusual inroad into very traditional engineering concepts. It is really fundamental stuff…So if you can become interested and take that class, for other reasons than just to play train or automobile, which is why a lot of students become interested in mechanical engineering…the very moving activity that we do is a very big piece of what mechanical engineering is. If you weren’t attracted before, you might be attracted through one of our types of activities or our approach to engineering.”

One of LaVier’s outreach goals for the future, in addition to doing GAMES camp again next summer, includes doing a robotics program back in eastern Kentucky where she’s from. She hopes to do a few workshops with them, then help them get a grant to buy their own robot.

“This is something that could engage a lot of students who don’t get that kind of exposure there. And whenever you go back home you always feel that you should be helping the place, and I think that’s the next project I have….I want to find new areas and new neighborhoods where I can take this, and that is my goal.”

Amy LaViers (right) works with a team of GAMES campers to help them troubleshoot the routine they choreographed for NAO.

AT WIE ORIENTATION, ENGINEERING FRESHMAN WOMEN EXPERIENCE CAMPUS, BUILD COMMUNITY

Left to right: the WIE Orientation 2016 planning committee: Rebecca Ficht, Liz Gazek, Lara Flasch, Sue Larson, and Angie Wolters.

September 13, 2016

The week before classes began for the Fall 2016 Semester, 251 Engineering freshman women sacrificed their last week of summer vacation to attend Women in Engineering (WIE) Orientation on August 16–18. These future engineers showed up early hoping to get a jump start on the fall semester… and they did. They got familiar with campus, learned about some support systems available to them, and built community—with staff and students in their own departments, with Engineering staff who hope to see them succeed, and with older female Engineering students on hand to show them the ropes.

What was new and different at this year's Freshman Orientation? The number of students… not at WIE Orientation itself (those numbers were similar to last year's)—but the number of female students in this year's Engineering freshman class: "This Orientation represents a class of freshmen women that's 25% of the freshman class," says Sue Larson, Associate Dean and WIE Director. "I guess that's part of what's new and different."

So our numbers are up!" exclaims Angie Wolters, WIE Assistant Director. There were huge smiles all around the table during the last planning session prior to Orientation, as these women—all so passionate about engineering...and increasing the number of women in engineering—celebrated this milestone in Engineering at Illinois. An even bigger celebration ensued when members of the biggest-ever freshman class of women in Engineering saw the numbers during Orientation's welcome session. (In fact, because of the bumper crop of incoming freshman women, those who could go to another new-student orientation besides WIE's were encouraged to do so in order to make WIE's numbers more manageable—something that would have been unheard of a few years ago.)

An Engineering freshman poses by Grainger Bob during WIE Orientation's scavenger hunt.

With the excitement of rising numbers came the negative side effect: rising costs. But stepping up to help were two corporate sponsors: Texas Instruments and Abbott, employer for Cindy Richartz, who, along with her daughter, Stephanie, served as WIE's keynote speakers. The mother-daughter team represented two generations who had studied industrial engineering at Illinois, Cindy shared her experience as a woman in engineering, while Stephanie shared that she had successfully made it through some early struggles to graduate and successfully land a job, and they could too.

One objective of Orientation was to connect girls with folks in their departments—including other freshmen—so they might see a familiar face the first day of class. So girls were grouped by department, older students in their departments served as mentors, and they met departmental personnel, including their advisors, during a luncheon held at their departments.

While all of Orientation's events were fun, they intentionally had multiple objectives. Yes, one object of the Amazing Race scavenger hunt, besides fun, was for freshmen to get familiar with campus so they

wouldn't be totally lost their first day of classes. But freshmen also built relationships with each other and their mentors, plus visited places that will be important over the next four years: their department's office, plus Engineering's Advising, Career Services, and Undergraduate Offices. Planners particularly wanted to emphasize CARE (the Center for Academic Resources and Engineering), Engineering's peer advising and tutoring center.

"The cool thing about the scavenger hunt," explains Wolters, "when they're going through, and they're visiting these spots, and they're doing their team activity at them, they're grabbing clues that they're going to use to do their build activity." Wolters was referring to the Lego Build project, the final activity of the Amazing Race, intentionally scheduled at CARE to expose the freshmen to the space on the 4th floor of Grainger Library.

"That's where they're going to be doing their studying," adds Larson. "There's resources there. If you have questions, there are group study rooms. There are tutors available. That's the place to go for studying."

The whole space at CARE is dedicated to engineering students. In addition to work stations, open tables, and individual study carrels, there are study rooms where groups of students can plug in a computer, project the image on a big screen, and work together on homework. "So we are going to send them to that space to do a build," Wolters explains, "essentially having them go their first time and see how they can use this space to collaborate with one another because that's the intent of the space for them as students."

A team of freshmen and their mentor do the Lego Build activity at CARE in Grainger Library.

A team of freshmen test the glider they designed during one of the scavenger hunt activities.

When planning Orientation, engineering seniors Rebecca Ficht, Lara Flasch, and Liz Gacek, the student coordinators, made sure the freshmen were exposed to things that might be new and, thus, possibly confusing to them. So most of the events, particularly the Day 3 workshops, exposed freshmen to new things they would encounter or should be aware of. For instance, as its name implies, during "All Things Google," the veterans taught the rookies about their Illinois Google email account, drive, and calendar.

Also, it was even easier for freshmen to stay in contact with their mentors due to a step up from just Facebook—GroupMe, some new technology for this year. Wolters says that before the week even started, mentors had already reached out individually to the girls, shared numbers, and created GroupMe's.

"We know that when we've created this much support, and in using social media as a way to get them connected before they come, we know it's a system that ends up lasting throughout the semester…and throughout the years."

Something new students with classes at opposite ends of campus would definitely need to learn about was the C-U MTD. Says Larson: "I think the coordinators have done a great job of determining what's new to students when they come here. The bus system is definitely something that's new to students."

Workshops also apprised students of other opportunities, like: undergrad research (a must if one intends to continue on to grad school),

RSOs (Registered Student Organizations, including SWE [Society of Women Engineers] a key organization for women in Engineering), and the Greek system.

For emphasis, organizers were also intentional about stressing things freshmen could and definitely should take advantage of. Keynote speakers Cindy and Stephanie Richarts advised students to go to Engineering Career Fair as freshmen; plus Engineering Career Services was a main station during the scavenger hunt.

Stressed over and over was the difference between high school and college classes. Even during the Chemistry Demo, Don Decoste and Gretchen Adams dispensed nuggets of wisdom about how to succeed in college. These were couched, of course, in their explosive brand of slap-stick chemistry, which delighted the girls, who alternated between laughing, clapping, and plugging their ears with their fingers.

Student coordinator Liz Gacek recalls the impact the chemistry demo had on her during her Freshman Orientation:"The chemistry demo was what really blows your mind; things are exploding left and right, and it just really draws you in."

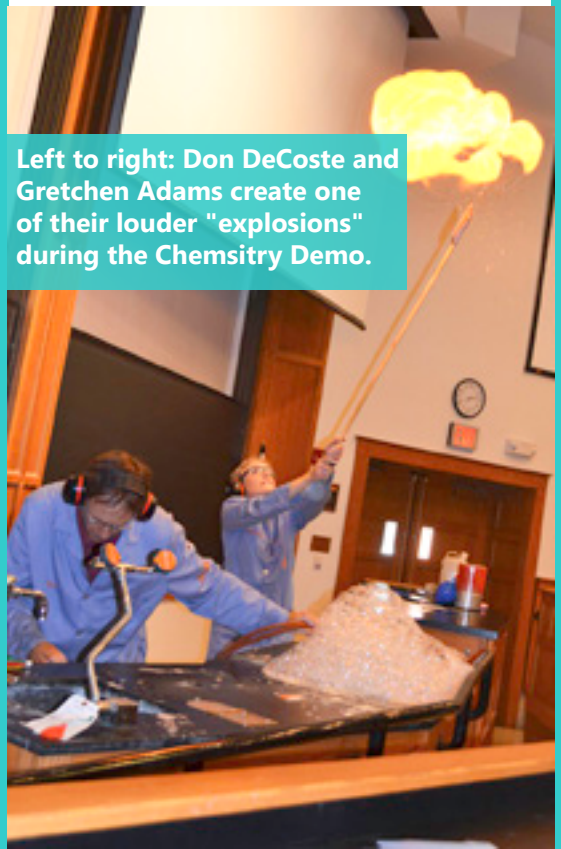
Decoste and Adams' advice?

1) Don't waste precious hours between your two or three classes a day; all of a sudden, you'll find that you're way behind.

2) Don't be afraid to approach your instructors: introduce yourself to your professor early in the semester, so you won't be afraid to approach him/her when you really need help later on.

A team of freshmen do a teamwork activity by Grainger Library: they must dump the bucket of balls into another bucket using only the ropes to guide the bucket.

Other orbs of wisdom: 3) Don't forget to eat and sleep! While students might have considered these no-brainers, lack of time management (see #1 above), can result in a vicious chicken-and-egg cycle: staying up late studying, which leads to sleeping in late, which leads to missing breakfast, which leads to going to class hungry, etc.



Left to right: Don DeCoste and Gretchen Adams create one of their louder "explosions" during the Chemsitry Demo.

Larson believes the practical advice about the difference between high school and college is much needed: "A lot of students have never had classes where the homework is posted online; if the student doesn't look online, and they just wait for the professors to write it on the board, they will be behind from day one."

Also stressed multiple times in multiple venues was campus resources freshmen could turn to for help: Engineering's offices and study places and most of all—people. People like Dean Pitts, the WIE directors, and the WIE Orientation mentors.

Older female engineering students whom the freshmen could approach with questions, both during Orientation and beyond, were considered key to a freshman's support system, and girls were encouraged early and often to take advantage of these mentors. To foster mentoring relationships, 49 female engineering students from the freshmen's own departments served as mentors, showing the girls the ropes; sharing their wisdom and expertise; and giving the girls a name, a face, and a number they could contact: someone who was—and in the future would be—just a text or a call away.

Ficht says the mentors she gained as a freshman were invaluable: "At Orientation, I met a lot of great mentors,

WIE Orientation freshman do a teamwork activity: they must traverse the hulahoop obstacle course...with their feet tied to their teammmates' feet.

and they helped me plan my schedule, and this is actually my first semester that I planned my schedule all on my own. So I've had upper classmen looking at my schedule and tell me what classes are good to take together and getting advice from that perspective. And it's also great because you get to meet the advisers earlier."

Having so many mentors also helped keep group sizes down—creating more intimate small groups. The ratio was 1 mentor to 5 or 6 girls, "so they really get some personal time as opposed to being lost in a big group of 20 or 30 of them," Ficht explains.

For undeclared freshmen, students who had themselves been undeclared freshmen mentored them. For example, Kate McDuff, a junior in Mechanical Engineering who mentored several undeclared majors, explains the importance of having so many mentors involved. "The really cool thing about when I came [to WIE Orientation], we really got the opportunity to not just talk to one mentor or three mentors, but we kind of did a round robin where you could ask anybody questions about anything. And that was awesome being undeclared, since you were interested in so many different fields of engineering. So we got to have our questions answered from more of a personal level from each individual girl. Everybody was just so helpful and welcoming, it just really made me feel like no matter which field I chose, I would always have people there to help me out, and do homework with me, and talk me through everything."

The mentors, a great asset and resource for Orientation, wanted to give back some of what they received when they were new students, and to ensure that these "newbies" in their own discipline were successful. Two mentors explained why they got involved:

According to McDuff: "When I was an incoming freshman, I attended this camp and it was one of the things that acclimated me to campus, as well as provided me with an opportunity to make some new friends and feel more comfortable coming in as a female engineer. So I just wanted to return the favor. Plus, I love helping younger people whenever they have questions or don't feel comfortable on campus. I'm here to make their lives as easy as possible."

Another mentor, Hannah Parker, reflects: "I've been really involved in the CS department and talking to students outside the program who are interested in getting into engineering, and I think women are especially an untapped group of that. So I think it's awesome that all these girls are so interested in coming early and trying to learn, and if I can make that experience any easier, I totally want to help."

The coordinators, all seniors, took on the task of organizing and running the Orientation because of their positive experiences at Orientation as freshmen. For Ficht, it resulted in a roomie.

"Freshmen year at Orientation, I met Liz, and now we are roommates and best friends. So that was great."

Two freshmen do a relay at the station by Alma Mater: they must use paper plates to successfully carry a stick of spaghetti the required distance without touching it.

WIE Orientation participants appreciate Decoste and Adams' antics.

"I know the stereotype about engineers is that women are not as well represented, and so to be able to meet other people in engineering and to get to know campus a little better, I thought it sounded appealing to get to know more girls in my classes and get to know more about the resources available on campus"

She also says it also gave her a leg up, helped her feel comfortable…and allowed the freshman girls to one up the guys.

"And I remember all the guys coming to campus after us, and they were all jealous because we already all knew each other by name. And we've already met a lot of the faculty. And the boys are kind of just there. It really gives us a leg up on feeling comfortable and making you love your home."

Liz Gacek recalls that it was the relationships she developed that made orientation special: "The support that you leave camp with, just friends, and Angie, and Sue Larson; it really makes you feel encouraged that you're going to do great in the College and do great in Engineering, and you just want to keep going further. So that would be a highlight for me."

For Lara Flasch, it was relationships built during the scavenger hunt. "I think the scavenger hunt is just a fun bonding time with the group and exploring the campus like you would on a normal day." Flasch shares about another fun, new technology they added, "And we have a customized snapchat filter set up for the day during the scavenger hunt."

With all the time, energy, and money spent on Orientation, was it a success? The freshman who attended seem to think so.

Abigail Iurio, an undeclared engineering freshman, explains why she attended Orientation and how she benefitted:

Orientation's activities helped Iurio adjust to the large-scale campus. "Just walking around has gotten me acclimated to campus," Iouro states. "Like I didn't know where this building was before. And to meet our advisors, even though I already met her, but to figure out where the advising offices are, and figuring out the different places I can go when I need help, like the Grainger Library."

Undeclared Selin Siphi describes her reasons for attending: "I thought it would help me be better acclimated to campus, and it's really interesting to meet all these women and hear their career paths and what they are interested in. And it's nice to see that there are people like me who are undeclared in engineering and it makes the transition of going into college a lot easier."

When asked what she's learned that she'll apply right away, Siphi reflects, "They've given a bunch of great advice, the mentors are being really helpful. I guess the main thing I've learned is to be really involved in campus, because that's really how you can meet people and get out of your own shell. Definitely time management is a big thing that I hear."

Left to right: Don Decoste and Gretchen Adams during the Chemistry Demo; Decoste's big beaker represents a professor's wealth of knowledge...Adam's little one—the student's.

Alexandra Fanning, also an undeclared engineering student, had similar motivations for attending WIE. “It’s one thing to hear what it is to be a woman in engineering, but I kind of wanted to get a better idea of what it meant to be in a group of women like that,” Fanning explains. “And also to learn as much as I could about what I’m getting myself into, I guess. There are a lot of awesome girls and mentors.”

Also looking for a tight-knit group of women engineers was Dinaz Kureishy, a Civil and Environmental Engineering (CEE) freshman who attended CEE’s GAMES camp last year. Her experience during GAMES helped her choose Illinois over 17 other schools. Kureishy explains:

“GAMES camp really moved me. I met so many great people there, I felt at home at Illinois, even though I’m from New Jersey. I had such a great week. I learned so much, and I found that everyone over here was really helpful, and if I had any questions about what I wanted to do in college or in my future, they would always be here to help and guide me in the right direction.”

And it was because of Illinois’ support system for women, that Kureishy attended WIE Orientation. “Last year at GAMES,” she elaborates, “it was obviously for women engineers, and I feel like at Illinois, they have a very strong support system for women in engineering. So when I got the email, it was a no brainer. I had to sign up for it. And I had actually met Angie Wolters last year at GAMES as well, and I had met her again at the admitted student’s day. When I heard she was running it and was involved with this, I was like, ‘I have to come.’”

Engineering freshmen do an activity on the Engineering Building's south portico.

A couple of teams take a break on the south portico of the Engineering Building.

Dean Pitts gives the girls some sage advice during the introductory session. And yes, that's Pitts in the background with a very big bunny—an image the ladies somehow managed to ferret out, all in good fun.

DEVON GOSZKOWICZ: FOLLOWING DAD'S FOOTSTEPS TO ILLINOIS—BLAZING HER OWN TRAIL IN OUTREACH

Devon Goszkowicz (left), chats with a recruiter at the recent Engineering Career Fair.

September 13, 2016

Devon Goszkowicz, a junior in Engineering, didn't attend any STEM camps or outreach activities when she was little. However, one very important person in her life—her father—was an engineer. And now, here she is at *Illinois*, studying to become one too. And though she didn't attend any STEM camps or outreach activities herself when little, she currently participates in several that expose girls of all ages and backgrounds to engineering. She's hoping to not just expose them to STEM, but to help them reach their potential, and to possibly even influence them to become engineers themselves.

Goszkowicz has wanted to be an engineer ever since she was little. "I think on some level, I've kind of always known," she admits. It also might have something to do with the fact that Daddy is an engineer too. Not only that, her dad, a Navy pilot, majored in Aerospace Engineering at *Illinois*.

Devon Goszkowicz (center) works with her teammates during a hands-on project when she was at GLAM GAMES in 2013.

"My dad's an engineer," she says, "and I think from the time that I was like 5, we started building rockets and launching them in the parks."

She recalls that as a kid, she even read books about engineers. "My 3rd grade book report, I read one of Stephen Hawking's books. I did a book report on that, so it kind of started at a really young age."

And because Daddy was an engineer, one would assume that she went to a bunch of STEM camps as a kid, but Goszkowicz says no.

"So because my dad was Navy, actually we moved around a lot. So every 2–3 years, we moved. And rather than going to a bunch of different summer camps, I went to a bunch of different countries. Yeah. So it's kind of a little bit of a tradeoff. I didn't go to as many camps as most people did over the summer, other than sports camps. GAMES camp is actually the only engineering camp I went to, at least that I can remember. But I did get to go to 35 countries before I was 16."

So instead of STEM, she was exposed to other cultures and other languages. In fact, she says she used to be able to speak French nearly fluently, and was conversational in Japanese. But now, she says she sometimes gets mixed up: "It's actually kind of funny, because every time I try to speak Japanese, I start speaking French. Even though I can think the Japanese words, French comes out anyways."

Devon (third from the left) and the rest of her team exhibit the solar collector they built during an activity at the 2013 GLAM GAMES camp.

One would also assume that because she's in engineering, she liked math as a kid. Goszkowicz reports that that took a while:

> **"I actually remember my mother buying me a book called Math Doesn't Suck, when I was in 6th grade, because I hated math. Up until I got to calculus, I hated math. And that's the main reason I kept thinking, 'Oh, maybe I shouldn't be an engineer!' But then I got to calculus, and everything made sense again."**

So Goszkowicz took calculus her senior year in high school, finally fell in love with math, and now she's studying Aerospace Engineering at *Illinois* just like Dad, right? Nope. She's majoring in Material Science and Engineering (MatSE). And Goszkowicz says one reason she chose Material Science was because she didn't want to be like dear old Dad.

"I feel like part of me was kind of pushing against, you know, exactly following my dad's footsteps."

In fact, because Dad had come to *Illinois*, she wasn't going to. "At first, I didn't even want to go to U of I, even though it's a great school, because I didn't want to be "that girl" who followed everything her parent did."

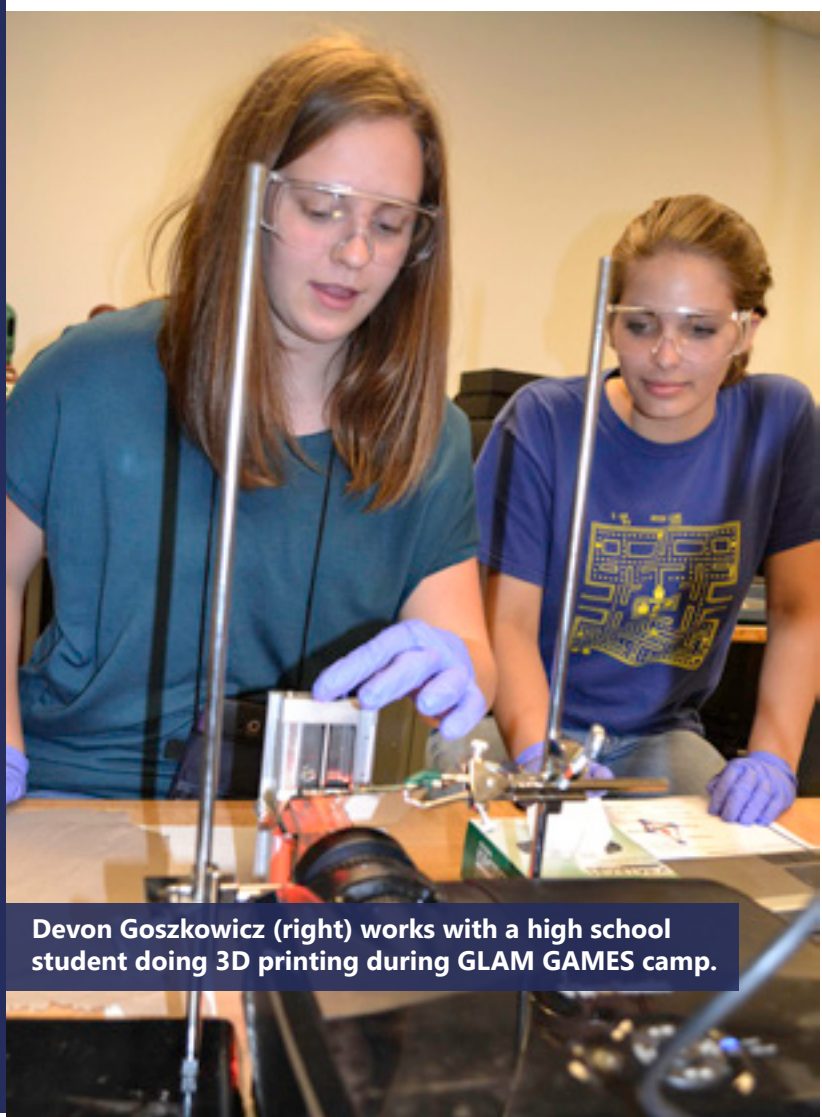
But fate stepped in. Goszkowicz, who had never gone to any STEM outreaches, ended up participating in the 2013 GLAM GAMES camp the summer before her senior year in high school. And despite her vow to not follow dad's footsteps to *Illinois*…that week was the turning point. For one, she discovered that she wanted to go into Materials Science.

"I think the 3rd day of GAMES camp for me, which was the Biomaterials day, was the day I thought 'Oh, this is actually way cooler than chemical engineering,'" says Goszkowicz. "Because that's what I originally wanted to do. And I think I called my mom that night and was like, 'Mom, I figured out my major; this is great!'"

While she hadn't at that point decided on *Illinois*, she had at least figured out, "Okay, I want to do materials science." But after discovering she could get a full tuition scholarship through the military, she chose *Illinois*.

> **And she says MatSE's ranking didn't hurt either. "It's #2 in the country for Material Science, so if you get in, you probably should go," she admitted.**

Ironically, while it was the GAMES Biomaterials session that helped her decide on Materials Science, she actually decided not to do Biomaterials. "It was my initial thought, like, 'Oh, this is super cool!" but then I found metals and plastics a lot more interesting once I got to the first MatSE class."



Devon Goszkowicz (right) works with a high school student doing 3D printing during GLAM GAMES camp.

In fact, she loves them both so much she's thinking of doing a double concentration in both metals and polymers, or of getting her concentration in polymers and her out-of-area in metals, "because there are really cool aspects to both of them," she admits.

Despite her full load, Goszkowicz still makes time in her busy schedule to share her love of engineering with others. Because, while she didn't do any STEM camps as a youngster, she knows the value of exposing youngsters to STEM and of giving younger students in her field a helping hand. In fact, Goszkowicz should be nicknamed the Queen of Outreach.

This reporter first ran into her this past summer, when she was working as a lab assistant at GLAM GAMES camp. (Which makes sense, of course. While it was the only STEM camp she ever attended, it had a significant impact on her). Goszkowicz explains why she participated in the GLAM GAMES Camp this summer: "I enjoy being able to share my love of MatSE with people—especially high school students who are starting to make decisions about what to study in college."

Then I ran into her again at the WIE Orientation. She was a mentor for a group of MatSE freshmen and was shepherding them around campus during the scavenger hunt. According to Goszkowicz, she participated in the Orientation because of the impact it had on her as a freshman:

WIE Orientation helps the freshmen women get adjusted to college life in a welcoming community of women like them. Going through WIE Orientation made the transition easier for me, and it's where I made some of my best friends in college! I am in contact with my mentors still—some have even become my close friends!"

Goszkowicz also participates in a STEM outreach for younger girls, MakerGirl, which exposes 7–10-year-old girls to 3D printing. As team manager, she makes sure the 31 volunteers are presenting correctly, and that they're signed up for some of MakerGirl's 18 sessions for the semester. These are held at Maker Lab in BIF on Tuesdays, some Mondays, and at weekend maker fairs held at the Maker Lab or off campus, such as at the Orpheum Children's Museum. Her goal is to "give the girls a worthwhile experience," she explains.

Left to right: Yusen Ye and Devon Goszkowicz. Ye is Goszkowicz's Material Advantage mentee (photo courtesy of Devon Goszkowicz).

"MakerGirl is having an extremely wide impact!" she says. "We have impacted over a thousand girls this summer alone, and are have multiple STEAM Courses this fall."

Goszkowicz is also president of the *Illinois* chapter of She's The First. While not necessarily STEM-focused, this organization provides scholarships for girls in low-income countries to receive a high school education. According to Goszkowicz, "It's called She's The First, because usually these girls are the first ones in their families to actually receive an education."

Milsa, the girl the *Illinois* chapter is currently sponsoring, is a 19-year-old from Guatemala who's going into her senior year of high school now.

"It's pretty amazing, actually," says Goszkowicz. "$1,400 covers their tuition, books, tutors, room and board if they need it. Basically everything that they and their families can't provide for themselves, we're able to provide for them, which is so cool."

Goszkowicz also serves as a MatSE mentor as a part of Material Advantage, MatSE's student organization, which helps students get to know other students within their major, but also helps students professionally, via resume critiques, mock interviews, etc. As a part of this program, she is mentoring an incoming freshman throughout his or her entire first year, acting as a resource for anything the student might need.

Not only that, but Goszkowicz also works for a company called Preemadonna making video tutorials about Material Science in the beauty industry. The videos, which she's currently still working on, will be both informative and contain

hands-on projects high school, maybe even middle school students could do to learn about Materials. Once her videos have been uploaded, she'll act as an online tutor for students interested in Material Science, answering any questions they might have about her videos.

So with graduation two years or so away, what are Goszkowicz's plans once she gets her degree? Industry? School?

"Industry," she replies, without a moment's hesitation. "I need a break from school. Maybe I'll go back, but not immediately. I need to work a little bit and kind of experience the different side of life before I continue more school."

And ironically, despite her earlier assertion that she wasn't going to follow in her dad's footsteps, the company that Goszkowicz would like to work for, Orbital ATK, is—you guessed it—an aerospace company. In fact, Goszkowicz has pretty much resigned herself to the fact that in many ways, following in dad's footsteps is exactly what she's doing, and she's ok with that. "But as you can see, I want to work for an aerospace company right now. I kind of am following in his footsteps."

But isn't she in the wrong department if she wants to work in aerospace? Shouldn't she be in Aerospace Engineering, like Dad? She says no.

"Actually, the versatility of materials science is one of the reasons I chose the major—because I've never had a specific career goal that I wanted. I just wanted to have options. And material science, I think, gives you probably the widest range of options out of all the engineering majors that I've seen. Because no matter what product you're making, if you're making a product, you need to have materials to do that."

However, despite having picked out the company, Goszkowicz still isn't sure what her ultimate career goals are. "I really like the entrepreneurship side of engineering," she admits, "but there's so many options, I'm not sure what I want yet." However, she is looking to get an internship next summer that will help her "narrow things down."

The one thing she does know for sure: whatever she does for a career, she wants to make a difference. According to Goszkowicz, her dream job would be:

"Some job where I feel like I'm accomplishing something every day that'll better the life of somebody. So whether that's making an improvement on airplane designs to make it more safe, or making plastics more biodegradable, something where I feel like I've accomplished something every day of work."

And despite Goszkowicz's earlier reservations regarding emulating her father, she is apparently glad she did follow her father's footsteps to *Illinois*, and believes she is definitely being well prepared for the future.

"I don't think any other university could have given me the same experience. Just between exposure with all these start-ups I've worked for; the labs that we're taking. The lab reports are time consuming, but, honestly, the labs themselves are very invaluable because they give us exposure to so many different instruments. Yeah, it's awesome."

With the Engineering Career Fair being the day after our interview, it was definitely on her mind. She adds, "I love going to career fairs, even though it's a little bit scary at times, but it feels really rewarding to be able to talk to people from your potential employers."

And always in outreach mode, she makes one final appeal, encouraging any girls who are considering careers in engineering to go for it:

"Go into engineering! If you're thinking about it try it. You might decide that it's not for you, and that's okay, but at least give it a shot. Because you might find out that you like it, or you love it, and that's what you want to do forever."

Devon Goszkowicz by Alma Mater

PAKELTIS SISTERS HOPE TO CHANGE THE WORLD THROUGH ENGINEERING...AND RECRUIT MORE WOMEN

October 7, 2016

"Sisters, sisters, there were never such devoted sisters!" – Irving Berlin

While the old Irving Berlin song, "Sisters, Sisters," may not exactly be the theme song of the two Pakeltis sisters, a couple of lines fit Grace and Abby to a T. One is the last part of the line:

"Two different faces,
But in tight places,
We think and act as one."

For instance, both are studying Engineering at *Illinois*. Both went to GAMES camp, got hooked on their respective disciplines there, and thus ended up at *Illinois*. Both are heavily involved in leadership in the *Illinois* chapter of SWE (Society of Women Engineers). Both are passionate about and involved in outreach. Both hope to change the world through Engineering. Then there's this line in the song: "Never had to have a chaperone, 'No, sir!' I'm here to keep my eye on her!" Who has been keeping her eye on whom over the last number of years? You be the judge.

So how did the Pakeltis girls both end up in Engineering at *Illinois*? For most of her childhood, Grace, the oldest, who is a senior in Materials Science Engineering (MatSE), wanted to be a teacher. But one math teacher pushed STEM because of her great math and science skills. Plus, her godmother (whose husband is an engineer) and high school teachers suggested she pursue engineering. That's how she ended up at GAMES camp in 2011. And because she couldn't get into Chemical Engineering GAMES, she opted for GLAM...and fell in love with materials.

The Pakeltis sisters (Abby and Grace) on the south portico of Engineering Hall.

"I loved what you could do with it," she admits. "I loved the activities, and I loved the people there. So then I started pursing materials science more."

But even before she decided on which field, she was aiming for *Illinois*.

"I came to U of I for a basketball tournament," she says, "and I saw the engineering quad and the big engineering library, and I realized that this is where I wanted to be. So all throughout high school, that was the goal: to get into U of I for engineering."

It wasn't until later that she discovered how good of an engineering school it is. "Our materials science program is #2 in the country," she admits, "and that really drove me to try it."

Abby, a sophomore in Mechanical Science & Engineering (MechSE), took a similar route to *Illinois*. Proof that Little Sister had been watching over the years, Abby reports that while her sister's participation in GAMES camp "intrigued" her, what had really impressed her was when Grace went to state in Science Olympiad: "So I saw that, and I thought it was a lot of fun."

Abby (center) and her teammates with the windmill they made during the competition the final day of G-BAM GAMES 2014 (photo courtesy of Abby Pakeltis).

Grace in her role as the 2016 president of SWE (photo courtesy of the SWE website.)

So like Big Sister, Abby, who liked math and science too, also got involved in Science Olympiad in high school. But she wanted to be a doctor, so she went to Bioengineering GAMES, then to another engineering camp, where some device (which looked like a wood engraver, but was used to remove organs during surgery) sparked her interest in medical devices.

Then the fall of her junior year, Abby took and liked physics, "and that was what made me think about mechanical." The following summer, attending MechSE's G-BAM GAMES camp sealed the deal. "I loved it; that's why I chose mechanical in the end."

She says participating in G-BAM "was definitely when I made my goal of coming to the University of *Illinois* for Engineering. It was always engineering, but I didn't know it was U of I all along."

With Abby emulating practically every step she's made in high school and now college, is Grace tired of Little Sister tagging along? Nope. She loves it.

"I've always liked having Abby at the same school as me," Grace admits. "And I really wanted Abby to come to U of I with me. It's great to have family on campus, and get to see her all the time. And, yea, it's just a great support to have as well."

Abby agrees, and doesn't find Big Sister's proximity too restricting: "I honestly couldn't imagine it any other way. We're different in our interests through engineering, although we are both in SWE, we are separate enough to be our own individual people."

In fact, Abby has her own built-in mentor in Grace.

"We are also close enough that we have each other to lean on, since she has already gone through the first years of college. And I am very grateful to have her as a role model. I do think of her as a mentor."

But while their journey so far has led through the same school, their paths will most likely diverge once they graduate: Grace is going on for a PhD; Abby is headed straight to industry. In addition, they hope to address very different problems.

Grace, for instance, is interested in electronic materials. "Materials are the future of electronics. There's no getting around that...I will be going to grad school to hopefully pursue my PhD in materials engineering, and from there I would like to work in research and development for the electronics field."

Grace interned this past summer at the University of California-Berkeley working with a multi-ferrous system, which she explains, "boils down to using the direction of magnetism to write and rewrite memory in your device." If possible, she would like to continue her work at Berkeley in that group for her grad school.

Abby's career goal is to work in industry in medical devices. "I don't know what kind of medical devices, but I want to work on something that will help increase the quality of life for other people. My passion in engineering comes from helping other people."

But while the two might not agree on which engineering problem to tackle, both agree that the "coolest thing" about *Illinois* (besides going to school with their sister, of course), is all of the opportunities for personal growth and for outreach.

For example, both are heavily involved in SWE. Grace was the Outreach Director her sophomore year. In fact, SWE's Engineeringl Round Robin outreach, which exposes girls to all the engineering disciplines, is her brainchild. Last year, she was the SWE EVP (External Vice President), and she is President this year.

Abby interacts with a kindergartener at SWE's FKO (For Kids Only) outreach at Leal School.

Grace waits to present her poster at a recent conference.

Last year, Abby was on SWE's outreach team; this year, she's a Team Tech Director. For this SWE competition, *Illinois*' team of about 10–12 female engineering students will work on a project throughout the year, to develop a new system or product for their sponsoring company, then present it at the national SWE conference, competing against teams from other universities.

"Through SWE," says Abby, "I have had the opportunity to work on a project for another company, and now I am leading a project as well. That's something that *Illinois* has already offered me."

Another great opportunity is the research, which Grace calls "really cool." Involved with research since her second semester freshmen year, she's currently working on her third project on this campus with MatSE Professor John Rogers. "The research was what sparked my interest in electronic materials," she admits.

Grace has particularly appreciated her two research experience mentors. Professor Rogers, whom she calls "a wonderful mentor," encourages his grad students to mentor undergrads. Another was a post-doc named Xing, now a professor at a university in China, whom Grace calls, "wonderful...He taught me how to do research."

Also, by doing undergrad research Grace also gets to be a part of ISUR (*Illinois* Scholars in Undergraduate Research), through which she's gotten to go to conferences for the past two years to present her research.

Abby has also had research opportunities, many through her MechE classes. "Right now I'm in ME 270, and we work in a group to create a medical device that we think can solve a problem in the world."

Another area where the two "think and act as one" is outreach; for instance, both are passionate about increasing the number of women in engineering.

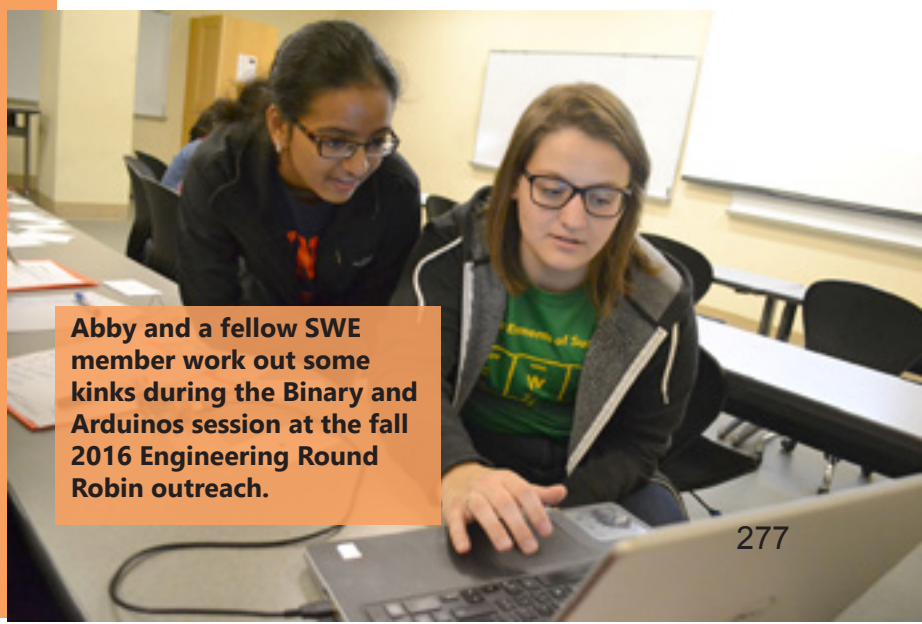
"I think outreach is vital for the gender gap in STEM," Grace says. "But beyond that, I think outreach is important that all students get the opportunity to experience STEM. Being able to introduce them to all the ways they can change the world through engineering is so important."

Grace also believes that for students who don't have teachers who will introduce them to STEM and GAMES camps, outreach gives them a chance to see if engineering is for them: "I was fortunate to have that push," she admits. "But a lot of people don't. And SWE does so many outreach programs throughout the year to let people come down and see engineering first hand, and see if this is the path that they want to take."

Abby hopes that through outreach, the notion of engineering as an attainable career would become more widespread. Actually, she would like to see it regularly show up in the short list kids rattle off when asked what they want to be when they grow up. "Engineering isn't something that many young kids, especially women, hear about as a job."

"So, for example, for me, I said I wanted to be a doctor growing up," she continues. "When you think of it as a little kid, you want to be an artist, doctor, or rock star. And engineering kind of incorporates all of those interests and sparks that creativity. So I think using outreach to give people the opportunity to experience it is the most important thing."

The two also want to show young people that engineers can change the world.



Abby and a fellow SWE member work out some kinks during the Binary and Arduinos session at the fall 2016 Engineering Round Robin outreach.

Abby interacts with EOH visitors playing at the air hockey table she helped build.

Grace says, “You hear people talk about going out there and saving people by being a doctor. But by being an engineer, you are doing that as well. You are making lives better and improving the world no matter what field of engineering you are in.”

In fact, Abby says engineers don’t get enough credit for all the things they do to make the world a better place: “In movies, they show doctors and surgeons saving lives, and you start thinking, ‘Oh, I want to do that!’ But they don’t show you who is making all the equipment they use. So that’s what outreach can do, it shows who made all that stuff!”

In keeping with their convictions about outreach, both have done numerous outreach activities. Both have been GAMES camp counselors, Grace in GLAM, Abby in G-BAM. Both participate in SWE outreaches, including the 2016 High School Round Robin. This year SWE expanded it to include middle schoolers, which Grace says is “a great idea. So now they are being exposed to all the different fields at an ever younger age.”

“I love the outreach events,” adds Grace, “and I try to go to as many as possible, even though I’ve changed positions.”

Both are also involved with Women In Engineering (WIE). “We work hand in hand with WIE," Grace says. "The collaboration on outreach between SWE and WIE has been a great thing for the gender gap to decrease.”

As part of SWE outreach last year, Abby helped make an air hockey table from scratch for Engineering Open House, then enjoyed interacting with the young visitors.

“I really enjoy sharing my passion for engineering with others,” she acknowledges.

Grace has also served as a role model for the previous two years in SWE's huge Invent It Build It outreach event during its National Conference. “Engineers come from all around the country and serve as role models for the girls...We worked on their design challenges and fostering their creativity.”

Abby will attend as well this year. “So this will be my first year that I get to be the role model there,” she says, “but I am excited to see it, because I love outreach events. And excited to do it at the national level."

While both enjoy being in Engineering together, there might be one fly in the ointment. Unlike the “Two different faces,” line in “Sisters, Sisters," they practically look like twins: "It’s funny,” admits Grace, adding one caveat regarding her sister being at *Illinois* too. "Now that she is team tech director of SWE, and I’m president, people see me and ask if they’ve seen me before. Then they’re like, ‘Oh, you’re Abby’s sister!’”

This reporter had a similar experience the first time I met the Pakeltis sisters: I was doing an article on the 2014 GAMES camp, and because I like to feature GAMES alumnae, had just interviewed and done a photo shoot with Grace, who was serving as a GLAM camp counselor that year. Then, when I showed up at G-BAM to get photos, behold, there she was again, but a camper! This threw me momentarily, until the light bulb went off, and I told myself, “Ha! This must be Grace’s sister.” It was.

Grace Pakeltis presents her research at a recent conference she attended as part of ISURS.

Grace and Abby Pakeltis, then... and now.

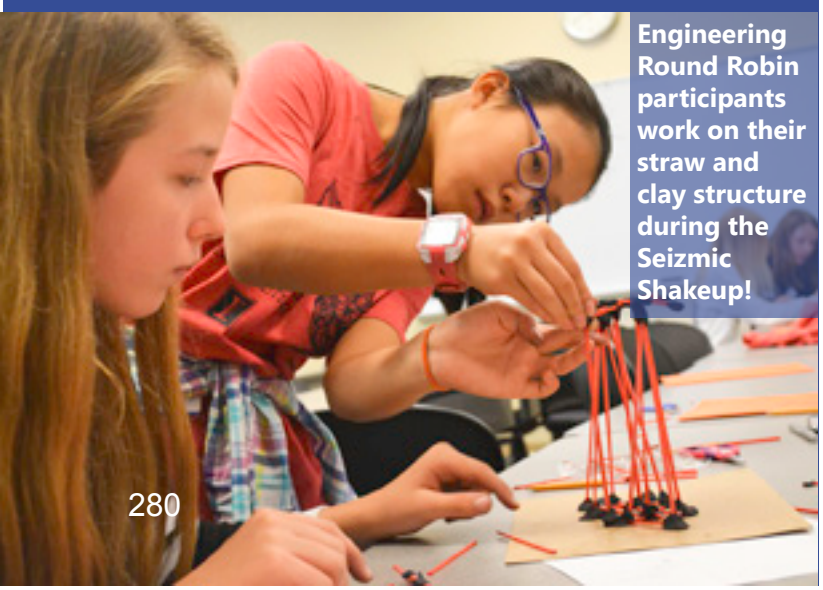
SWE'S ROCKIN' ROUND ROBIN TELLS GIRLS: "YOU CAN BE AN ENGINEER AND STILL BE YOURSELF!"

October 17, 2016

SWE's (Society of Women Engineers) Engineering Round Robin, an outreach designed to expose girls to the different engineering disciplines, isn't just for high school girls any more. Of the 45 girls who converged on *Illinois*' Siebold Center on Saturday, October 8th, 20 were middle school students. Also different from past years was the interdisciplinary emphasis. Not only cutting across engineering disciplines, the program had a hint of STEAM (STEM + Art = STEAM). The goal? To show girls that they could become engineers and still be themselves.

New to the event this year was the inclusion of middle school students. According to SWE Co-Outreach Coordinator Molly McGiles, event planners combined high school and middle school girls to "create a more unique experience where the girls are learning the same materials, but doing them at a different level."

Why open up the event to younger students? For one, so the older girls can serve as mentors and role models to the younger ones. The goal was for the high school girls to help the middle schoolers, plus to allow middle school girls to "see high school girls who are still interested in engineering in high school and they can help to keep them interested... and to be a role model for them." The two age groups were separated for the hands-on activities, which were made more or less complex depending on the age group. For other parts of the day's events, such as for lunch, ice breakers and team-building exercises, both groups were together.



Engineering Round Robin participants work on their straw and clay structure during the Seizmic Shakeup!

A high school student explains a concept to her teammate about the protective eyewear they're designing during the "Protect Those Eyes!" session.

In addition to the inclusion of younger students, several other program changes were implemented in the fall 2016 Round Robin. In the past, the girls had rotated through separate hands-on activities emphasizing each engineering discipline, then had done a separate design challenge. But McGiles says that the goal was to make the event more like what real engineers experience. So they combined the two and had the girls go through the design process while doing the hands-on activities. "We really wanted to combine them this year, so that they understand that when they're in the field, they're doing both at the same time." So, instead, the girls rotated through three different activities focused on the interdisciplinary aspects of engineering.

Seizmic Shakeup!

During this activity, which emphasized Mechanical, Civil, Environmental, and Aerospace Engineering, the girls used modeling clay, straws, and other materials to design a tower that could withstand an earthquake! The goal: to see how tall a skyscraper they could build that wouldn't fall apart when shaken on an earthquake table.

SWE co-outreach coordinator, Molly McGiles, who had built and tested a structure during a dry run prior to the event, confesses: "I tested it on the Seizmic Shakeup table, and when I shook it, my structure fell, and I thought I spent a lot of time on it!" (Luckily for McGiles, she's in Chemical Engineering, not Civil.)

Protect Those Eyes!

For this activity, which featured Biomedical, Chemical, and Materials Science Engineering, the girls designed protective wear, such as safety goggles, for their eyes, Then they wore them to do an experiment where they turned milk into plastic.

Binary Numbers and Arduinos.

In this activity, the girls learned about Electrical and Computer Engineering and Computer Science. The goal was that they "learn to speak in binary and use binary code," explains McGiles, "and then they make their bread board, and they program it to be able to send messages to a friend across the room."

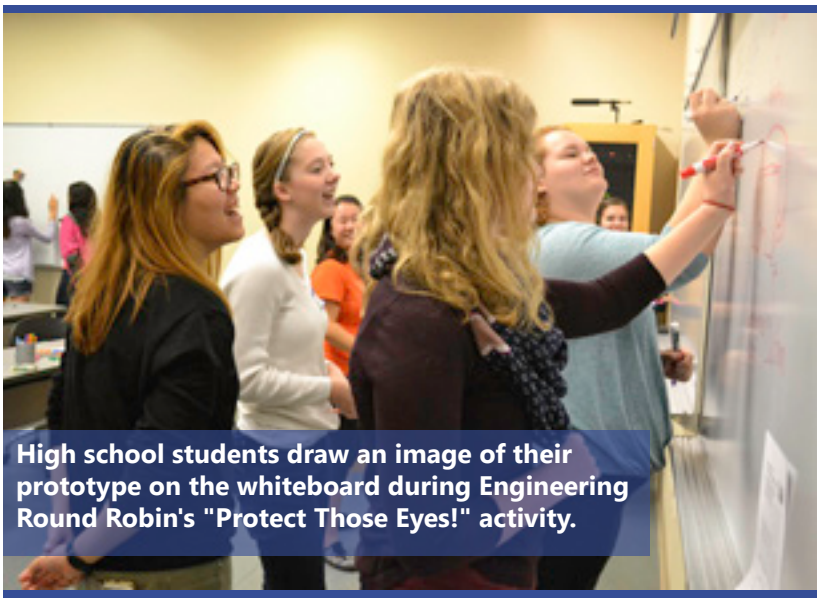
In addition to the interdisciplinary emphasis on engineering, the goal was to make the event even more broadly interdisciplinary. While still considered STEM outreach, the program gave a nod to STEAM this year. (All the rage in the STEM world, STEAM (Science, Technology, Engineering, Arts, and Mathematics) adds "arts" to the mix.

Thus, the theme for this year's event was Rockin' Robin; teams had names like "Hip-Hop Pop" and "Rock & Roll," plus each activity had a sentence or two that tied it into the arts. "STEAM is starting to take off," McGiles admits, "and though our main focus is STEM, we wanted to show a little glimpse of how STEAM can be incorporated. So focus it on STEM, but show how that "A" is sneaking in there."

According to McGiles, a junior in Chemical Engineering this fall, the interdisciplinary emphasis was to show the girls that they can become engineers and still be themselves.

"We also wanted to incorporate all of what engineering is. I'm not just an engineer."

During Seizmic Shakeup, Engineering students shake a team's structure to see if it will stand the test.



High school students draw an image of their prototype on the whiteboard during Engineering Round Robin's "Protect Those Eyes!" activity.

McGiles goes on to explain that she's been a dancer since she was little, and she loves music.

"And I love my social media and my pop culture," she adds. "We just want to show the girls that there's more to being an engineer than just being an engineer. You're still you; you don't have to give up "you" to be an engineer."

She adds that one of the goals of the interdisciplinary emphasis was to show the girls that their other interests can still be incorporated into an engineering career. "You being an engineer is still you being you. You don't have to decide, 'Oh, I'm going to be an engineer or I'm going to be an artist.' You can kind of be both."

She indicates that other non-engineering-related skills are still important, too. For example, engineers often have to write descriptions of things, so they must call on their English skills. Or at times, a project requires that they draw something, for which their artistic skills would come in handy.

Why all the changes to Round Robin, now in its third year? "We're trying to be really different. We do these engineering events all the time, and they're really successful, but we want to adapt them more, change them up a little bit."

The new twist on the event that McGiles was most excited about, was…lunch. For starters, as an icebreaker, from a list of things on the board, the girls found someone who had something in common with them to be their "buddy." Lunch also featured a student panel, so girls could get answers to their questions about engineering

Co-SWE Outreach Coordinator Abigail Gerth (right) helps with the Lip Balm activity in SWE's room during EOH 16.

and what being a student at *Illinois* is like. Plus, girls participated in some team-building activities.

“So it makes lunch a learning experience,” explains McGiles. “It’s not just, you’re coming in, and you’re eating your food, and then you’re going back to learning. It continues the learning process.”

So what kind of impact did Round Robin seem to have on the participants? Abigail Gerth, SWE's other 2016–2017 Co-Outreach Coordinator, reports that the middle schoolers definitely "seemed engaged throughout the activities." She adds that she was "really impressed with their creative solutions to the design challenges. They seemed to like working together in groups."

What about the highschoolers? Does Gerth believe the event impacted their choosing engineering careers?

"I definitely think the girls got something out of it. I think the longer activity rotations gave them an opportunity to ask more questions about the specific majors and really get to know what each one was about."

Why does McGiles spend so much time on outreach? For one, she loves engineering.

“It doesn’t feel like it’s a lot of extra time; it just feels like it’s an extra part of my school life being here, because it’s something I’m so passionate about.”

One reason she’s so passionate is because of the impact it had on her personally.

“The only reason I’m in Engineering at *Illinois* is because of an outreach event that I went to here when I was in middle school and in high school. I came to *Illinois’* campus for an outreach event over the summer. It was a camp. I came, and I fell in love with engineering.”

In fact, she wasn’t even going to study engineering; she intended to study American sign language interpreting: “And then I went to this program, and I fell in love with engineering, and I fell in love with *Illinois*, and I just want to share that passion back with everyone.”

Like McGiles, Gerth also considers outreach an opportunity to give back.

"I've always loved kids and loved helping people, and Outreach gives me an opportunity to do both on pretty much a daily basis. Seeing girls' faces light up as they explain to me the design they are working on is such a rewarding experience."

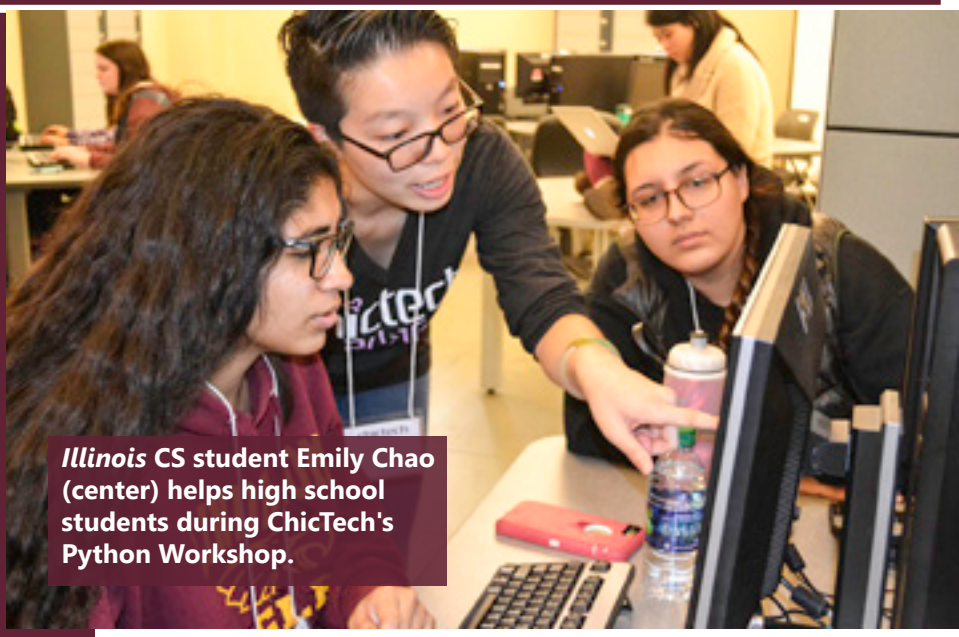
Middle schoolers make a circuit in the "Binary Numbers & Arduinos" workshop.

A middle school student works on her team's protective eyewear design during the "Protect Those Eyes! workshop.

CHICTECH SEEKS TO INCREASE THE NUMBER OF WOMEN IN COMPUTER SCIENCE—AND IS SUCCEEDING!

November 16, 2016

Computer Science is only for guys who are nerdy geeks and who sit glued to their computers 24/7! This is one of the myths about computer science (CS) that the fall 2016 ChicTech outreach set about to dispel, while showing 61 visiting high school girls (up from 50 last year) that CS is cool. Held November 12–13, the event, hosted by *Illinois*' Women in Computer Science (WCS), was designed to show girls that they too can do CS, that it's lots of fun, what it's like to be a CS student at *Illinois*, and what a CS career might be like. And as its name implies, ChicTech sought to show girls that they can be CS majors and still be chic—still be all girl! Finally, ChicTech underscored that if these young women matriculate to *Illinois*, they will have a great support system of other women in CS.



***Illinois* CS student Emily Chao (center) helps high school students during ChicTech's Python Workshop.**

One of ChicTech's main goals was to show girls who had no coding experience, nor access to it in high school, that not only could they do computer coding, but that it's fun! So three sessions were devoted to coding workshops. Girls were divided by expertise into three groups: girls who had never coded before, those with some experience, and, finally, computer-savvy girls with a lot of experience. Then, during the workshops, they learned to use applications based on their skill levels: beginners used HTML and CSS to design a web page; students with intermediate-level skills used JAVA; advanced-level students worked with Python.

To show the girls career opportunities available in CS, during lunch, Sharon Zhu from Huawei presented so the girls could find out what they might expect after college if they went into industry.

Another important goal of ChicTech was to show the visitors what life as a CS student at *Illinois* is like. So the event fostered interactions with nearly 80 CS students (mostly women) who volunteered to work with participants. A large number of CS students were on hand to teach participants during the workshops.

CS students also participated in other ChicTech activities to show girls that there's more to being a CS student than being glued to a computer screen. They shepherded groups of girls around campus during Saturday afternoon's photo scavenger hunt. In addition to introducing them to campus icons Alma Mater and Grainger Bob, the scavenger hunt required some borderline-impossible photos, such as one with a minimum of five squirrels (Photoshop, anyone?). To further expose girls to college life, on Sunday, a panel of current CS students answered any questions girls might have had.

ChicTech participants discover campus during the Photo Scavenger Hunt.

Saturday evening's activities were designed to further develop relationships among the girls themselves and the CS students. Students played Jeopardy!,

which included some questions about famous females in technology or tech companies that got their start at *Illinois*, along with a team-building activity: an egg-drop challenge. And to show the visitors that they don't have to give up being girly-girly to be computer science majors, Girls' Night featured painting nails, making jewelry out of computer parts, and decorating cupcakes.

Sunday afternoon's events included the girls' parents, who were invited for pizza and a talk by a CS Professor Anna Yershova, who spoke about virtual reality, as well as the final session where girls presented their projects so their folks could see what they'd learned over the weekend.

ChicTech's overarching goal was to show girls that if they studied CS at *Illinois*, they wouldn't have to go it alone, but would have the support of other women in CS who have already been through it all and could be a great resource.

Planning committee for the fall 2016 ChicTech.

Nor would they be the token girl in any CS classroom any more. They learned that the percentage of women in CS at *Illinois* is on the rise: it appears the numerous outreach events, such as Chic Tech, that WCS has been holding over the last several years are starting to pay off—big time! Almost half (46%) of the 190 freshmen in *Illinois*' CS Department are women (significantly greater than the 18% in CS nationwide), almost a 50% increase over the 24% in last year's freshman class, and a drastic increase from JUST 6% back in 2012.

What role did ChicTech and other WCS outreaches play in the ground-breaking number of women in *Illinois*' fall 2016 CS freshmen class? Those data weren't available, but when it comes to ChicTech's success rate among two of the women currently studying CS at *Illinois*, it's 2 for 2.

WCS Outreach Chair Brianna Ifft and fellow CS major Emily Chao, two current ChicTech leaders, both came to ChicTech as highschoolers in Spring 2013. Ironically, they never met. "We both went the same year," Ifft acknowledges, "We sat one table apart, but we didn't meet till freshmen year."

What kind of impact did ChicTech have on Ifft ending up at *Illinois* studying CS??

Although ChicTech didn't introduce Ifft to CS (she took classes in high school), "It definitely impacted my decision to come to *Illinois*," she admits. That's why she's so sold on Chic Tech, and why as WCS's outreach chair, she's devoted to outreach—because of the impact it had on her personally. So she hopes to pass it on.


ChicTech participants practice coding iduring the CSS/ HTML Workshop.

WCS Outreach Chair Brianna Ifft in *Illinois*' Siebel Center.

Ifft's commitment to outreach is motivated by a desire to increase the number of women in CS:

"I think the big reason is because girls are a minority in tech, and to get girls exposed to this," she admits.

She feels WCS outreach fills a niche for students don't have access to CS courses in high school.

"I think it can sometimes be overwhelming or scary to approach it, but we're trying to get them in and show them that they can do it on their own. They can start doing it right away, and [we] show them how powerful coding is. A lot of high schools don't have computer science classes, so if they didn't then they can find out if they like it and decide if this is what they want to do when they get to college."

According to Ifft, WCS has been working hard to keep the STEM pipeline to *Illinois* flowing and to recruit more women to CS. For example, in addition to ChicTech, WCS hosts GEMS (Girls Engaged in Math and Science) for middle school girls. They've also visited several local high schools a number of times. Ifft reports that a lot of girls come to all or manyh WCS outreach activities.

"So I think it's really helpful that we do have so many different things going on, and not just one," she admits.

Plus, girls who came to ChicTech last year were invited to come back this year, and WCS will keep in contact with this year's participants as well. "We make a Facebook page for them all to join, and we paste things such as scholarship opportunities in for them. So we try to keep in touch with them a little bit with the FB group." The girls will also be invited to CS@*Illinois* SAIL outreach.

And, of course, Ifft would like them to come to *Illinois*:

"So, yea, basically just getting them exposed to coding and getting them to U of I to show them what we have to offer here. By getting them involved with CS girls and CS@Illinois, they can decide if they want to come here in the future, and they can see that they would have a great support network here."

And once girls apply and are admitted to *Illinois*, WCS also works hard to "wine and dine" them, to ensure that they feel welcome and to assure them that, should they attend *Illinois*. they would have the support of many other women in CS—including some they've met at outreach events.

WCS also stays involved with girls through admitted-student events. Both last fall and this past spring, WCS invited women to campus for Women in CS Admitted Day. Ifft, who helped run the events, says visitors got a taste of university life, ate lunch in dorms, talked to people in CS, and met WCS girls.

A ChicTech participant engaging with one of *Illinois*' CS students during a workshop.

A ChicTech participant learns about HTML/CSS during a workshop.

MOMMY, ME, & SWE: MIDDLE SCHOOL GIRLS FIND OUT ABOUT ENGINEERING WHILE FINDING DORY

November 16, 2016

Engineering is not only fun, but can be used to help solve practical, real-world problems —even not-so-real problems—like finding Dory. This is the message Mommy, Me, and SWE sought to convey to the 30 local middle school girls (and their moms) who participated in the all-day outreach event on Saturday, November 12th. While participating in the event's fun and engaging hands-on activities, the mother-daughter teams were exposed to a number of different engineering disciplines as Illinois students brought engineering down to a level the kids (and even the moms) could understand.

Hosted by the Illinois chapter of SWE (Society of Women Engineers), the day was made even more special because most of the events featured characters from a recent movie most of the kids had no doubt seen—Finding Dory. For instance, in most activities, the mother-daughter teams were challenged to use the different engineering disciplines in some fashion to help the characters from the movie find Dory.

For example, in one activity, mother-daughter teams were to use

A mother-daughter team works on cleaning up the oil spill during the Chemical Engineering rotation at Mommy, Me, and SWE.

Mechanical Engineering to help Dory jump back into her tank. Using the available materials, they were to design a lever-like contrivance that would send Dory (represented by a ping pong ball) flying back into the "tank."

According to SWE Co-Outreach Coordinator Abbie Gerth, this activity appeared to be one of the kids' favorites. "They really enjoyed the mechanical engineering activity," Gerth says, "which was a sling shot in the form of a lever. So they really liked learning about levers and making the see-saw sling shot—especially getting to fling the ping pong balls. So that one was definitely a hit. That one we'll keep on doing."

A Mommy, Me, and SWE participant launches the catapult she designed in the Mechanical Engineering activity.

For the Chemical Engineering activity, the scenario was that the kids couldn't find Dory because the water was made dark and murky by an oil spill. So mother-daughter teams used a variety of materials (dish detergent, flour, cotton balls, etc.) to determine which material/method was most effective in cleaning up the oil spill.

A local youngster does an electrical engineering hands-on activity during Mommy, Me, and SWE.

The Civil & Environmental Engineering activity featured a scenario where Dory got swept away by the undertow, and while trying to find Dory, kids learned about ocean currents.

In the Aerospace Engineering activity, the scenario began with, "We've searched the entire ocean! Why don't we try searching the sky?" Then mother-daughter teams designed a plane some characters could use to search for Dory. One caveat: since the characters are fish, they have to stay underwater, which is heavy; so the planes had to have weights taped to them and still fly.

A local middle school student, Olivia, tests the prototype for the engineering design challenge.

In the Computer Science Engineering activity, the scenario was that Dory needs to choose between Destiny and Bailey to help her to find her way. So girls used a logic model, similar to what might be used in computer science, to decide.

For the final activity, the kids helped Dory, who was playing hide and seek with her mom and dad, to find them. So the teams used electrical engineering concepts to make a spinning Dory so she could look for her parents.

Even the design challenge for the day was to help Dory. Teams were to build some kind of device or machine that could help Dory get from the "tank" she was trapped in and back into the "ocean."

Exposure to the different engineering disciplines was one of the main reasons several of the mothers brought their daughters to the event. According to Julia Wertin, one local mom explains why she brought her daughter Olivia to Mommy, Me, and SWE:

"I wanted her to get exposed to all of the different things that you could do in engineering. I don't know much about engineering. I used to work as an architectural drafter, so I know there's a lot of opportunities for engineers in a lot of different areas—construction, transportation. Just a lot of different kinds of things that you can go into. I just wanted her to see all the different things."

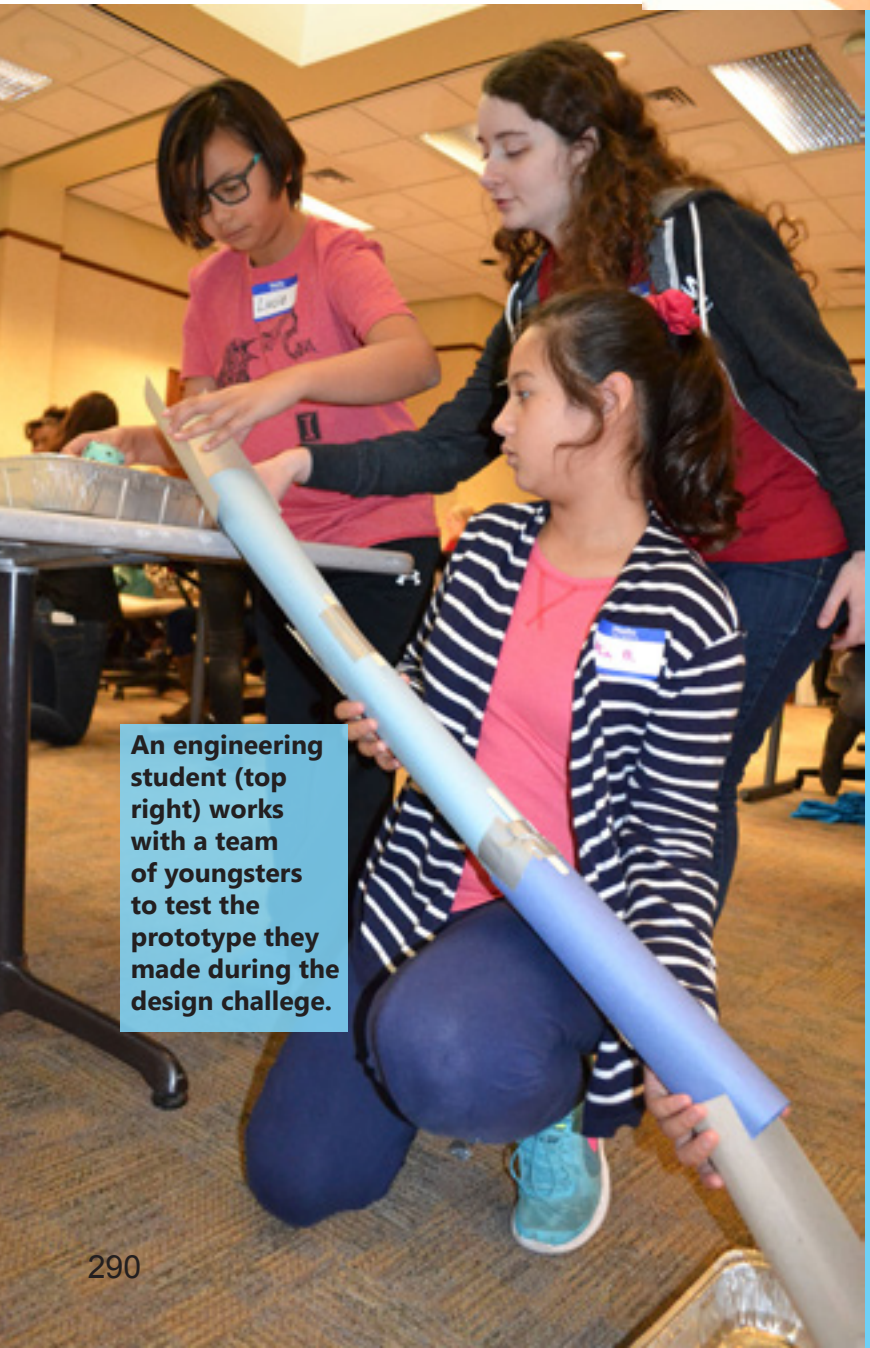
Another local Mom, Gianna Williams, says participating in Mommy, Me, and SWE is now a mother-daughter tradition in her family:

"I came about two years ago with my oldest daughter, and it was a blast. It was nice getting all the information, learning about the different fields of engineering and what girls can do in the same field."

So this year, she brought her daughter Kady, who thinks engineering might be a possibility down the road. "Yes, it's interesting," she admits. "I would like to learn more about it."

Attending for the second year in a row was local mom, Carolyn Bartalotta and her daughter Mia.

(Left to right) Gianna Williams and her daughter Kady work on their design challenge.



An engineering student (top right) works with a team of youngsters to test the prototype they made during the design challege.

"We attended with our friends last year for the first time," Bartalotta explains, "and we really enjoyed it. So my support for my daughter is to get her exposed as much as I can to see what she really enjoys."

Does Mia have tendencies that might make her a good engineer down the road? Mom says yes!

"She likes to build things," Bartalotta explains. "She likes to take things apart. The first thing that pops into my head is a little mouse that we had that was broken. I was about to throw it away, and she snatched it out of my hands and said, 'This is my next project to see why it's not working.' So it's sitting in her closet to see what will happen. She just likes building, so we'll see what happens."

Mia wasn't the only middle schooler with the potential to blossom into an engineer. SWE's Co-Outreach Coordinator Abbie Gerth believes several future engineers were among the youngsters, and loved that the moms were enjoying it too. "That's one of the coolest things about this event, is that you get to see the moms learn alongside with their daughters. It's really a bonding experience for them and it's something really cool to see as a volunteer for this event. We hope that they'll continue following their passions."

Gerth believes the outreach was a success: "The girls were really engaged in the activities in the morning. They seemed to understand what was going on, and got a lot out of them," she says.

Mommy, Me, and SWE chair Chelsea Wong also believes that participating in SWE's outreach had a positive impact on the participants who were not only "exposed to engineering and the different fields that there are," but she also believes they learned, "how creativity and innovation is so important in anything that they do."

Wong participated in the event to have a positive impact on the community.

"I really wanted to be involved in a large-scale event that really could make a difference in the community. A lot of the kids that showed up today and their parents are all from the community, and definitely being able to see young children who are interested in doing STEM and different engineering disciplines is awesome…Being able to be an impact in their lives in this way and being able to motivate them into doing engineering is just awesome.

Like Gerth, Wong believes she also saw a number of future engineers.

"A lot of them are so creative in thinking. Even as fourth graders to sixth graders, they know about all these different ideas that I don't even think I knew about in fourth grade."

She was also excited to give the middle schoolers the kind of exposure to engineering that she wishes she had had at that age.

"It's awesome!" Wong exclaims. "I wish I had that when I was younger…I feel like back in the day, there was not that much STEM for females, not as much exposure as there is now. In elementary school and middle school, I never heard, 'Do you want to be an engineer?' as a young fourth grader. I think it's awesome that these girls have this opportunity."

Teammates test their design prototype to get Dory back into the ocean during the Mommy, Me, and SWE design challenge.

A local youngster enjoys the Crystal Ball activity at the Orpheum's Spooktacular.

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