

I-STEM

EDUCATION INITIATIVE

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

2017: THE YEAR IN STEM EDUCATION



I ILLINOIS

University of Illinois at Urbana-Champaign

A SAMPLING OF ILLINOIS STEM EDUCATION: OUTREACH PROGRAMS, ORGANIZATIONS, AND EVENTS*

- ❑ ACES Family Academies: <https://acesalumni.illinois.edu/events/aces-family-academies>
- ❑ Aerospace Engineering
 - Illinois Space Society: <http://iss.ae.illinois.edu/>
 - IAI-Illinois Aerospace Institute: <http://iai.aerospace.illinois.edu/>
 - IAO-Illini Aerospace Outreach; email: aero-outreach@illinois.edu
- ❑ BMES–Biomedical Engineering Group: <http://bmes.ec.illinois.edu/>
- ❑ Biology/Microbiology
 - Chung Lab: <https://mcb.illinois.edu/chunghj/neuroscience-outreach/>
 - GEEB-Graduates in Ecology and Evolutionary Biology: <https://www.life.illinois.edu/geeb/>
 - MCBees-MCB Graduate Student Organization: <https://www.facebook.com/mcb.gsa/>
 - PBAGS-Plant Biology Association of Graduate Students: <https://www.life.illinois.edu/pbags/>
- ❑ Biolmaging REU–Biolmaging Research Experience for Undergraduates: <http://nano.illinois.edu/REU-Bioimaging/>
- ❑ 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/>
- ❑ Chemistry
 - Bonding With Chemistry: <https://chemistry.illinois.edu/resources/women-chemistry/women-chemists-committee/events/bonding-chemistry>
 - REACT: <http://www.chemistry.illinois.edu/outreach/react/index.html>; email: thereactprogram@gmail.com
 - Women Chemists Committee (WCC): <https://chemistry.illinois.edu/resources/women-chemistry/women-chemists-committee>
- ❑ Center for Global Studies: <http://cgs.illinois.edu/>
- ❑ Computer Science
 - ChicTech: <http://wcs.illinois.edu/chictech/>
 - CS@Illinois Sail: <https://www.facebook.com/illinoissail/>
 - GEMS-Girls Engaged in Math & Science: <https://cs.illinois.edu/outreach/gems-computer-science-camp-girls>
 - Women in Computer Science (WCS): <http://wcs.illinois.edu/>
- ❑ EBICS (Emergent Behaviors of Integrated Cellular Systems)
 - EBICS REU: <http://ebics.engr.illinois.edu/>
 - EBICS SPHERES (SParking High Schooler's Excitement for Research in Engineering and Science) for high school students from underrepresented backgrounds in Champaign-Urbana (Unit 4 and District 116): <http://ebics.engr.illinois.edu/>
- ❑ Engineering
 - Engineering Advocates: <http://eib.ec.illinois.edu/engineering-advocates/>
 - Engineering for Social Justice Scholars (ESJ):
 - Engineering Open House (EOH): <http://eoh.ec.illinois.edu/>
 - Engineering Outreach Society (EOS): <https://publish.illinois.edu/engineeringoutreachsociety/>
 - Engineering Without Borders (EWB)
 - ICANEXSEL: Illinois-ChiS&E Alliance for Nurturing Excellence in STEM Education Leadership; email: info@chiprep.org
 - Illinois Engineering Ambassadors: <http://ambassadors.engr.illinois.edu/news.html>

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

Front cover: Electrical and Computer Engineering Ph.D. student Lonna Edwards (left) works with an Urbana High School student who is soldering a circuit during ECE Day of I-STEM's Summer Camp.

Back cover: An Illinois engineering student shows off her memory-metal-equipped origami crane during Engineering Open House 2017.

- ❑ Genome Day
- ❑ GAMES (Girls' Adventures in Mathematics, Engineering, & Science) Camps <http://wie.engineering.illinois.edu/k-12-programs-resources/gameswyse-camp/>
 - GLAM (Girls Learn About Materials); (Material Science and Engineering)
 - GLAM-Mid (Girls Learning About Materials): <https://engage.illinois.edu/entry/32238>
 - Bioengineering GAMES
 - Chemical Engineering GAMES
 - GLEE (Girls Learn Electrical Engineering)
 - Aerospace Engineering GAMES
 - Computer Science Engineering
 - G-BAM (Girls Build Awesome Machines): (Mechanical Engineering GAMES)
- ❑ Graduate College Educational Equity Programs: <http://www.grad.illinois.edu/eep/diversity>
 - COS (Community of Scholars), a campus visit program
 - SROP (Summer Research Opportunities Program);
 - URAP (Undergraduate Research Apprenticeship Program);
 - ASPIRE (Fall Early Application and Visit Diversity Recruitment Initiative)
 - SPI (Summer Pre-Doctoral Institute)
- ❑ Illinois Partnership for Respecting the Identities of Students in Engineering (iRISE): <http://irise.illinois.edu/>
- ❑ Illinois 4-H: <https://4h.extension.illinois.edu/>
- ❑ I-STEM
 - [I-STEM DNA Day](#)
 - [I-STEM Multidisciplinary Summer Camp](#)
- ❑ MakerGirl: <https://makergirl.us/>
- ❑ Mathematics
 - AWM—Association of Women in Math: <http://www.math.illinois.edu/awm/>
 - GEMS (Girls Engaged in Math and Science: <https://math.illinois.edu/gems>
 - Illinois Geometry Lab; email: igl@math.uiuc.edu
 - Math Carnival: Gathering for Gardner: <https://faculty.math.illinois.edu/~lanius2/outreach.html>
 - SIM-Summer Illinois Math Camp: https://faculty.math.illinois.edu/~emerrim2/SIM_Camp/
 - Sonia Math Day: <https://math.illinois.edu/sonia-math-day>
 - Urbana High School Project (ALEKS, Math)
- ❑ Mechanical Science and Engineering (MechSE)
 - ASME—American Society of Mechanical Engineers: <http://asme.mechse.illinois.edu/>
 - Bahl Research Group: <http://bahl.mechse.illinois.edu/>
 - ENVISION-Engineers Volunteering in STEM EducatIOn: <https://publish.illinois.edu/envisionuiuc/events/>
 - MechSE Education Outreach (Joe Muskin: Education Coordinator: jmuskin@illinois.edu)
 - Paper2Tree: <https://paper2tree.org/>
 - Pi Tau Sigma; url: <http://pitaisigma.mechse.illinois.edu/>; email: ptsillinoisalpha@gmail.com
 - Rheology Zoo: <http://ewoldt.mechanical.illinois.edu/index.html>
- ❑ NanoSTRUcT: <http://nano.illinois.edu/education/index.html>
- ❑ NCSA (National Center for Supercomputing Applications)
 - Blue Waters Graduate Fellowship Program: <https://bluewaters.ncsa.illinois.edu/fellowships>
 - Blue Waters Internship Program: <https://bluewaters.ncsa.illinois.edu/internships>
 - CADENS: <http://avl.ncsa.illinois.edu/category/cadens>
 - INCLUSION (Incubating a New Community of Leaders Using Software, Inclusion, Innovation, Interdisciplinary and Open-Science) REU (Research Experience for Undergraduates); <http://reu.ncsa.illinois.edu/>
 - SPIN:
- ❑ NutriImpact: <http://publish.illinois.edu/nutrimpack/>; email: nutrimpack@gmail.com

- ❑ Physics Van: physvan@physics.illinois.edu
- ❑ POETS
 - POETS Research Experience for Undergraduates (REU): <https://poets-erc.org/reu/>
 - POETS Research Experience for Teachers (RET):
 - POETS Young Scholars Program
- ❑ Pollinatorium: <https://pollinatorium.illinois.edu/>
- ❑ Robotics
 - Illinois First: <http://www.firstillinoisrobotics.org/>
 - iRobotics: robotics student group; email: irobotics.illinois@gmail.com
- ❑ SACNAS (Society for Advancement of Hispanics/Chicanos and Native Americans in Science); email: uiuc.sacnas@gmail.com
 - Cena & Ciencias (SACNAS): <http://publish.illinois.edu/cenayciencias/>
- ❑ Sistas in STEM: https://twitter.com/sistas_in_stem?lang=en
- ❑ SWE (Society of Women Engineers, Illinois chapter): <http://societyofwomenengineers.illinois.edu/outreach/>
 - DADDS (Dads and Daughters Do Science). 1st–3rd grade girls and their dads to do hands-on engineering activities together.
 - Engineering Round Robin: day-long campus visit allows high school girls to explore engineering fields: <https://www.societyofwomenengineers.illinois.edu/upcoming-events/2017/10/7/engineering-round-robin>
 - FKO (For Kids Only). SWE engineering students visit Leal Elementary’s kindergarten class weekly to do an engineering lesson and a hands-on activity.
 - Introduce-A-Girl-to-Engineering Day: <https://www.societyofwomenengineers.illinois.edu/upcoming-events/2018/2/17/introduce-a-girl-to-engineering-day-2018>
 - Mommy, Me, and SWE: outreach for 4th–6th grade girls and their moms.
 - Outreach to Champaign-Urbana Special Recreation Center (monthly)
 - Step-Up. Monthly outreach at St. Matthew Middle School doing STEM topics and an engineering project.
- ❑ Veterinary Medicine
 - Vet Med Open House: <http://vetmed.illinois.edu/about/open-house-demos-and-exhibits/>
 - Veterinary Student Outreach Program: <http://vetmed.illinois.edu/asa/vsop/>
 - Summer Research Training Program (SRTP)
- ❑ Women in Engineering (WIE): <http://wie.engineering.illinois.edu/>
 - WIE Orientation
 - WIE Lead
- ❑ WYSE (World-wide Youth in Science and Engineering) camps: <https://wyse.engineering.illinois.edu/>
 - Exploring Your Options (Sessions I and II)
 - Discover Engineering
 - Discover Bioengineering
 - Exploring Mechanical Engineering
 - Exploring Nuclear Engineering
- ❑ XSEDE (Extreme Science and Engineering Discovery Environment)
 - XSEDE Scholars Program: <https://www.xsede.org/xsede-scholars-program>
 - XSEDE Student Champions Program: <https://www.xsede.org/web/guest/student-champions>

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FOSTERING STEM CITIZENSHIP

This is the third year of I-STEM's magazine, featuring once again over 300 pages not only of descriptions of cutting-edge research innovations transferred to STEM education initiatives, but also of direct testimonies of the participants' experiences. From the renewed, open-to-the-public mathematics carnival, to already-established science fairs and design contests, you can read about novel STEM education initiatives at Illinois and different experiences with recurring programs.

For each STEM unit on our campus, the 2017 year may have had a special significance. For the College of Engineering, it could be that the Quintessential Engineer statue celebrating women in Engineering was unveiled.

Alternatively, it could be that a new course, "Engineering for Social Justice," was launched. For ACES, it could be that the summer retreat connected three generations of alumni. For I-STEM, its intriguing new multidisciplinary, pilot summer program combining two different models might indicate that in 2017, a new research experience approach for high-school students was instituted at Illinois.

All these new experiences, in old or novel contexts, continue to push a renovation of the current policies existent to broaden participation in STEM education. They aim to inform for future careers, but also for the public education. Whether or not participants pursue careers in science, technology, engineering, and 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. To maintain the vitality of STEM creativity, it is essential that we engage diverse citizens to be well-informed and active participants in society, thus safeguarding the multiplicity of perspectives and thinking in classrooms, laboratories, and workspaces.

We praise our campus-wide STEM communities and are thankful to our faculty, staff, and students for fostering STEM citizenship and thus contributing to Illinois' public mission as a land-grant university!

Luisa-Maria Rosu

Interim Director, I-STEM Education Initiative



I-STEM Interim Director, Luisa-Maria Rosu, presents her keynote address at the National Conference of Community Science Education in Bucharest, Romania.



INTERDISCIPLINARY STEM EDUCATION OUTREACH





**Math Carnival: A
Gathering for Gardner
Planners Melinda
Lanius and Phillipp
Hieronymi**

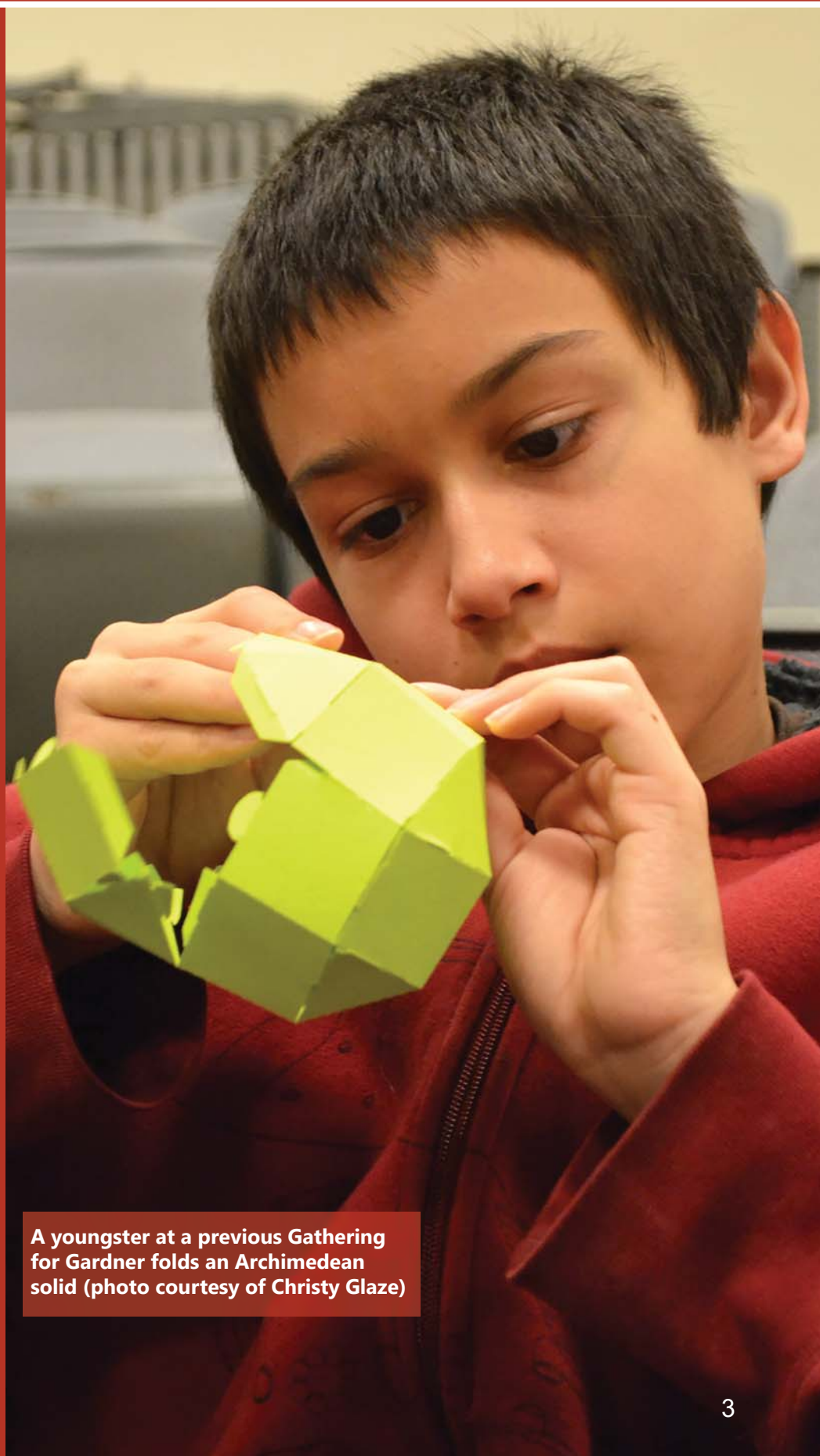
MATH CARNIVAL: GATHERING FOR GARDNER TO SHOW KIDS—MATH IS PLAY...AND FUN!

January 20, 2017

"It's flipping the switch. Every time we have this event, kids are like, 'Wait, this counts as math?' Because they're having fun!" – Melinda Lanius

The math folks in charge of the 2017 edition of the Math Carnival: Gathering for Gardner have one goal in mind: trying to get kids to realize that math is more than just some dry formulas memorized in school, but it's a creative, problem-solving process that's fun. So from 2:00-5:00 pm on Saturday, January 28th, volunteers from the Department of Mathematics, IGL (Illinois Geometry Lab), and Association for Women in Mathematics will be on hand at Altgeld Hall to get the community, especially local kindergarten through middle school youngsters, engaged and playing with math. "That's the spirit behind this—Math is play!" says Melinda Lanius, a math Ph.D. student who, along with Assistant Professor Philipp Hieronymi, is organizing this year's event.

The event is named after Martin Gardner, a popular writer known for his mathematical puzzles. According to Gardner, "A puzzle in a sense models what all scientists are doing. They are trying to solve puzzles about the nature of the universe. Puzzles can lead you into almost every branch of mathematics." So in honor of Gardner, the Math Carnival, the fifth Gathering for Gardner at Illinois, features...puzzles.



A youngster at a previous Gathering for Gardner folds an Archimedean solid (photo courtesy of Christy Glaze)

For example, during Tile Emporium, students will be given a set of tiles and asked to use several to create first a square, then increasingly more complicated shapes using the L shape. According to Lanius, this activity exposes students to mathematical induction, which she explains via a dominoes illustration.

"I want to knock over a line of dominoes," she says, "the first will hit the 2nd, and the 2nd will hit the third, and so on. I first learned this concept in college, and this puzzle really captures this idea. And kids get it—how you use previous smaller squares to make a bigger one."

During Penny Parade, while stacking, sliding, flipping, and arranging pennies, youngsters will "explore game strategy, spatial reasoning, and learn to think outside the box," according to Lanius.

At Estimation Station, visitors will learn how to estimate quantities. "Humans are terrible at estimating and have terrible number sense," admits Lanius. So after learning some quick tricks on estimating, participants will then use them to estimate how many pieces are in a jar of candy. Whoever gets closest, wins a prize.

"Cause this is a math carnival," Lanius exclaims, "so there will be prizes!"

In another fun hands-on activity, kids will learn about the math behind a snowflake, then create one themselves. "We will talk to them about the symmetry behind snowflakes," Lanius explains. "Snowflakes have six rotational symmetry and for some reason, all snowflakes want to have this rotational symmetry. And they're all unique. And depending on what the temperature is or what part of the sky it falls from, the rotational symmetry is



This image illustrates a snowflake's six-pointed rotational symmetry (Image courtesy of the Huffington Post) website.

different. I look forward to sharing this with the kids."

Hieronymi appreciates the hands-on approach employed during the Carnival:

"That's something that's really invaluable. Because mathematics in elementary school is counting or something. Even in middle and high school, it's numerical methods to solve certain boring problems. Here, it's truly hands on; you don't need a calculator or anything."

To ensure that mathematicians involved with the event express math concepts in a way that, say, a kindergartener could understand, volunteers will attend training sessions so they can:

Dominoes illustrate mathematical induction (Image courtesy of SPEAR Education) website.



"Practice our examples," says Lanius. "We have to make sure that we are good with children, you know, because as abstract mathematicians, we usually only explain things to our colleagues."

So, are the kids going to make the connection that these fun puzzles and games are math? Will a little light bulb go off in their heads that says, "Gee, this is math!"

"We'll tell them that it counts as mathematics, but sometimes it's so far divorced from what they see in school, they may not believe us," admits Lanius. "It may be years from now that they realize, 'That was math!' But really, it counts. It counts!"

Hieronymi likes the idea of exposing kids to the problem-solving mindset of math early on as an alternative to what they get in school.

"When kids see mathematics in school for the very first time, it is numerical; they learn to add and subtract. Even my wife, I think, still has the wrong idea of what we do as mathematicians. So I think it is very important to show early on what math really is. It is a problem solving and understanding phase, and I think this can be done at an earlier age—elementary and middle school."

Lanius agrees with Hieronymi that schools don't quite convey to kids what math is:

"In school, when they first are introduced to mathematics, it is quite dry and they're learning tools that will be useful to be good citizens, but they don't get a good snapshot of what it is like to be a mathematics researcher. So what we do is take these abstract building blocks, but we are playing around with it. All we really are doing is playing as mathematicians, and it really does have a creative side. So we really want to give children that snapshot, that mathematics is play, and that you can be creative and that this is an avenue of study for you. Math is about playing and learning a way of thinking."

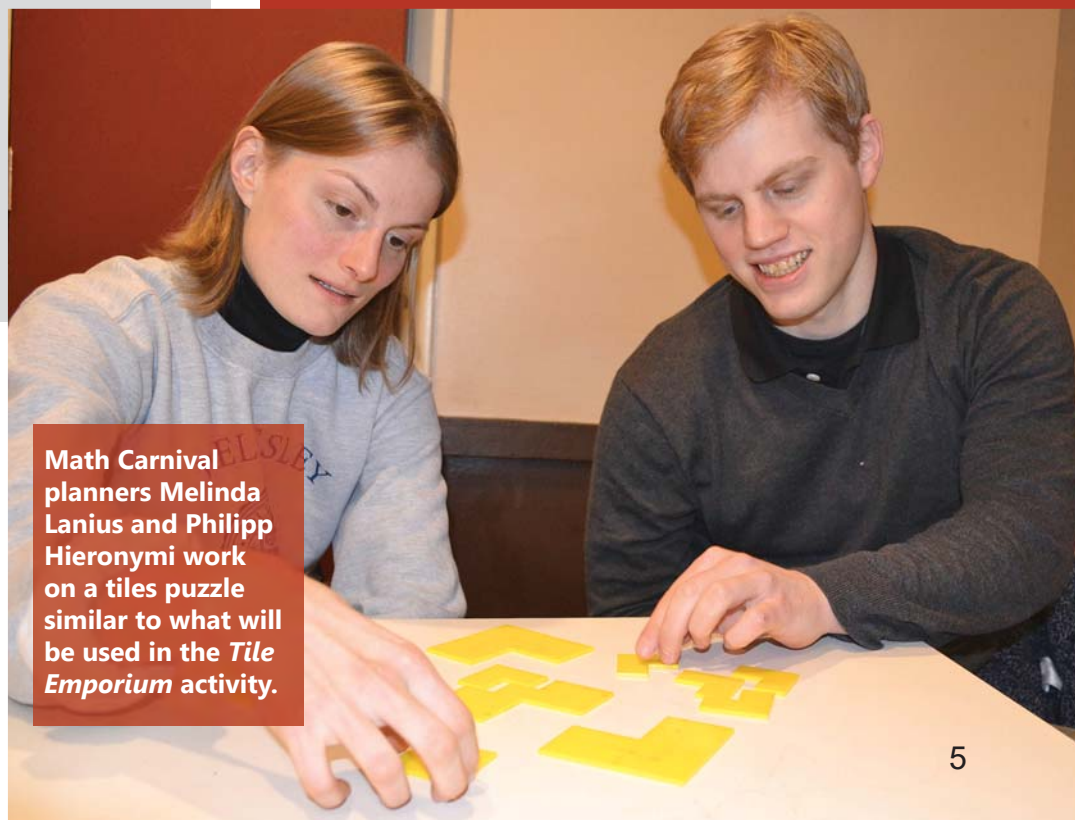
While the two won't necessarily immediately see the fruit of their labors, both hope more mathematicians will be added to their ranks down the road, or at least choose STEM careers as a result. And Hieronymi says if even only a few kids get turned on to math, it's well worth it.

"You know, the batting average is pretty low. So if 200 kids come, and ten decide they want a career in STEM because of this, then this is the best event ever. If you give kids enough opportunities to do these things, and if some recognize that this is something they find interesting, then you get kids to become mathematicians, engineers, scientists."

According to Lanius, their event could be the catalyst that gets the ball rolling: "It snowballs. One kid finds it very interesting, and they join a board game club at their school, and that actually counts as mathematics. That is game theory. And maybe in high school, they'll join math club or the robotics team. And hopefully by the time they get to college, they'll become one of us."

Why do the two do this event year after year? In addition to the potential of recruiting more kids into STEM, Hieronymi sees holding community events like Math Carnival as a mandate:

"As a public university, I think it's our responsibility to educate outside our population of students and have something for the outer community. This is a fun event, and it allows us to share our passion with the next generation."



Math Carnival planners Melinda Lanius and Philipp Hieronymi work on a tiles puzzle similar to what will be used in the *Tile Emporium* activity.

NEXT GENERATION PRESCHOOL'S GRAZI MIRA IMPARTS LOVE OF SCIENCE, ANIMALS TO STUDENTS

January 30, 2017

Practically the first thing one sees upon entering Next Generation School's Preschool is an intriguing, glass-enclosed structure—science teacher Grazi Mira's classroom. When one ventures into the room, replete with exhibits, butterfly-filled cases, and animals in enclosures that simulate the different habitats the animals are from, her love of animals—and her students—is quite apparent. That her students love her and her hands-on style of teaching science is also readily apparent. The kids not only get to look at and hear about the eclectic range of animal friends in Mira's menagerie, they get to meet them face to face—animals like Lizzy the Leopard Gecko, Gizmo the Bunny, Arnaldo the Chinese Water Dragon, and Bridget the Fire Corn Snake. They even get to touch them...if they're brave enough.



Murad's preschool students arch their backs like the cat in the book she's reading about animals' unique characteristics.

For Mira, who is a biologist, teaching science to Next Generation's preschoolers is a perfect fit:

"I just love animals. And I love kids. And I think the interaction between animals and kids is great...I tell them what the animal has, what they do, what they don't do. They learn. They're so curious. This is what I love about that age. They're curious, and they love everything you bring."

Murad shows off one of her unique animals, Juan the Crested Ghecko from the forest in New Caledonia, Australia.



Mira says kids do well when touching the fragile creatures: "The kids are really careful, and control their bodies and their behavior, and they're gentle. It's so beautiful when they're interested." And on the cold Tuesday morning in January that this reporter visited the classroom, the youngsters were very interested and engaged...and gentle.

to give her young charges a chance to work off some of their excess energy and to settle down. They began class by doing some welcome-to-science-class stretching exercises, and singing a song, followed by an interactive session reading a book about different animals.

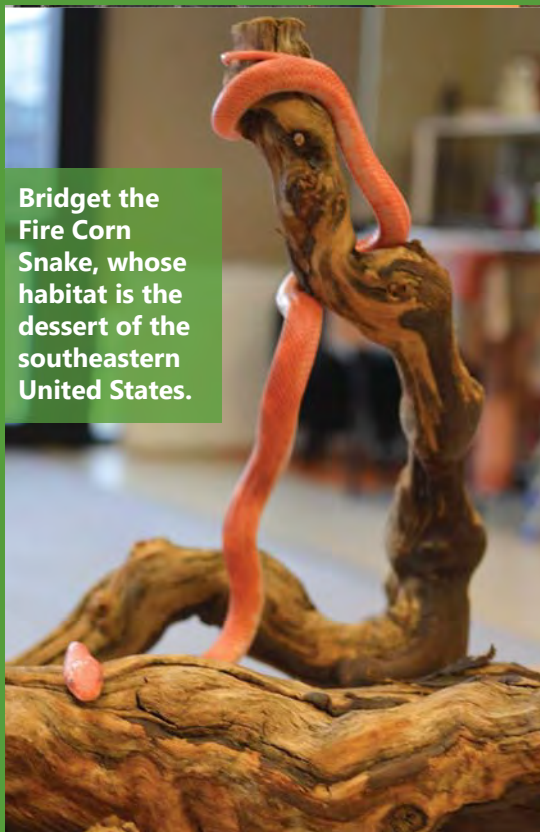
Mira says she visits the local library every week to get new material—apparent by the selection of books about animals that line her window shelf. The day this reporter visited, she read the children *From Head to Toe*, a book about a number of different animals, some of their unique features, and some of the different ways they move their bodies, which the kids then tried to emulate with their own bodies—perfect for preschoolers.

Then it was time to introduce the youngsters to the animal to be spotlighted for the day's lesson: Lizzy the Leopard Gecko. And to ensure that the children remained gentle once she got Lizzy from her enclosure, Mira had the kids review their animal-time etiquette—a set of classroom protocols which she had put into place to ensure that the animals don't get injured. First, she had her students sit and cross their legs (so the creature wouldn't inadvertently get kicked or stepped on) and keep their hands in their laps until it was their turn to touch. She also went over the touching protocols. Regarding their up-close-and-personal interactions with the animal, they weren't to touch its head, lest they injure it, and were only allowed to pet the animal in a downward motion on its back because of its scales.

Mira indicates that the science lessons she teaches the



Murad interacts with Bambi the Guinea Pig.



Bridget the Fire Corn Snake, whose habitat is the desert of the southeastern United States.



One of Murad's tree frogs.

students tend to be based on their interests.

"I'm always searching for new things to bring to the kids, and I love hands on. I came from a Montessori background, and I just love the whole, 'They can do it. They build their own materials. They build their own experiments.'"

So when she arrived to teach at the school in August of 2016, and the kids wanted to know about the animals she had brought, she decided, "Hey, let's start with the habitats of the world, because we have animals from all habitats in here. So let's do that, because the kids, they want to know. They want to learn about those animals. So let's learn about those animals because they want to."

During their study of habitats, they learned about animals that can live in those habitats and, according to Mira, "We focused on their body's adaptations to live in those interesting and sometimes extreme habitats."

She discusses what the animals eat and drink, whether or not they swim, if they breathe air, or they breathe air in the water. "They just start asking questions. I kind of follow the kids' questions. It's simple. It's beautiful. They're so interested in it," Mira exclaims.

So every month since she arrived, they've learned about a different habitat. The first month was the forest. "Then we talked about the forest, and the animals that live in the forest, and we talked about what



Grazi Murad (center) interacts with a preschooler during her science class.

“Oh yes!” she says, then admits that they’re even thinking about the class when they’re away from it. “They love the animals. Sometimes they find insects during the weekend and parents have to save them so they can bring it to me,” she says.

And she’s quite proud of her collection of “show-and-tell” treasures the kids have brought in to her, which she keeps in a special box: coral, a seahorse, a shell, insects, a gecko egg. Her little box even contained a couple of Bridget the Fire Corn Snake’s old snakeskins that she had shed.

they need to survive,” she explains. In October, they learned about the desert habitat, followed by oceans and rivers in November, and (extremely apropos for December, with Santa preparing for his journey from the North Pole) the polar habitats. In the Spring 2017 semester, they’ll address some themes other than habitats: the Human Body (Feb), Insects and Bugs (March) and, just in time for spring, Plants, Flowers, and Seeds (April).

And, since hands-on seems to be one of the chief ways of learning in Mira’s classroom, once class was over, this reporter got to meet and touch (and photograph) the animals herself. (Not enamored with snakes, in general, I even drummed up the courage to touch Bridget the Fire Corn Snake. After all, how ashamed would I have been if 4-year-olds had been brave enough to touch the snake, but I wasn’t?)

Regarding touching the different animals, Mira explains, “I think it’s good for the kids. They’re not scared,” then qualified her statement with, “Sometimes they are, and it’s ok. They deal with their feelings and we talk.”

She also enjoys collaborating with the other preschool teachers. “I love big projects, joining the other teachers. I love being here and doing everything with the kids and just go with their interests”

Does she see any future scientists among her flock?

And to get them in the mindset of thinking that they can be scientists, Mira is constantly encouraging the children that science is a viable career field and that they can become scientists by liberally sprinkling throughout her teaching the word “scientist.” For instance, she addresses them as scientists, and commends them when they’re displaying the characteristics of good scientists.

“I love when their eyes shine about a story or an animal I can bring,” she admits, “It’s special. I love every day that I’m here with the kids.”



Murad’s preschoolers get a chance to pet Lizzy the Leopard Gecko.



**NGS Pre-School
Science Teacher
Grazi Murad with
Gizmo the Bunny.**



**A local youngster
shows off the
"snowflake"
she made at the
Math Carnival's
Snowflake station.**

LOTS OF LOCAL KIDS (AND PARENTS) HAVE FUN WITH MATH AT MATH CARNIVAL: GATHERING FOR GARDNER

January 30, 2017

Hundreds of local adults and children converged on Altgeld Hall on Saturday, January 28th for Math Carnival: Gathering for Gardner. As they participated in the numerous puzzles, games, riddles, magic tricks, and other hands-on activities, they discovered that math is more than just figures and formulas. According to Melinda Lanius, a math Ph.D. student who, along with Assistant Professor Philipp Hieronymi, organized this year's event, "Math is play!" So numerous volunteers from Illinois' Department of Mathematics, Illinois Geometry Lab, and Association for Women in Mathematics spent the afternoon showing members of the community that math can indeed be play—and that it's fun.

The event was extremely successful, with families showing up throughout the afternoon. Although only 250 persons officially signed in, Hieronymi suspects that not everyone signed in, and that often one parent signed in for the whole family. His best guess? Between 750 and 1000 people showed up.

"The turnout was fantastic," admits Hieronymi, "albeit above everything I could have imagined. This shows that there is a great demand for such activities in the Urbana-Champaign community."

Visitors could participate in a variety of math-related activities spread out in stations over several different rooms in Altgeld, ranging from hands-on activities to riddles, to magic tricks, to games, to estimation activities.

For example, one popular hands-on activity was the Snowflake Station, where kids learned about snowflakes, how they're six-sided, and how falling through clouds with different temperatures and



An Illinois math student (right) works on a tile puzzle with a local youngster at the Math Carnival's Tile Emporium station.

moisture levels shapes each one in a unique way. The youngsters then proceeded to use scissors and paper to create their own, unique snowflake, which they got to take home.

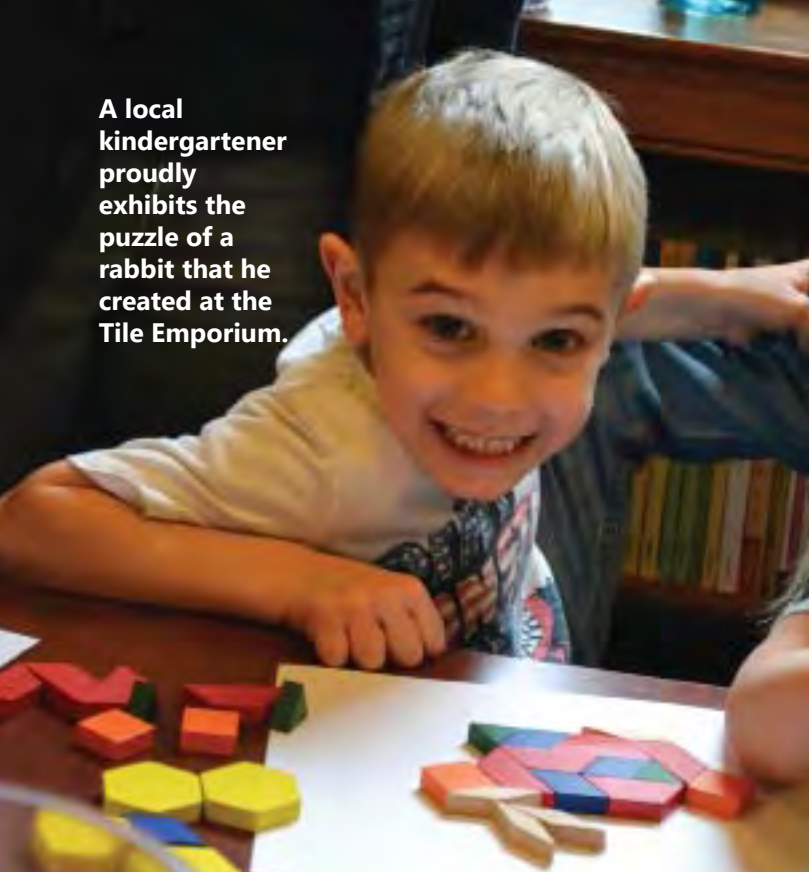
Another popular station was the Tile Emporium, where a variety of wooden puzzles of different colors and shapes called on students' mathematical reasoning and problem-solving skills.

Kids could also try to solve a couple of riddles at the Riddle Mania station. One was a kind of shell game where they were to guess, based on logic clues, which colorful box had an object underneath. (Spoiler alert: It was the yellow box.)

Another was a classic math riddle, Crossing the River (with a lion, a goat, and a tin can.) Here's the scenario: A man comes to a river with a boat. He has with him a lion, a goat, and a tin can. The man can only carry one single passenger besides himself in the boat. How can he get them all to the other side without the goat eating the tin can, or the lion eating the goat?

Helping to make the day special were the many volunteers who shared their passion for math with visitors. Hieronymi applauds the math students: "I think our students did an outstanding job, and they

A local kindergartener proudly exhibits the puzzle of a rabbit that he created at the Tile Emporium.



"I think that it is wonderful for everybody from kids in elementary school to grownups to participate in a little bit of mathematics in a playful way. 'Cause I know many people are afraid of mathematics or they don't like mathematics because they have had bad experiences with it. But this is a way where everyone can enjoy mathematics through magic tricks, riddles, games."

He also believes it's a great way to interact with the community: "It's something that brings a lot of the community from Urbana-Champaign onto campus to enjoy something that is so passionate for me."

Helping with Estimation Station was 2nd year math graduate student, Hadrian Quan, whose specialization is in Geometric Analysis. Visitors who dropped by his station were to guess how many nuts of various sizes fit into three jars. Quan led a discussion of different ways to better estimate these numbers.

He was especially excited about his station because "Humans are notoriously bad about estimating large distances/ lengths/quantities or having an intuitive sense for these relative sizes," he says. "However, we can very quickly learn how to improve our gut instincts, and it was exciting to talk with children of all ages about these ideas."

Excited about participating in the Carnival, Quan hoped to "remove some of the seriousness of math. As a student of mathematics, I like to remind others that math can be recreational and fun. Getting to interact with hundreds of children and their families at a math carnival is my ideal Saturday."

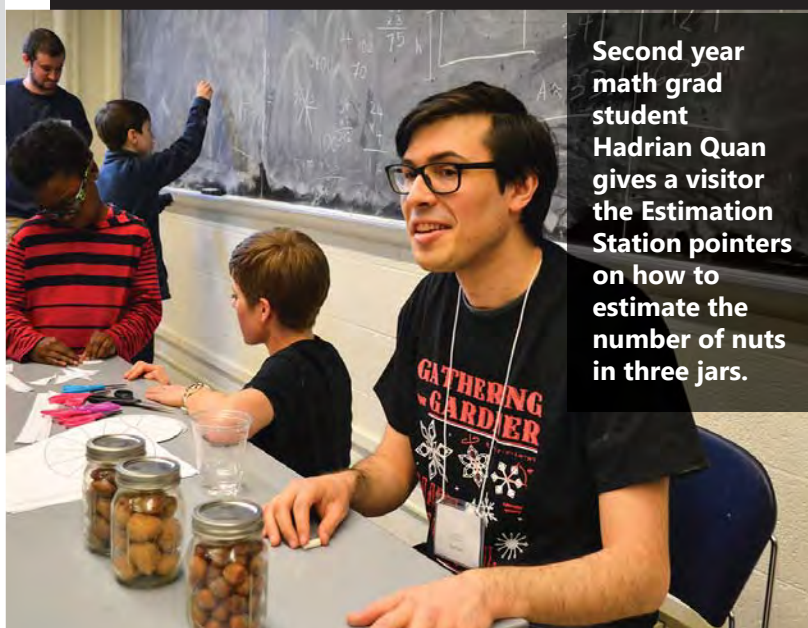
were all fantastic ambassadors for mathematics. And even though the turnout was way larger than expected, they handled everything with great patience and enthusiasm." He also had high praise for Melinda Lanius, who organized and prepared all the puzzles and demonstrations.

One Illinois student who helped with the event was sophomore Emily Alameda, who participated in the Math Carnival because she loves working with kids. Pleased with the event's impact, she says:

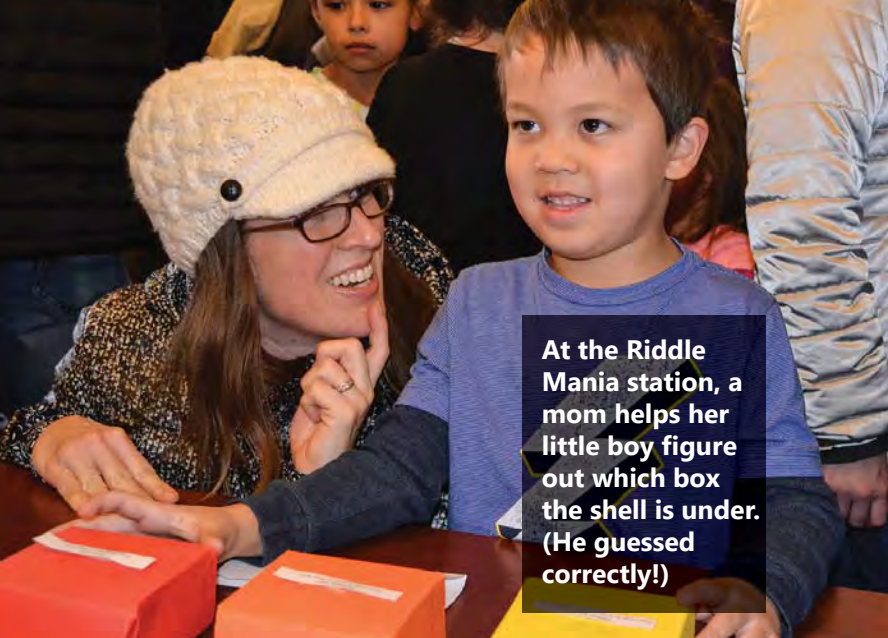
"I was actually not expecting the turnout we had, but I think kids who participated in the logic games felt confident. I like how the department made an event that shows just how interesting and interactive math is."

Alameda also was excited about giving the kids the opportunity to experience math at a fun event like the Carnival—something that she didn't get to do as a youngster. "I didn't have exposure to this in high school or in elementary school/ middle school, and I think if I had understood how math really is, how fun it can be, I would have been more interested in studying it earlier."

Another participant was Santiago Camacho, a math Ph.D. student who helped with the Riddle Mania station. His goal in volunteering was to help folks get over their fear or dislike of math.



Second year math grad student Hadrian Quan gives a visitor the Estimation Station pointers on how to estimate the number of nuts in three jars.



At the Riddle Mania station, a mom helps her little boy figure out which box the shell is under. (He guessed correctly!)

number of cookie runs Hieronymi had to make before and throughout the afternoon (three all total) to keep the snack table stocked up, and on the number of cookies purchased (200 cookies + 100 cookies + 150 cookies = a successful event). According to Hieronymi, after his second trip,

"I put them down on the table. I looked up. I looked down, and the cookies were also gone." So he went and bought another 150 cookies, which lasted till the end, which he says "was a good thing," because they only had oatmeal-raisin cookies left at the store.

A local mother acknowledges that she brought her two kids to the Carnival to expose them to STEM: "I want them to be exposed to science, technology, math and engineering, and we support the STEM department at the University of Illinois."

She particularly felt the event would be of benefit to her nine-year-old daughter, Ella, who says math is her favorite subject.

"Especially for my daughter, I want her to know that girls can do anything boys can do! And she can be a math teacher or an engineer if she wants to be!"

What kind of impact did the event have? According to Hieronymi, "This event surely had the impact we expected. We wanted to engage children with mathematics in a fun, hands-on way, and I think we managed to do so. Of course, you don't reach every kid, but from the impression I got, many of the children thoroughly enjoyed the event and many stayed for much if not all of the three hours of the event."

Did they succeed in recruiting any kids into STEM? "While probably few children become scientists just because of a single event," Hieronymi admits, "I do strongly believe that such experiences (in particular, when repeated) can make a huge difference in the attitude of children towards STEM fields and may encourage them to pursue a career in such fields."

While anecdotal evidence is acceptable as proof of the event's success, being a math event, mathematical proof, which we'll call *the cookie theorem*, seems apropos. It's based on the

Based on the resounding success of the event, Hieronymi is already planning for next year. "It is clear that such an event should have a permanent place in the UIUC calendar, and that next time we will need more or bigger rooms."



Illinois sophomore Emily Alameda does the Crossing the River activity with a local youngster at the Riddle Mania station.

A group of children are gathered around a table, focused on building a LEGO structure. In the foreground, a boy with blonde hair, wearing a grey t-shirt with a 'STAR WARS' graphic, is carefully placing a white LEGO brick onto a blue baseplate. Behind him, a girl with long brown hair, wearing a light blue dress, is also working on the project. The table is covered with various LEGO bricks in different colors (red, yellow, green, black, white) and a blue baseplate. A maroon backpack is visible in the background. The scene is set indoors, likely in a classroom or a workshop.

**A STEAM
Studio
student
does a
Lego
activity
during the
Fu project
final
event.**

WAI-TAT FU'S LAB PARTNERS WITH STEAM STUDIO TO MAKE STEM, SPATIAL REASONING FUN

February 21, 2017

Can exposing youngsters to technology that develops their spatial reasoning skills increase their chances of succeeding in STEM (Science, Technology, Engineering, and Mathematics) later on? Wai-Tat Fu, Associate Professor in Computer Science, and the students in his human-computer interaction lab are investigating the notion. So they recently partnered with STEAM Studio, Next Generation School's after-school program, on a project that introduced kids in the Tera group to a couple of spatial-reasoning technologies, TinkerCad and 3D printing. But while the project might have been research for Fu and company, for the STEAM Studio kids, what could be more fun than playing with VEX robots, which they had built, on an obstacle course peppered with obstacles, which they had designed then 3D printed?



An older STEAM Studio student explains something to a younger one at the project's final event.

The first step in the project was to design the obstacle course. According to STEAM Studio Angela Nelson, "I would say that spatial relations and reasoning really came in when they started to try and make an obstacle course, and they realized, 'Well, first of all, where do we start? We have this robot, and how do we make something that is the right size, shape, design that it will actually function?'"

Nelson liked the idea that this next step in the project encouraged the youngsters to employ spatial reasoning skills as they made the mental jump from two dimensions to three.

"Now that we have this idea, what do we make it out of? If we're going to use a 3D printer, what's that process, and how do you take something that's sitting on a piece of paper and make it into something you can actually see and use?"

Helen Wauck, a Ph.D. student in Fu's lab, explains spatial reasoning as "how you perceive other objects in your environment relative to yourself."



A STEAM Studio teacher helps a participant trouble shoot his robot.

"Can you imagine how that 3D object would look in your mind if you rotate it a certain way?" she continues. "Also, task related to navigation. How would this room look if I was standing over there facing a different direction as opposed to if I was standing here?"

To help the kids visualize these different perspectives, the project introduced them to TinkerCAD, a kid-friendly CAD (Computer-Aided-Design) software, via which the youngsters could learn some of the intricacies of 3D design. As part of the training, they also visited the Champaign-Urbana Community Fab Lab, where they learned all about 3D printing.

Then, once the obstacles they designed had been 3D printed, on February 16th, during a special final session, the kids tested the robots they had built to see how well they could navigate the course. To add to the fun (and bedlam!), several groups of younger STEAM Studio students were invited to attend the event so they could learn a bit of what the older kids had experienced.

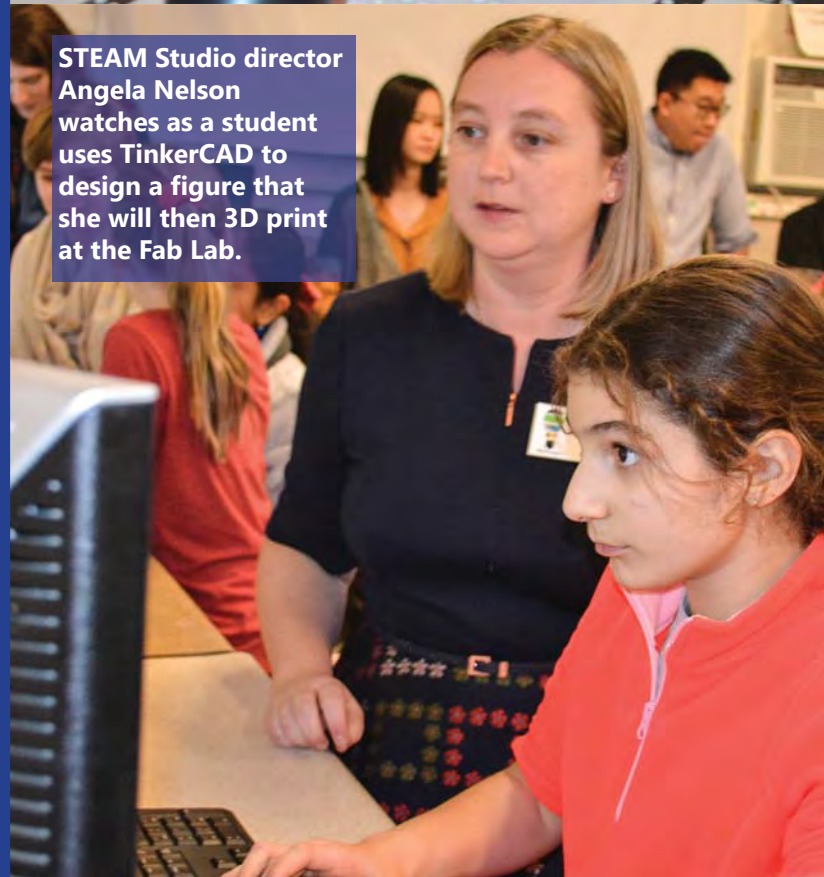
Why did Fu and his students get involved in the STEAM Studio partnership? Fu acknowledges that one facet of his lab's research at the intersection of cognitive science, AI, and human-computer interaction targets Educational Technology.

"We are particularly interested in this project in early education and how we can use technology to help children to build a better foundation for science learning, and also skills that we believe are essential for them to be interested in science and engineering."

So he contacted STEAM Studio about collaborating on a project that would expose the children to some cutting-edge technologies. The collaboration is part of a bigger project: Fu and company are writing a proposal to the National Science Foundation's Cyber Learning and Future Learning Technologies divisions about using 3D printing and other activities to help prepare elementary students for STEM. Fu claims that they are especially focusing on spatial reasoning to "see to what extent we can train spatial reasoning in ways that we can actually find evidence that is supporting later STEM education and learning and the capacity to be interested in various disciplines of science."



A STEAM Studio participant (center) seeks to navigate a robot around a pillar on the obstacle course.



STEAM Studio director Angela Nelson watches as a student uses TinkerCAD to design a figure that she will then 3D print at the Fab Lab.

So the premise of this project is that spatial reasoning skills are important for future success in STEM. And according to Helen Wauck, "Those spatial reasoning abilities have been shown to be highly correlated for success in STEM majors and STEM careers."

Plus, one would expect Wauck to be particularly interested in the TinkerCAD aspect of the project, because as part of her research in this area, Wauck is studying game-based interventions. She says, "Because quite a few commercial games that weren't designed to do this have been shown to train spatial reasoning skills. So we want to figure out what makes them tick."

Are there certain games that she says are the best? Portal "a new genre of spatial brain teasers" by Valve. Wauck describes it as a first-person puzzle game: "You shoot portals at walls, and then you can hop through the portal and come out somewhere else. You basically solve all of these physical puzzles that way."

Ziang Xiao, a first-year PhD Student in Computer Science, explains, "We already know the spatial reasoning skill is very important for the future success of the student," he says, "We want to find if there are any other [skills] so we can intervene as early as possible to clear the obstacles for the children to get into the STEM field."

Yuqi Yao, a Research Assistant in Dr. Fu's lab, a recent Illinois graduate in Developmental Psychology, is interested in children's education and spatial thinking. She feels this collaboration with STEAM Studio is "a perfect opportunity for me to get my concentration deeper."

While some of the younger children appeared to be having some trouble being able to read complicated models, Yao doesn't think it's because they lack of spatial skills. "It's more likely due to their lack of practice," she says.

"This is giving them the opportunity to practice a skill that they already have, but they never got to explore before."

STEAM Studio director Angela Nelson was pleased that the project exposed her students to so many aspects of STEAM. Of course, the robotics aspect addressed a couple of different engineering disciplines. She felt the spatial reasoning and 3D printing: "really grew their conception of the process and the connection between the different STEM fields from art."

A STEAM Studio student from the Tera group has just finished trouble shooting a robot.



STEAM—to the technology of their robots and the tinker CAD to the science of evaluating the device. So all of that came in, as well as the math. They calculated the dimensions of their obstacle course. They looked at the speeds of their robots. So all of those pieces interconnected."

According to Nelson that's one of their goals at STEAM Studio, to emphasize that all of the disciplines that comprise STEAM are interconnected:

"That's something that we're really encouraging, is that each letter of STEM doesn't work on its own. It is a process that they come together and start to see a bigger purpose—something like this obstacle course allowed them to see a larger purpose."



A student explains her project to an Illinois MCB Ph.D. student during Next Generation School's Science Fair.

AT NGS' SCIENCE & ENGINEERING FAIR 2017, EVERY STUDENT IS A WINNER!

March 6, 2017

Friday, February 17th, 2017 wasn't just any day at Next Generation School in Champaign; it was the day of the much-anticipated 2017 Science & Engineering Fair. And just as in previous years, it wasn't a competition—no individual student or team won a ribbon or prize for having the best project. All the students were winners: they designed and completed a research project, learned the scientific or engineering method, and prepared a poster. Then, after working on their project for weeks, students finally got to present them to community experts, many from the University of Illinois, who provided not only positive comments about what students had done well, but ways they needed to improve, and even suggestions regarding further research they might do in the future.

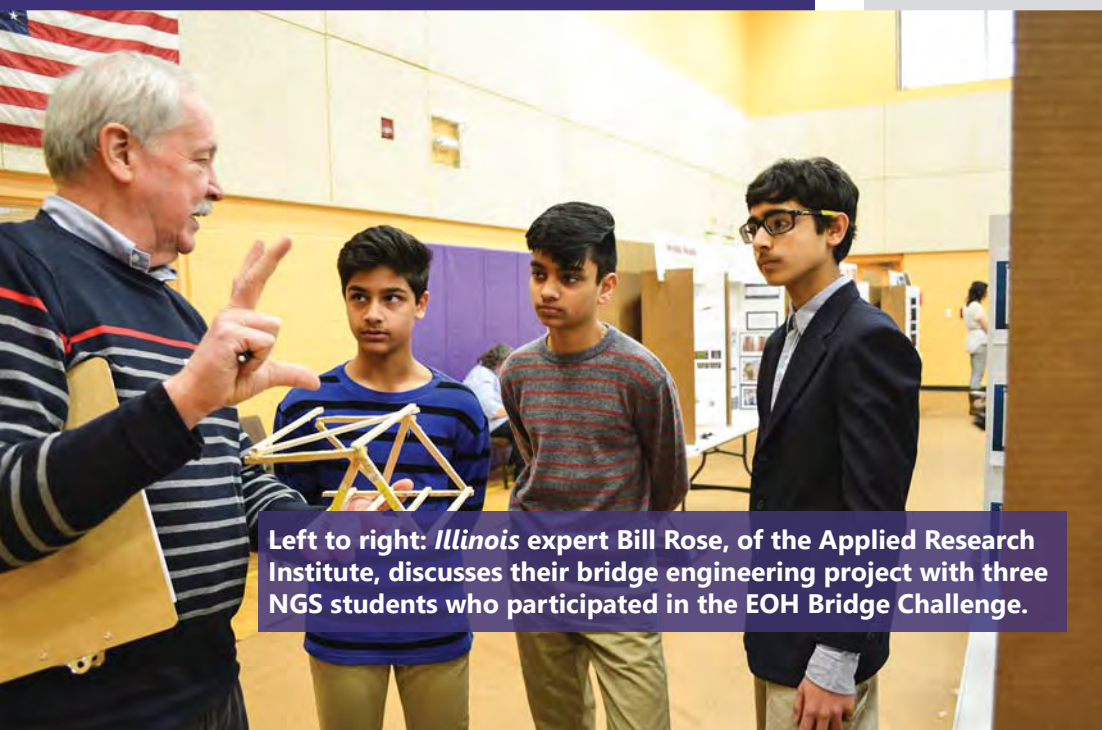
In choosing this year's project, the students had been encouraged to choose something that was relevant to them—something they were interested in. According to STEAM Studio director Angela



An NGS student presents her research to MCB Ph.D. student Mara Livezey.

Nelson, who served as one of the community experts who helped evaluate the kids' projects, this is one thing that makes the Fair so special.

"I love seeing the range of products that these students come up with," she acknowledges. "Their interests that show up—you might not even realize where their interests lie, and all of a sudden they've created this amazing project and product that they're so proud of related to topics that they enjoy."



Left to right: Illinois expert Bill Rose, of the Applied Research Institute, discusses their bridge engineering project with three NGS students who participated in the EOH Bridge Challenge.

In regards to choosing their project, one thing that was different about the fair this year was that a number of the kids built bridges. Students were made aware of the opportunity to participate in a challenge sponsored by the College of Engineering at Illinois called the Engineering

Open House (EOH) Bridge Challenge. So several groups of NGS students not only got to design a bridge and create a model which they presented at NGS's Science Fair, they will also get to present it some of the thousands of visitors who will visit campus at the EOH in March.

According to Bronowski, the middle school science teacher, Bryant Fritz, learned about the challenge through an email and thought, "That's so cool! Lets see if we can incorporate it!" They gave kids the option of doing it, and "A few of the kids jumped on it!" she says.

After choosing a research subject that intrigued them, students researched their subject in depth, designed their study, then conducted the research project. Of course, in addition to performing their experiments, another key aspect of the project was learning how to make a high-quality research poster. And of course, for the pièce de résistance, they got to present their project to a local expert.

Head of School Chris Bronowski stresses how important meeting with an expert is to her students: "All of the children coming in this morning, dressed up, kind of nervous, and butterflies, but excited... and to see those interactions!"



Three NGS students discuss their science fair project about whether salt impacts the growth of plants with Illinois expert Max Baymiller.

And according to Bronowski, the impact of meeting and engaging with a real-world scientist is not just for the day of the Fair...and maybe the day after. "Students talk about their expert that they presented to for years. I mean years. So it's a really powerful, powerful thing that they're doing for us."

To participate in the Fair, most of these faculty and graduate students put their research and other responsibilities on hold for a morning in order to interact with the next generation's budding scientists/engineers. And while the students know it's an "expert," most probably don't have any idea the important research some of these folks are doing. For example, this year Illinois Chemistry professor Martin Burke, whose research to create molecules more quickly will someday lead to cures for numerous diseases, could be found at

the Fair, kneeling on the floor across from a young student, discussing his or her project with them. (Many of the experts tend to bend or squat down so they're on eye level with the young scientist-to-be whose project they're evaluating.)

Another community expert was graduate student Madhura Duttagupta, who participated in the Fair as an expert for the very first time was. A first-year grad student in Illinois' School of Molecular and Cellular Biology, her research looks at the formation and breakdown of



Head of the School, Chris Bronowski (center), and Angela Nelson (right), director of NGS' after-school STEAM Studio program, listen as an NGS student discusses his research project.

cell cytoskeleton, specifically at the breakdown of a protein called actin.

Duttagupta recalls receiving an email saying, "This is fun; maybe you should try it!" from the MCBees outreach coordinator Mara Livezey. So she thought, "Yea, I liked to do these kinds of things when I was in school." She reports feeling "really out of touch, since grad school is very hectic. So we don't get to see that fun aspect of doing science every day," she continues, "because we're stuck in our experiments and literature. So I thought that this would be really fun."

Duttagupta also saw it as a great way to get involved with the community. "I am kind of new here," she admits, "and I thought that going out and meeting with the kids would be a fun way of getting into and interacting with the community."

STEAM Studio director Angela Nelson echoes the importance of the community experts: "I also love the connection with the community—that we have all of these guest experts that come in and work with the students and give them that feedback on all that hard work that they've done."

But while the students most likely believed that presenting their research to an expert was their



An Illinois graduate student in MCB listens as a student presents her research.

most important take-away from the Fair, Bronowski believes it's the process they went through preparing for the Fair—and learning from their failures. She says that's why they do it every year.

"Well, we do it because of what it gives our students. There's a lot of work that goes into it, both on our end of things and on the students' end of things, for parents. There are probably times when families probably feel like, 'Why are we doing this?' when it's failed. But, through that, through those failures, through that process, they learn so much, and I think we have done a better job of helping students be ok with the process, and understanding that it's not going to go the way that you expect all the time, and that that's ok, and how do we move through it?"

Left to right: primary science teachers Ashley Kozak and Desaray Shepston; Bryant Fritz, Middle school/ junior high science teacher; Kathy Feser, primary science teacher.



Nor do the experts, many of whom are students themselves, who are busy doing their own research and working on their PhDs, grasp just how appreciative Bronowski and her staff are of the people that volunteer their time to come in and be the community experts.

She sought to express her gratitude. "I'm sure that it is difficult for people



Desaray Shepston, the new NGS primary science teacher.

“It gets them really thinking about what it means to be a scientist. They get to think through things that they are interested in, but, also work on the scientific method, in what would be a real-world setting. If they go on into science and engineering, they will be continuing to do this sort of process throughout their lives.”

She also says that because it’s a different way of learning compared to in a classroom setting, it can help to interest kids in STEM:

“It also, I think, engages them in the material in a way that’s different than class. They get to think about it for weeks at a time, and they take ownership of what they are doing, and so they are highly invested in it. And I think that is something that can really pique a student’s interest in science, and technology, and engineering. So I think this is a really great opportunity for students at this age.”

who just come in—they talk to students, and then they leave—to understand how important their role is, and how much it means to the students, and how much it means to us to be able to provide that for our students. There’s no way to thank them enough for giving up their time to do that.”

While the kids might have been beside themselves with anticipation, it wasn’t just youngsters who were excited. For Desaray Shepston, a new primary science teacher who has been teaching at the school for less than a month, this was the first time that she’d ever done a primary-level education science fair sort of thing. She reported, “I’m actually looking forward to it, very much.”

Specializing in environmental studies, Shepston came to Next Gen from the University of Illinois in Springfield with a Ph.D. in environmental geography. She indicates that the primary level (kindergarten to 5th grade) had a lot of “really impressive projects that students have been very creative in coming up with the ideas for what they’re doing.”

And considering her penchant for environmental studies, it makes sense that she recommended that visitors to the fair catch the primary C (2nd grade) class which she claimed, “has done a really interesting project on pollution and plants, so that’s doing to be a good class to look for.” She also asserted that her older students in the independent levels, Primary D, E, and F (3rd through 5th grades), “just had a lot of very creative and very challenging projects, that they’ve done very well on.”

Shepston claims that one reason the fair is of benefit to the kids is that the projects deal with real-world issues and, of course, the kids have a chance to employ the scientific method.



An NGS student present his research to Brian San Francisco, an Illinois IGB researcher.

Bronowski, who wears two hats (Head of School and, more importantly, Mother) gained some new perspective this year regarding the Fair's impact. She shares an anecdote about her kids which captures the anticipation and excitement students are sensing...sometimes years before they actually participate!

"I think this year, especially, for me, personally, was a bit of a revelation," she explains, "because my daughter is in 1st grade this year."

(As an aside, when this reporter teases her about how for years, as head of the school, she's been "dishing it out"...but now, as a parent in the throes of helping her kid prepare for the Fair, she's on the receiving end—she laughingly agrees, admitting, "I'm on the other end of things.")

She explains that last year she went through the process when her daughter was a kindergartener, but now, she's in first grade.

"And what has been so cool for me to see, is how... this year, she understands it at a deeper level, and she's already starting to think about what her project is going to be, and she's looking forward to when she gets her own board, to present. And she's starting to look around. She rides horses, and so, now at the barn, she's looking around, because she's decided she's doing an engineering project when she does her first project. So she's looking around for things that she can improve, and problems that she can work on. So, to see her thinking in that way, and to hear her and my son, who is in kindergarten, so now they're talking



An Illinois researcher and an NGS student interact while she presents her research poster.



Illinois Chemistry instructor and Chemistry Merit Director, Gretchen Adams

about it a lot...to hear the conversations that they have... this is why we do it!"

On hearing that this reporter had been hearing from colleagues whose kids go to NGS—not complaints, mind you, but honest assessments—about the amount of work that's involved in helping their kid prepare for the fair, Bronowski laughs, then acknowledges:

"No doubt about it, it's a lot of work! But that's ok. Sometimes there's just a lot of work that has to go into things."

BARKSTALL STEM NIGHT EXPOSES STUDENTS AND THEIR FAMILIES TO FUN SCIENCE AND ENGINEERING

March 15, 2017

A large number of Barkstall Elementary School students, along with their parents and siblings, ended up back at school on Thursday evening, February 23rd to take part in the school's

STEM Night. In addition to viewing science fair project posters made by Barkstall students, participants took part in a number of fun, STEM-related hands-on activities and demonstrations presented by Barkstall folks, as well as University of Illinois students, including some from the Physics Van and REACT outreach groups.

According to the Barkstall Principal, Peter Foertsch, the school tries to do academic nights to get families involved by coming out to participate in a variety of activities. He reports that in the past, they've done a reading night, and writing night as well, but that this particular night's activities were an extension of students' enrichment activities:

"And this night is for our STEM night, which encompasses science, math, and some engineering things that our fifth graders are working on, and our other kids in enrichment are working on as well. We can extend that through this fun night tonight."

One popular STEM night activity students could participate in was to build a boat out of available materials



A Barkstall student tests the "boat" she built to see how many pennies it will hold.

(wooden popsicle sticks, aluminum foil, paper, tape, etc.), then test it in a container of water to see how many pennies they could add to their boat before the weight would make it sink,

Several University of Illinois Physics Van members were on hand to do some fun science demonstrations using liquid nitrogen.

For example, one involved immersing a blown-up balloon into liquid nitrogen; as the air molecules inside the balloon were cooled, they would contract, causing the balloon to shrivel; once the balloon was removed from the liquid nitrogen, it would then expand to its previous size as the air in the balloon returned to room temperature. The Physics Van students also quick froze some flower blossoms, which young STEM Night visitors could then shatter.

Another demonstration involved shooting a cork from a Liquid Nitrogen Cannon. When liquid nitrogen was poured into the cannon, which was warm compared to the liquid nitrogen, it turned to a gas, expanded, popping out the cork. In the Banana Hammer demonstration, Illinois Physics students would immerse a banana into liquid nitrogen until it was frozen hard enough to hammer nails into wood.

Another Illinois student, Danielle Cooney, a graduate student in Crop Sciences, exposed young STEM Night visitors to a demonstration about erosion. She would pour equal amounts of water into three containers: one was planted with thick grass, one contained a mixture of bark and chips, and was filled with soil only. After water had

Crop Sciences grad student Danielle Cooney interacts with young visitors, describing how tall the potted grass might grow.



been poured into the three containers, students were then asked to point out which water was the cleanest (the container with the grass); most could see how a cover crop, like the grass, helped prevent erosion.

Several students from REACT (Reaching and Educating America's Chemists of Tomorrow) an Illinois student outreach group that does Chemistry demonstrations and hands-on activities. Students were able to get their hands on Oobleck (the non-Newtonian slimy substance that acts like a liquid—unless force is applied; then it acts like a solid.

Crop Sciences grad student Danielle Cooney does the erosion demonstration for a mother and her two small children.



One Illinois student who participated in the event as a part of REACT was Connor McCloskey, a sophomore studying computer science. He says one way events like Barkstall's STEM Night benefits kids is that it “gives them another way to look at things.”

“They always seem to be interested or fascinated, especially with chemistry,” he continues. “The study of change is something that really hooks the kids. And it’s good to just see how creative they are, especially when they are starting to answer questions, and make connections.”

Did McCloskey see some kids that are going to end up in STEM? “Of course I did,” he says. “I saw a bunch of them, especially any of the kids that were involved in all these experiments just seemed to love it.”

Did the principal see any future scientists or engineers during the event? “All of them!” acknowledges Foertsch: “Everybody’s got the potential to be a scientist or engineer.”

Meha Akella, a sophomore studying biochemistry at Illinois who’s also on the REACT board, saw some future scientists as well.

“Oh, definitely! A lot of them actually knew some of the experiments we were doing. They were like, ‘I know exactly what that is; that’s corn starch in water.’ Or for the Cartesian Divers, ‘Its pressure that does that!’ It was amazing to see them.”

Akella says that events like STEM night help youngsters realize that they can actually do STEM:

Physics Van member William Helgren prepares to shoot a cork out of the liquid nitrogen cannon.



“Because a lot of kids, especially young girls—I know it was a problem for me—they don’t really get to see how much they know, how good they are at things,” she admits.

She also says that while kids are learning science in schools, activities like the ones they’re doing can help get kids more excited in science.

"I know, especially for me in elementary school, a lot of the things we learned were so basic, and it was hard to have a sort of passion and interest for it. And I think this helps show them that there is more to what they're doing right now; there's more to learn, and there's more they can do with science."

Why pique kids' interest in science? "I think that's really important," she continues. "We always can use more scientists and engineers out there."

A local mother shares why she brought her daughter to STEM night:

"Because I want her to get even more curious than she already is. And I think exposing her to all these different activities that are fun and are different can get her brain to think further. And I know she can."



Physics Van member Taylor Sabatini (right) immerses a balloon in liquid nitrogen, where it will shrivel as the air molecules condense.

She also believes events like STEM night give kids the opportunity to do things they might not have time to do during school.

"I don't think they are exposed to all these fun experiments during the year at school because there is so much

to cover at school that they don't get to just play and experiment in kind of a fun way—playing, and seeing and comparing—and so this is a great time for them to do that."



A young visitor to Barkstall STEM Night engaged during a demonstration about erosion by Danielle Cooney, an Illinois Crop Sciences graduate student.

REACT: RECRUITING TOMORROW'S CHEMISTS TODAY VIA FUN, HANDS-ON ACTIVITIES

March 17, 2017

If you happen to visit a local 2nd, 3rd, or 4th grade classroom and find the students doing an engaging, hands-on activity about chemistry, it's probably being led by members of REACT (Reaching and Educating America's Chemists of Tomorrow). Chemistry's student outreach group, which specializes in engaging hands-on activities and demonstrations, can be found in local classrooms, school STEM nights, and other community outreach events, showing learners of all ages that Chemistry is fun and exciting.

Surprisingly, although REACT is about chemistry, it's not just chemistry students who are involved. Students from across a number of disciplines get involved in the organization as freshmen to fulfill requirements for the James Scholar program...then end up staying on because they find it so fulfilling.

For instance, Angela Hyon, a junior majoring in Anthropology, got involved her freshman year as a typical James Scholar student. She recalls that, as a premed student, she initially got into REACT because of the chemistry courses, and, "One thing led to another."

"I really liked what we stood for," Hyon continues, "inspiring students and teaching them that STEM is not all just math and stress and numbers. It can be fun when you can see reactions actually happening."

She also finds it rewarding to expose today's kids to something she would have loved, but didn't have access to, as a youngster. "I know, when I was around their age, I didn't have a program like this. Actually attending those programs as a volunteer,



REACT board member, Meha Akella (left), and a visitor to the Barkstall STEM Night play in Oobleck.

you can see their eyes light up and how excited they are about learning more about chemistry. I think that is initially why I began."

Hyon says she became a coordinator because she "wanted to help improve the program, expand it." And as she said, "One thing led to another." And now she's the president of REACT.

REACT began in 2002, working mainly with elementary schools, but they're now trying to expand more into middle schools and high schools. For instance, they recently participated in I-STEM's DNA Day for Urbana High School students.

Also, because they're expanding their services, school visits are being adapted to meet the various schools' needs. According to Hyon, they're doing more than ten visits this semester to a local second grade classroom, and also to Lincoln Trail Elementary School in Mohomet. REACT also participated in EOH this year, in part to highlight their sponsorship with Shell.

Although the bulk of REACT members still get involved initially to meet James Scholar requirements, the group also gets a large number of volunteers. "I think through the actual experience



Two students enjoy playing in oobleck.

of volunteering, that's how they get in," Hyon explains.

Take Connor McCloskey, a sophomore studying computer science. Needing a freshman chemistry class, when he heard about the REACT program via a roommate, he told himself, "I guess I'll do it." And once he had gotten involved, he was hooked.

"I originally did it the first semester for James Scholar credit, but I've been volunteering ever since," he admits.

McCloskey recently participated in REACT's outreach at Barkstall's STEM Night, which he found to be rewarding. "I've never actually been in this kind of setting. I've always done 3rd or 4th grade classroom visits, which I'm more used to. But, yeah, I decided to do one of these, and it has been a lot of fun so far."

According to McCloskey, kids tend to find the REACT activities intriguing: "They always seem to be interested or fascinated, especially with chemistry," he continues. "The study of change is something that really hooks the kids."

And like the organization's name implies, McCloskey also feels like he's helping recruit some of tomorrow's Chemists: "I really feel like I can almost pick out the kids that are definitely going to be doing something in the science field, because they seem to love this."

REACT board member, Meha Akella, a sophomore majoring in biochemistry, says one reason REACT is so effective is that it exposes youngsters to different aspects of science than they might get in school: "They don't really get to experience the more fun side of chemistry," she says. So REACT, through a variety of hands-on activities, has figured out how to pique kids' interest in science. And like McCloskey, Akella sees it as a way of recruiting for the future. "We always can use more scientists and engineers out there," she admits.

Along with changing some of their outreach strategies, REACT has also seen some changes

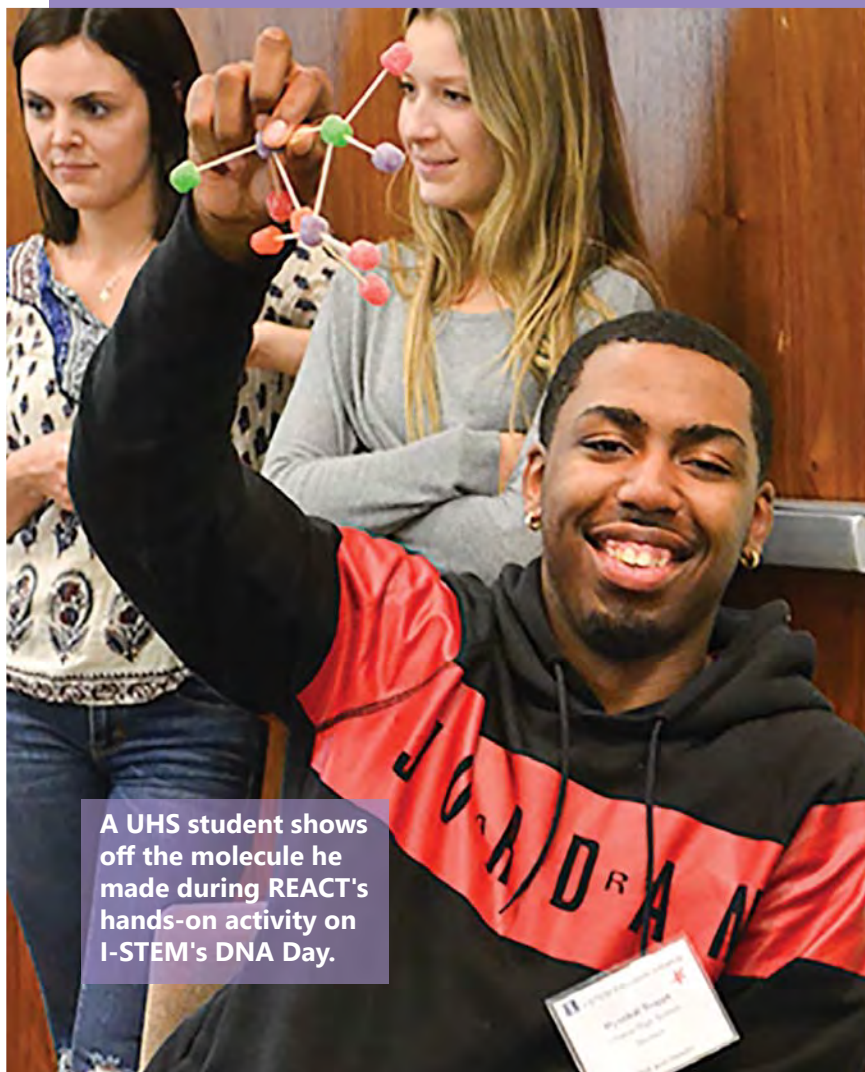


REACT member Connor McCloskey (left), a sophomore in computer engineering, helps two visitors to Barkstall's recent STEM Night make silly putty.

in faces and places. For instance, Dr. Tina Huang, an instructor in Chemistry, came on board last spring as the organization's new faculty advisor. No slouch herself when it comes to chemistry

demos, Huang has participated in Chemistry's Holiday Magic show for the past several years.

REACT also just got new digs in the brand-spanking-new Chemistry Annex building which has been under construction for the past two and a half years. According to Hyon, "We used to be in a very small closet!" Now REACT shares a lab, and has their own office, which she calls "really nice and convenient. I feel like we're on the move to expanding and to see where this program can go."



A UHS student shows off the molecule he made during REACT's hands-on activity on I-STEM's DNA Day.

EOS CONTEST EXPOSES LOCAL KIDS TO ENGINEERING DURING ENGINEERING OPEN HOUSE

March 21, 2017

66 **H**ail to the Orange, Hail to the Roof!" This was emblazoned in bright orange on the front of the blue t-shirts more than 200 local 1st, 3rd, and 4th grade students wore as they invaded Engineering Open House (EOH) on Friday, March 10. They showed up to participate in the Engineering Outreach Society (EOS) engineering contest. Their main goal? To determine how well the house their team had constructed—particularly the roof—would stand up to the test: an avalanche of "hail" stones EOS members poured down upon their model. Whether they experienced the thrill of victory (as their model stood up to the deluge of stones) or the agony of defeat (as their building was virtually decimated), the students had fun, experienced the thrill of competition, and got a taste of what engineering is like.

According to Cavita Desai, the engineering physics major in charge of the contest, EOS holds a contest with elementary school students every year. For this year's, "Hail to the Orange, Hail to the Roof" (whose cutesy name was partially plagiarized from the Illinois Loyalty, "Hail to the Orange, Hail to the Blue..."), the kids were to design then build houses that could withstand damage from hail. "So they had to take into consideration materials and



A team of students proudly shows off the house they designed—pre testing.



The team above just as proudly shows off its rather dilapidated house—post the bonus round.

how well their structures could stand against having something hitting it constantly," says Desai.

So back in the third week of January, EOS members visited the participating 1st, 3rd, and 4th grade classrooms of the two Urbana schools involved (Dr. Williams and Leal) to teach them some engineering principles, lay the contest's ground rules, and oversee the project. Students were divided into groups, with three to six students per group; there were 43 entries all total. Then students had one week to plan and five weeks to build their project, using a variety of materials: popsicle sticks, straws, tin foil, tape, etc. And, of course, for the pièce de résistance of the contest...they attended EOH as guests of EOS, where each house would be tested.



The 43 houses stoically await their doom. Close to the back is the house with the tallest tower, which had been constructed of straws.

Testing involved bombarding each house with three containers of rocks. To ensure fairness in testing, one EOH member would hold a yardstick, so the bucket would be at a uniform height throughout all of the tests.

For the first round, a pitcher of smaller-sized rocks was dumped on the house. If the house withstood the first test (most did), a second then a third bucket filled with increasingly larger stones was dumped on the house. If a house made it past the first three rounds, the team was given the option of subjecting their house to a final, bonus round (a bucket full of REALLY GINORMOUS rocks which, in all fairness, was proportionally like exposing a real house to automobile-sized hail stones.) Practically no house stood up through the final bonus round, but teams proudly posed for photos with their flattened houses, grinning anyway. It was all in good fun, and clearly, the EOS students had as much fun dumping the rocks as the elementary students did watching their houses being flattened.

Plus, the young students learned some valuable lessons through the project... how to design something according to certain specifications, with certain materials, and in a specific time-frame; teamwork; and how to fail. They learned that in engineering, sometimes your



The thrill of victory.

design doesn't work, and you have to go back to the drawing board.

While at EOH, students got further exposure to engineering. When not in testing, they got to visit many different exhibits. (They also, no doubt, took advantage of the proximity of a cotton-candy-spinning machine and a chocolate tempering exhibit with Dove samples just down the hall from the contest).

Why does EOS do this contest every year? To expose youngsters to STEM.

"I love working with kids," admits Desai. "I am so excited to get started. It's just amazing to see what they come up with, and they can be so innovative. And they get to practice STEM at such an early age. And just to have them come up here and not just see our exhibit, but to see other exhibits and to start inspiring their minds."



The agony of defeat.

Teams could win in several different categories, such as the tallest tower, the shortest house, the heaviest; plus teams could win points for creativity. According to Desai, some students actually built tee pees:

“It’s interesting to see what they define as a house and a roof,” she admits. “So this is one group’s definition of the tallest tower (she points to a very tall tower). And just to see their creativity is so inspiring.”

The houses had all been turned in ahead of time, judged, and winners assigned in the various categories. There’s just one catch: the house must have survived the testing to be the winner of the category.

If a team’s house survived the bonus round, did they win a prize? Nope, it was just for fun.

While the engineering skills the kids learned in designing their house would probably technically be classified as Civil Engineering, EOS students didn’t differentiate when explaining the contest to the kids:

“We explained to them that engineers do all sorts of different things,” explains Desai, “and that engineering is such a broad scope with project design, and teamwork. That was kind of the goal of the project.”

An engineering student performs the round 1 test on a house...a pitcherful of smaller stones.



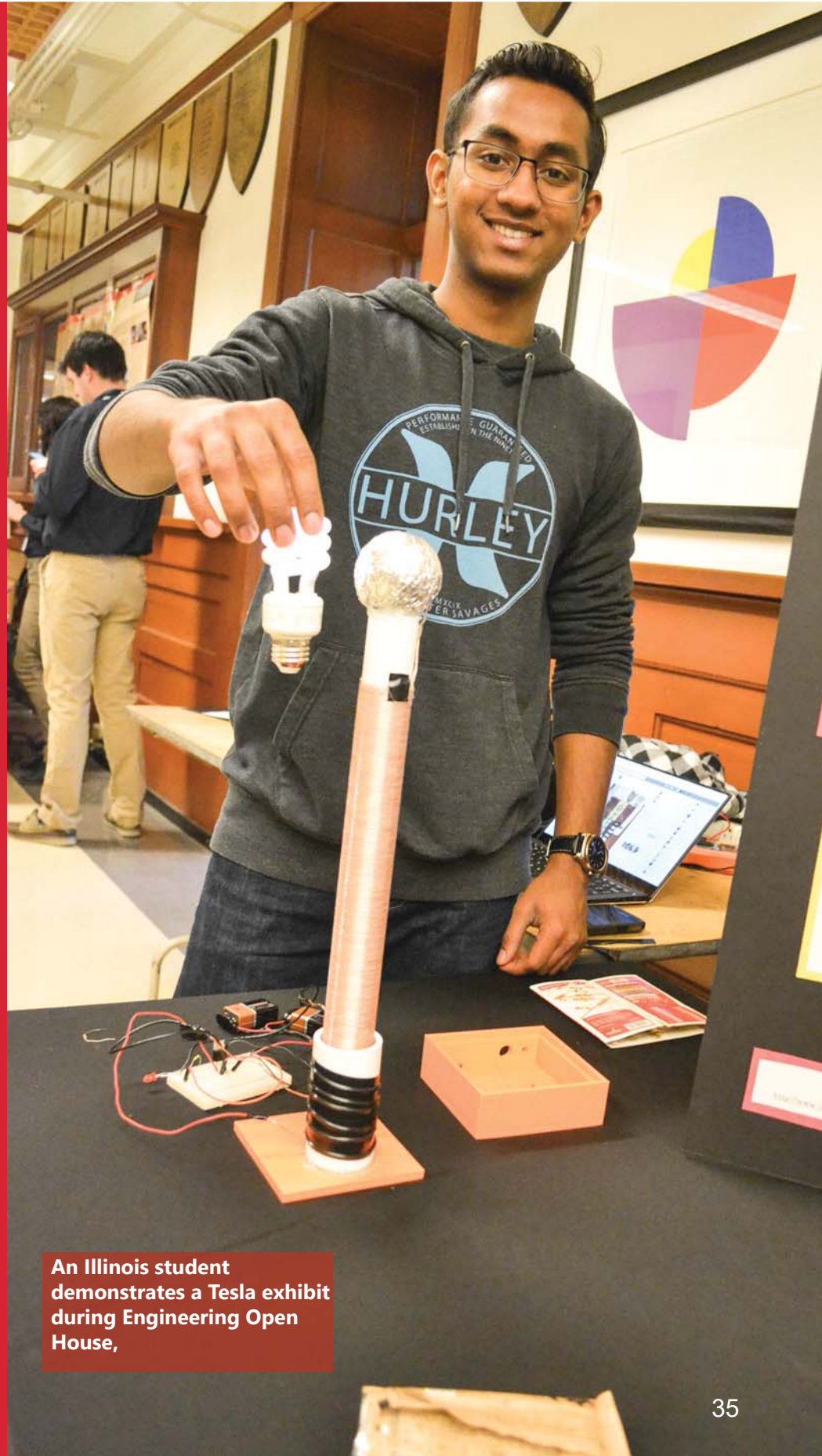
EOH VISITORS DISCOVER THAT ENGINEERING IS FUN, EXCITING, AND CAN CHANGE THE WORLD

March 27, 2017

Making the pilgrimage to Illinois to take part in Illuminate New Horizons, the 2017 edition of Engineering Open House (EOH), were thousands of visitors, young and old, including numerous classes on field trips, and lots of families. During the event, held on March 10–11, visitors encountered some of the faces of engineering, ranging from current engineering students from all across campus, to alumni, who were excited to come back to their alma mater to show visitors some of the exciting projects they're currently involved in...and possibly do some recruiting. Exhibitors hoped to engage visitors in their demonstrations and exhibits, many of which included interesting hands-on activities, to show them not only the breadth of the field of engineering, but that it's fun and exciting, and that engineers can change the world.

Scores of classes from nearby schools showed up on field trips to take advantage of EOH's myriad informal learning opportunities. Some came specifically to participate in contests organized by student organizations or the EOH committee itself.

For example, "Hail to the Orange, Hail to the Roof," sponsored by the Engineering Outreach Society (EOS), brought more than 200 local 1st, 3rd, and 4th grade students to campus for the final event of a several-week-long project during which teams of students were to build houses strong enough to withstand a hail



An Illinois student demonstrates a Tesla exhibit during Engineering Open House,



EOH exhibitors Namita Kulkarni and Julia Schultz demonstrate how memory metal can revert to its previous shape when heated up.

storm. During the final event on Friday, March 10th, EOS members tested their houses' strength by bombarding them with "hail" stones to see which, if any, would be left standing.

Another contest, an EOH-sponsored Middle School Design Contest, gave schools the opportunity to form teams of middle school students to collaborate to build bridges. Held on Saturday, March 11th, the contest participants were on hand to watch engineering students attach a bucket to their bridge and add sand to see how much weight their bridge could hold.

The bridge contest was headed up Alix Ramos, a sophomore in Computer Engineering, who explains why she got involved.

"So last year I was an exhibitor at EOH, and I wanted to get more involved because I really loved it. And I wanted to be a part of putting it on," she explains.

Last year, Ramos was involved in EOS' outreach program, similar to "Hail to the Roof" above, where Illinois engineering students visit schools and teach kids basic engineering concepts, then bring them to EOH as their guests. She shares why she finds outreach events for younger students, such as through EOS or this year's EOH bridge contest, to be rewarding for her and valuable for the kids.

"They go to local elementary schools and introduce them the concepts and show that engineering is fun and that there are cool applications. If you have that early interest, then it creates more curiosity in the subject for them."

So being in charge of the middle school design competition seemed a perfect fit. She not only organized the competition, but came up with a scavenger hunt for the kids, including exhibits she thought might interest them, and also set up little engineering challenges. "I kind of have the role of getting children in middle school and elementary schools interested, and getting things for them to do in EOH."



Two students at the Candy Fiber Pull exhibit demonstrate pulling candy fiber.

Running many exhibits were engineering students who, passionate about their disciplines, were eager to share with visitors. For instance, Materials Science and Engineering (MatSE) freshman Emily Laugheav, interested in biomaterials, sees EOH as a great way to get youngsters hooked on STEM, especially engineering.

"I think it's a cool way to immerse kids in all different types of engineering, not just materials science, because there's stuff going all around campus. I think it's important to expose kids to engineering at a very young age, because there's so many possibilities that you can do with it, and so many ways to change the world that kids should be aware of."



MatSE students Emily Laugheav and Tyler Jensen at the Superconductors exhibit demonstrate how the object immersed in liquid nitrogen has unique properties and can "float" briefly as it is repelled from another object.



MatSE student Anna Jedralski interacts with Ash Pawate's daughter during EOH.

crane's wings were embedded with strips of memory metal, the flow of electricity provided by the attached battery makes the memory metal "remember" its previous shape, and the crane's wings slowly curve (see the image at the top of the article).

Lots of local parents showed up with their kids, too. For example, one parent, Ash Pawate, explains why he and his wife brought their son and daughter to EOH.

"We come here every year because it's a lot of fun," he admits, "and they really enjoy all the exhibits. It's something that we don't miss."

Does Pawate think either of his kids will end up in a STEM field, such as engineering? "He likes science a lot," reports Dad. So he asked his son right then and there what he wants to be when he grows up. "He wants to be an engineer," he says, "and a lot of other stuff."

Palak Patel, a junior in Chemical Engineering, participated in EOH because of its impact on kids, and hopes to be a role model, especially for girls.

"I think it does a really good job of exposing very young kids to STEM, especially girls," she says. "It's fun to have them see what cool things that we engineers can do. And especially for girls, they can see that other girls do this too, and that it's not just for boys. And we also do a variety of things: easy, cool, hard, fun, all sorts of stuff."

At the EOH Origami Gone Wild exhibit, MatSE freshman Julia Schultz reports that her life-long love of origami cranes was the inspiration behind the exhibit. So she decided to combine two things she's crazy about—materials science and origami cranes.

"Cranes have been a really big part of my life," she admits.

She goes on to explain that the idea stemmed from a period in her childhood when her dad was really sick.

"He told me that folding a thousand cranes will heal anyone that was sick. And he actually got better. So Origami has always been a good thing for me. So for this project, I wanted to see if I could apply something I love to origami. It's been really cool because it uses materials science; it uses some basic electrical."

The material being highlighted at Schultz's Origami Gone Wild exhibit was memory metal, which when heated, reverts back to its previous shape. Since the

Chemical Engineering student Palak Patel exhibits one of the items for her crystallization exhibit.



NGS MIDDLE SCHOOLERS BUILD BRIDGES, EXPERIENCE ENGINEERING DURING EOH DESIGN CONTEST

March 23, 2017

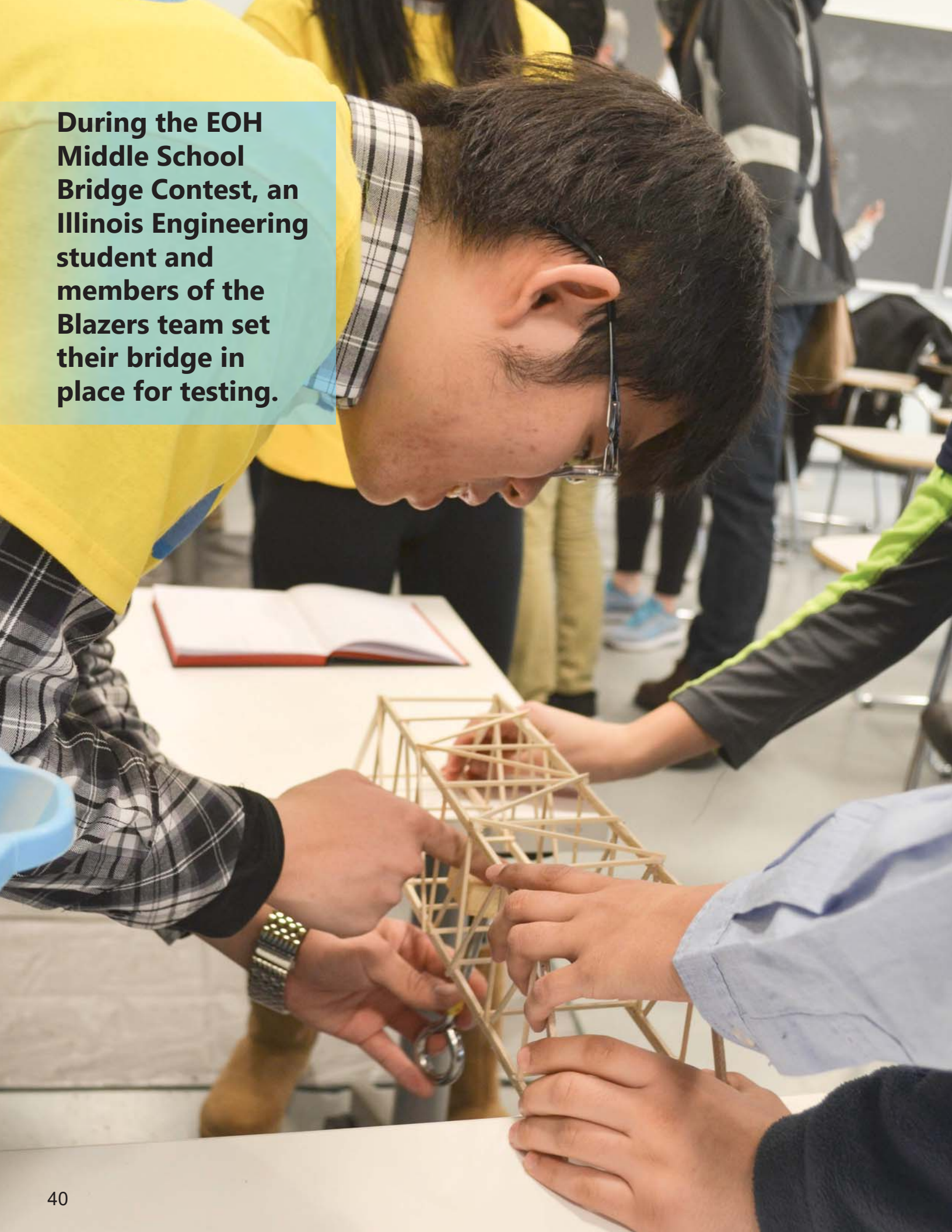
It had all come down to this. It was crunch time—figuratively, and possibly literally, if the bridge built as part of the Engineering Open House (EOH) Middle School Design Contest collapsed while being tested. For weeks, three teams of middle school students from Next Generation School (NGS) in Champaign had been designing bridges—building their prototypes, testing them, working out any kinks. Finally, Saturday, March 11th, the day of the contest, had arrived. With their fingers crossed, each team eagerly watched Illinois engineering students attach a bucket to their bridge then slowly fill it with sand. The idea was to see how much sand could be added before their bridge buckled. And whether they won an award or not, they'd learned a lot: about teamwork; about the engineering process; and what being a Civil Engineer might be like.

The rules of the contest run by Illinois engineering student Alix Ramos and her team of students were pretty specific. The bridge was to be built of wood: either balsa (lightweight, cheaper, but weaker) or bass (stronger, but heavier and more expensive) and adhesive. It was to span an opening of 40 cm, weigh less than 70 grams, and have a 3/8 inch hole for an eyebolt. Along with bridge specifications, descriptions of several truss designs were included in the contest packet to get students' juices flowing. Testing would involve attaching a bucket to the eyebolt and adding



An Illinois engineering student helping with the EOH Middle School Design Project pours sand into a bucket to test the strength of the Big Papa team's bridge.

During the EOH Middle School Bridge Contest, an Illinois Engineering student and members of the Blazers team set their bridge in place for testing.



sand until the bridge either broke or bent more than 2 cm.

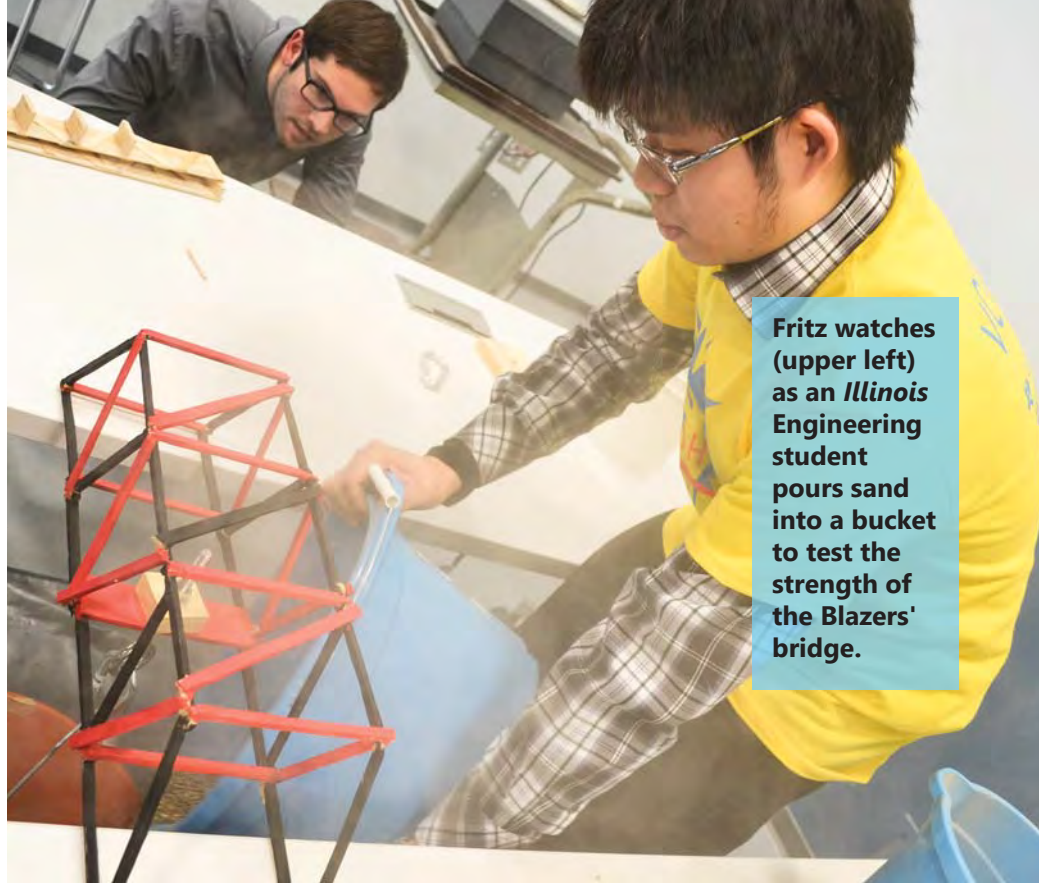
When designing their bridges, students could target one or more of the award categories, which included:

- ❑ Most Innovative
- ❑ Lightest Bridge (must be capable of lifting a minimum weight TBA)
- ❑ Most Aesthetic
- ❑ Viewer's Choice
- ❑ Lifts the Most Weight Overall
- ❑ Best Presentation
- ❑ Best Weight Lifted to Weight of Bridge Ratio
- ❑ Enthusiasm Award

According to Bryant Fritz, who teaches Middle School Science at NGS, one of the challenges his students encountered in doing this project was understanding the rules of the contest.

"I think the first challenge was just being very clear with the constraints that they were given," he says. "They had a lot of questions on whether they could or could not do something. I sent some messages to the contest organizers to make sure they had everything straight."

Before beginning their design, teams had to research what makes the strongest bridge. In this area, Fritz's teams might have had a slight head



Fritz watches (upper left) as an Illinois Engineering student pours sand into a bucket to test the strength of the Blazers' bridge.

start compared to other teams, because several weeks before the EOH contest, his teams had used the bridges as their project for their school's science fair, which Fritz says involved doing background research:


"So they looked up different types of bridge designs, and they learned why they might be used, and what their different applications were. So from that research, they started to formulate their first prototype ideas." He adds that throughout the process, his teams had experimented with using just balsa or just bass wood, or using both to reduce the weight.

Fritz describes another challenge they encountered. When going through the design process, his students would discover a weakness in their bridge, or a change they needed to make. This cropped up when testing their bridges initially.

"When they were building the prototype, and breaking them." Fritz explains, "They tested several of them in my room, and they realized that was a constraint, because each prototype takes time to build, because you have to cut each individual piece. So they made as many as they could, and that's something I know was challenging for several of them."



NGS' Big Papa team: Alexander Comet and Miles Wood, with their very sturdy bridge.

A group of students are gathered around a table, focused on constructing a bridge model. One student in the foreground is using a pair of pliers to adjust a component of the bridge. The bridge is made of thin wooden sticks and is supported by a base. Other students are looking on, some pointing at the structure. The background shows a classroom setting with other students and tables.

Noah Lanave and Navid Tajkhorshid watch as the eyebolt is attached to their bridge.

“I think just the whole process of solving a problem from the very beginning with all the frustrations and challenges when things don’t work the way you want them to, I think that’s a very valuable experience,” he acknowledges. “And then having the satisfaction of finishing it, and to see today how their work will do in the performance stage is very exciting for them.”

And according to Alix Ramos, an Illinois Sophomore in Computer Engineering who was in charge of the Middle School Design Contest, that’s why she took the project on—so students would not only engage with Engineering at Illinois, but would learn some engineering skills...and maybe discover that they loved engineering.

“I really just wanted to have an opportunity to have kids engaged with EOH. And when they come in for the competition, we also give them time to go out and wander around. And also the fact that this is a competition where they can work on engineering skills like design, and critical thinking, and building. It’s a really great way to start early and learn what they like and don’t like, and start to branch out. I really like how it engages younger children and exposes them to engineering.”

Fritz reports that his students also grew a lot through the exercise:

Since building bridges is Civil Engineering, did Fritz see any future Engineers among his students? He saw several. And one student he might have kept his eye on was Hadi Ahmad. It makes sense that Hadi got involved in the bridge-building project—after all, his grandfather was a civil engineer who built bridges. Does Hadi plan to follow in

Granddad’s footsteps and become a civil engineer himself?

“Something like that,” he admits. He also acknowledges that his grandfather, who’s retired now, would like that. “Yes, he is encouraging me towards civil engineering, somewhat,” he says.

Fritz admits that having a student involved in the contest whose grandfather actually built bridges was pretty special. “It’s really neat that he’s potentially following in his footsteps by doing an activity like this.”

Should Hadi consider a career in the field down the road, he learned some things about building



The Big Papa team (center) watches as their bridge is successfully holding a great deal of weight during testing.



The Blazers team and some of their classmates watch as sand is being poured in to test their bridge.

bridges while doing the project. For one thing, becoming a civil engineer who specializes in bridges—like Granddad—would mean job security.

“I learned that there are many bridges in America that are quite old and in dire need of maintenance,” he explains. Something else he learned related to bridge-building? “That one small issue in the building can lead to a large impact and total the whole thing.”

Hadi’s team, The Blazers, ran into one such issue while working on their project. Both he and teammate Tabeeb Khandaker agreed that one challenge was “making the joints of the bridge,” says Tabeeb. “Because it wouldn’t be clean all the time.” But luckily, they were able to pick the brain of one of the community experts at the science fair: “A judge at our science fair gave us a few tips,” admits Tabeeb.

Their third teammate, Abhinav Sattiraju, who also thinks he might be a civil engineer down the road, but definitely wants to do something involving mathematics, explains why he got involved with this project.

“Well, we thought it was really fun and interesting how bridges work in real life. And we wanted to try making a model bridge. And we’ve seen a bunch of other contests where you can build and the applications you can have for these things. It’s cool and fun to work with your friend, building bridges and cutting pieces out. His take on the contest, “This project was a lot of fun!”

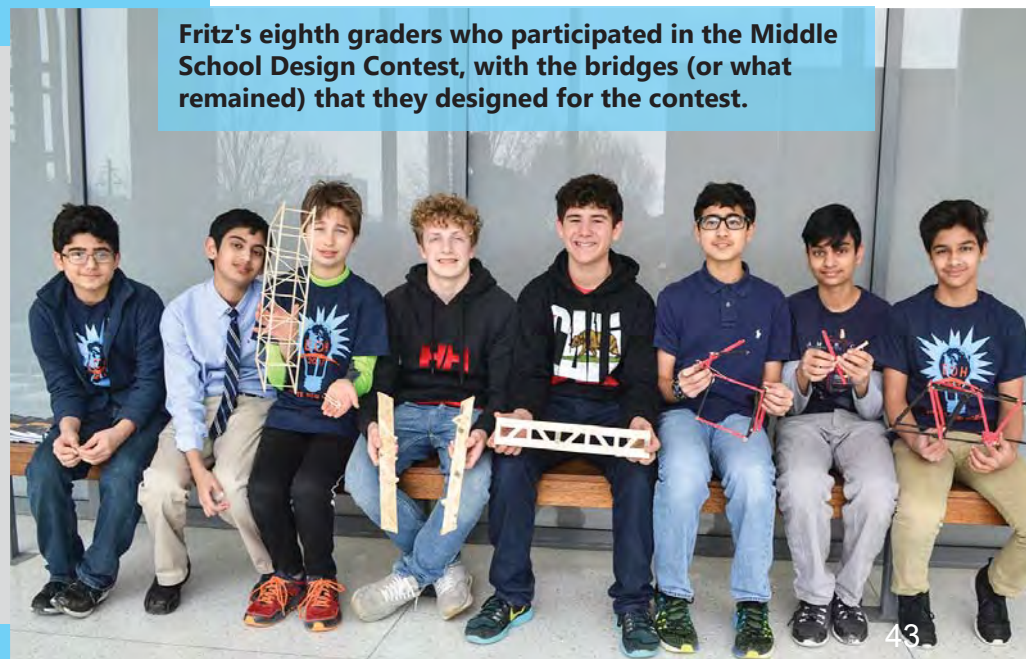
Another of Fritz’ teams, Big Papa, built a bridge that was a whopping 68 grams (just 2 grams shy of the weight limit). And not only did it weigh a lot, it could carry its own weight when tested. Even the Illinois engineering students testing it were amazed at the amount of weight the bridge held. The two report, “We were just trying to make our bridge strong.” They succeeded.

While Alexander doesn’t think he’ll do civil engineering (“I like sports. I’ll keep it in mind though!”), teammate Miles thinks he might. “Maybe,” he says. “I’ve always enjoyed building and designing things. I’m on a Lego robotics thing, and since I was little, I’ve liked to design and build things.”

How’d the students do? The Blazers (Hadi Ahmad, Tabeeb Khandaker, and Abhinav Sattiraju), ended up winning 1st place for the Viewer’s Choice award! The Big Papa team, Alexander Comet and Miles Wood, had the leading bridge weight for a while (58.8 lbs), but got passed at the end. But they did take 2nd place for the Viewer’s Choice Award.

Does Fritz think any of them will do the contest again next year? Yep.

“I’ve already had some of them asking what the contest would be next year, as we were walking around EOH,” Fritz admits. “And they already said they will be interested. So I think we will be back again. I had a lot of fun. And they all had a great day.”



Fritz’s eighth graders who participated in the Middle School Design Contest, with the bridges (or what remained) that they designed for the contest.



A Sangamon 2nd grader (left) enjoys discovering which of her predictions were correct.

MAHOMET SECOND-GRADERS EXPERIENCE HANDS-ON CHEMISTRY COURTESY OF REACT

April 5, 2017

When members of Illinois' REACT

(Reaching and Educating America's Chemists of Tomorrow) program visited Sangamon Elementary School's 2nd grade classrooms the week of April 4–8 to lead the students in several chemistry activities, it was a win-win for all involved. The teachers met some of their Next Generation Science standards about the properties of matter. REACT students had the rewarding experience of giving back to their community. And while participating in several hands-on activities and demonstrations, the 2nd-graders learned some things about chemistry...and discovered that science is fun.

Teachers in Illinois are now required to meet the new Next Generation Science Standards for science instruction. So when the second grade teachers in Mahomet's Sangamon Elementary were wrestling with how to make this material come alive, Kelli Benner, a second grade teacher, decided to contact Illinois' REACT program for some help.

"We wanted to come up with ways that students could get hands-on learning experiences that correlate with what we're teaching in class," Benner explains. "So the REACT program from Chemistry said that they could create a presentation to put on for our students that would match up with our standards."

And according to Benner, it was exactly what they needed. "It worked perfectly!" she claims. "It talked



REACT board member Emilee Nawa engages with a second grader who's making predictions during a visit to Ms. Jones' classroom on April 5th.

about all the different properties of matter, and we're studying that right now. So along with the introduction that we're doing in our classrooms, it matched up perfectly and they were able to do experiments with what we've been learning about."

The activities the REACT students did dealt with the states of matter (solids, liquids, and gases), density, and how chemical reactions can cause pressure to build up and be released. For instance, during one activity, students created a lava lamp. Oil was added to a small amount of colored water which, because it was denser, settled to the bottom. Then, to make the "lava" erupt, a half tablet of Alka-Seltzer was added; the chemical reaction caused some of the red liquid bubble up to the top like a lava lamp.

In another activity, a bottle rocket, a small amount of baking soda was added to water in a bottle, which was corked. To the students' delight, enough air pressure built up to pop the cork.

To increase students' learning during the hands-on activities, they also did worksheets. Before each activity, they were to predict what they thought would happen, then record what actually happened and if they had been right or wrong.



A second grader makes predictions during a REACT visit to Ms. Jones' classroom on April 5th.

Benner is a big fan of hands-on activities like the ones the REACT team introduced to her students.

"I feel like it makes a better impact on their learning. It helps them to remember it. A lot of kids are visual learners and learn better by experiencing it and doing it, rather than just seeing it and learning it in a book or on paper or even in a video. I feel like just by them experiencing it, it's going to leave a lasting impact on their education."

According to Benner, the REACT team's activities had a very positive impact on her students.

"My students just loved it," Benner says, regarding the five different experiments the REACT team did with her students. "They just thought every single one of them was engaging and exciting, and they couldn't wait to see what happened next."

Helping during the presentation to Ms. Jones' second grade class was REACT board member Emilee Nawa. A senior majoring in Molecular and Cellular Biology, with a minor in Chemistry, she's also the REACT 3rd Grade Coordinator. Nawa

enjoys participating in REACT because of the impact it has on the children they interact with.

"Every visit I have been on, the students show so much gratitude and excitement towards the experiments we bring with us," she says. "It is a great feeling to be able to help them learn about chemistry in a hands-on way."

Nawa believes outreach efforts like the classroom visits at Sangamon are beneficial "to show these kids that we can relate science to everyday life." Another benefit? The possibility of recruiting youngsters into science:

"We engage students in a fun way, especially those interested in pursuing science when they get older," she admits."



REACT volunteer Vincent Cornelius waits for the raisins in the right beaker to float.

LOCAL YOUTHS' RENEWABLE ENERGY INVENTION PROPELS THEM TO THE REGIONALS IN TOSHIBA'S EXPLORAVISION CONTEST*

April 20, 2017

One doesn't have to be an adult to be an inventor. Nor does one have to be an adult to be Green. Dina Hashash and Lawrence Zhao, two local 7th graders at Next Generation School in Champaign are doing their part to promote renewable energy in order to help solve the energy crunch. As part of ExploraVision, Toshiba's K–12 program designed to “engage the next generation in real-world problem solving, with a strong emphasis on STEM,” the two invented the BioKT. It's a watch-like device that harvests both kinetic and thermal energy from the body of its wearer. Their innovative design helped them reach the Regionals of the contest, an achievement celebrated by an awards ceremony at their school on April 13th.

On hand to present awards and gifts to both Dina, Lawrence, and their Middle School Science Teacher, Bryant Fritz, for his classroom, was Kennedy Cross, a senior district sales manager in the Toshiba America Business Solutions division out of Chicago. Cross says ExploraVision started in 1992 with 500 entries, but has grown to around 5000 entries every year, with only about 24 teams making it to semifinals.

Cross calls Toshiba's contest a corporate social responsibility that “teaches kids that there are no boundaries within science, technology, and mathematics, and as a kind of way to jumpstart



Lawrence Zhao and Dina Hashash with the plaques they received from Toshiba at the awards ceremony.

them into understanding that. Then when they do, we are rewarding them for their great ideas, and hopefully inventions.”

So last summer, Dina and Lawrence decided they wanted to participate. Since ExploraVision participants were to envision what technology might be like 20 years from now, the two started brainstorming, “bouncing ideas off each other for what problems we can fix in the world,” explains Dina. Some of their rejected ideas? Headaches. “Both of us suffer from that,” Lawrence admits. “My grandfather needs hearing aids, so we considered possibly improving hearing aids.” Then Dina’s dad suggested trying to solve the world’s increasing need for renewable energy. That piqued their interest.

“We were thinking about the growing need for energy that we are facing now,” says Dina. Knowing that most energy comes from fossil fuels or coal, they decided to target a renewable energy resource “that would completely eliminate the need for coal and other fossil fuels,” she continues. After considering the sun and plants, then came up with the human body, “because it is always accessible to us,” Dina explains. “And our human body actually lets off a lot of energy in forms that we usually don’t think of when we think of energy. But it is there. So our product focuses on thermal energy in the form of heat that comes off of our body and kinetic energy that comes off of our body when we move. So that’s how we developed BioKT.”



Left to right: Lawrence Zhao, Dina Hasash, Kennedy Cross, and Bryant Fritz during the awards ceremony.

BioKT is a watch-like device that’s a few millimeters thick and is very light. It not only it harvests thermal energy from heat that comes from your skin and kinetic energy when you move, but it’s also waterproof.

Some of the broader fields or topics the two explored included chemistry, biology, 3D modeling, thermoelectric energy, capacitors, and batteries. Some of the more specific areas, including some cutting-edge technology, included: kinetic and thermal harvesters, super conductors, aluminum graphite batteries, lithium salts, and carbon nanotubes.

“We basically covered the entire field of energy,” says Lawrence. How does their BioKT watch absorb thermal energy? According to Lawrence, it uses an effect that produces voltage from the temperature difference of a person’s body and the air. “So the colder it is outside, the more voltage you produce. So it would produce more voltage in the winter because the temperature difference is greater,” he explains. One caveat: it won’t work as well in the summer. But that’s when the kinetic energy harvester ostensibly kicks in, when one is probably more active. “If something goes wrong with one, the other one can take over,” Lawrence explains.

Dina explains what happens to the energy their device harvests: “So when the energy is harvested with the kinetic and thermal harvester, it is transferred using super conducting wires into an aluminum graphite battery. And this battery consists of an aluminum anode and a graphite cathode separated by lithium salts, and features carbon nanotubes that increase how much energy it can hold.”

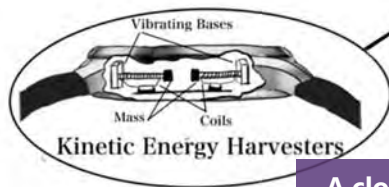


CAD-generated image of the BioKT.



Thermoelectric Harvesters

A close-up image shows the various components of the BioKT.



A close-up image shows the various components of the BioKT.

So how is it that seventh graders know about cutting-edge technology, casually tossing around high-tech jargon like superconductors and nanotubes? Primarily through the internet.

"It took a lot of research, but we were able to get to the final project. We went through website resources and book resources in the library. And we just read a bunch about batteries and energy harvesters, and that's how we came up with that idea. But it was a lot of research and a lot of work to get to this."

And once energy is stored in the battery, it can be used to charge any electronic device. Here's a scenario: suppose you're out running around and discover that your phone is down to 3%. Can you charge your phone on your BioKT? Lawrence says yes.

"The purpose of the battery is to store for later use. So when you plug in the phone to the watch, it has a really fast discharge rate. So it lets go of all the energy and discharges it to your phone in like thirty seconds."

And while their watch currently only has a USB port, being tech visionaries, the two foresee wireless charging down the road, "In the future there might be wireless charging which uses electromagnetic pulse from induction," Lawrence explains. "So we might consider that. And that might be an alternative to plugging it in to a USB."



So someday, when you're jogging, and discover that your i-phone is running on fumes, you might be able to go into your settings and tell it to recharge wirelessly—through your BioKT, of course.

How efficient is their invention? According to Lawrence, they haven't as yet tried to measure how much energy they've harvested in a given time period: "We haven't because it depends on the conditions of the weather. There are a lot of factors to consider."

While neither of the two acknowledge pursuing something like this as a career down the road (Lawrence says, "Maybe, I'm not sure"), they evidently don't see the project as just a one-time deal, either.

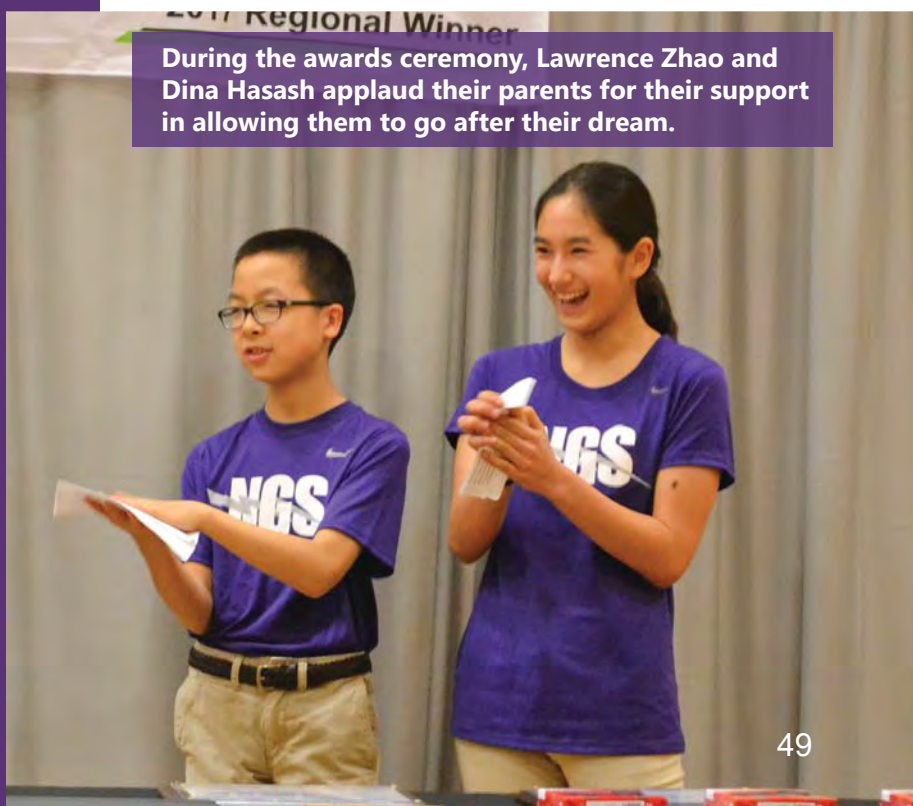
For one, they envision improvements:

"So our thermal harvesters right now are not as efficient as we would like them to be," Dina admits. "Right now they lose heat, and we don't want that, so we have to perfect that."

Another thing that might be in the works down the road is a patent. "Lawrence and I might further continue with this idea and hopefully prototype this," says Dina, "and maybe we can get this commercially available, but that's something that we will have to wait and see."

And should they win the ExploraVision contest, according to Cross, they'll get lots of help from Toshiba in this area:

During the awards ceremony, Lawrence Zhao and Dina Hasash applaud their parents for their support in allowing them to go after their dream.



“We do everything we can to help them take their ideas to market. And if they do win the national championship, we actually have a meeting with the patent department to discuss how to go about patenting their ideas, and making it a viable, sellable product.”

And that’s one thing the two are hoping for in the not-too-distant future—to become national finalists in ExploraVision. They’ll find out on May 7th whether or not they are. If they make the final cut, and become finalists, they will receive a \$5000 savings bond, and they and their family will be flown to Washington, DC for the finals the first week of June.

“We want to make this a family event,” says Cross. “We put them up in a very nice hotel. It is a Thursday night to Sunday. We’ll even have Bill Nye the Science Guy.” As part of the event, on Saturday they’ll do a day of interviewing with TV affiliates all across the country, hosted by Bill Nye. Then the weekend will conclude with a formal dinner, attended by the Prime Minister of Japan as well as the chairman of the Toshiba foundation. “It’s a very elaborate, formal, and prestigious dinner that they have to announce the great efforts that they have done,” Cross explains.

And, as if the two students needed additional incentive, first place winners each get a \$10,000 savings bond.

“It’s really a potentially exciting thing,” admits Bryant Fritz, “thinking about if they get to that point.”

One of the dynamic duo’s biggest fans, Fritz says that when the two approached him about the contest, he knew they had what it takes to do well.

“Dina and Lawrence are two of the students that I have who are really willing to push their interest in science and engineering. And so I knew that when they came to me, the level of work ethic and the amount of passion that they would put into the project would give them the opportunity to be successful.”

He also stressed that while he was delighted to be involved, he “really didn’t do very much. Dina and Lawrence did most of this on their own, and that’s something I really want to stress.”

Kennedy Cross presents a gift to Lawrence Zhao and Dina Hashash along with their plaques.

Head of School Chris Bronowski shares some of the benefits her students gained by participating in the project. For one, she says:

“It kind of helped them have a really big challenge presented to them, and showed them that they can rise to it. And it took a lot of organization and thought into how they were going to accomplish the things that they did. And it’s also facing some fears and some unknowns, and sorting all that out... I think this was a great opportunity for them.”

Dina agrees:

“It really opened our eyes to things we didn’t see before and how things will look like 20 years from now, and it was an amazing opportunity for us to learn.”

***LATE BREAKING NEWS FLASH:** Next Generation’s Lawrence Zhao and Dina Hashash **WON** the National Competition...This nets them each a \$10,000 prize, plus a meeting with the patent folks at Toshiba!

Left to right: Kennedy Cross, Lawrence Zhao, Dina Hasash, and Bryant Fritz with the many awards and prizes Lawrence, Dina, and Mr. Fritz received from Toshiba.



SUMMER CAMPS EXPOSE STUDENTS TO ENGINEERING, COLLEGE LIFE AT ILLINOIS

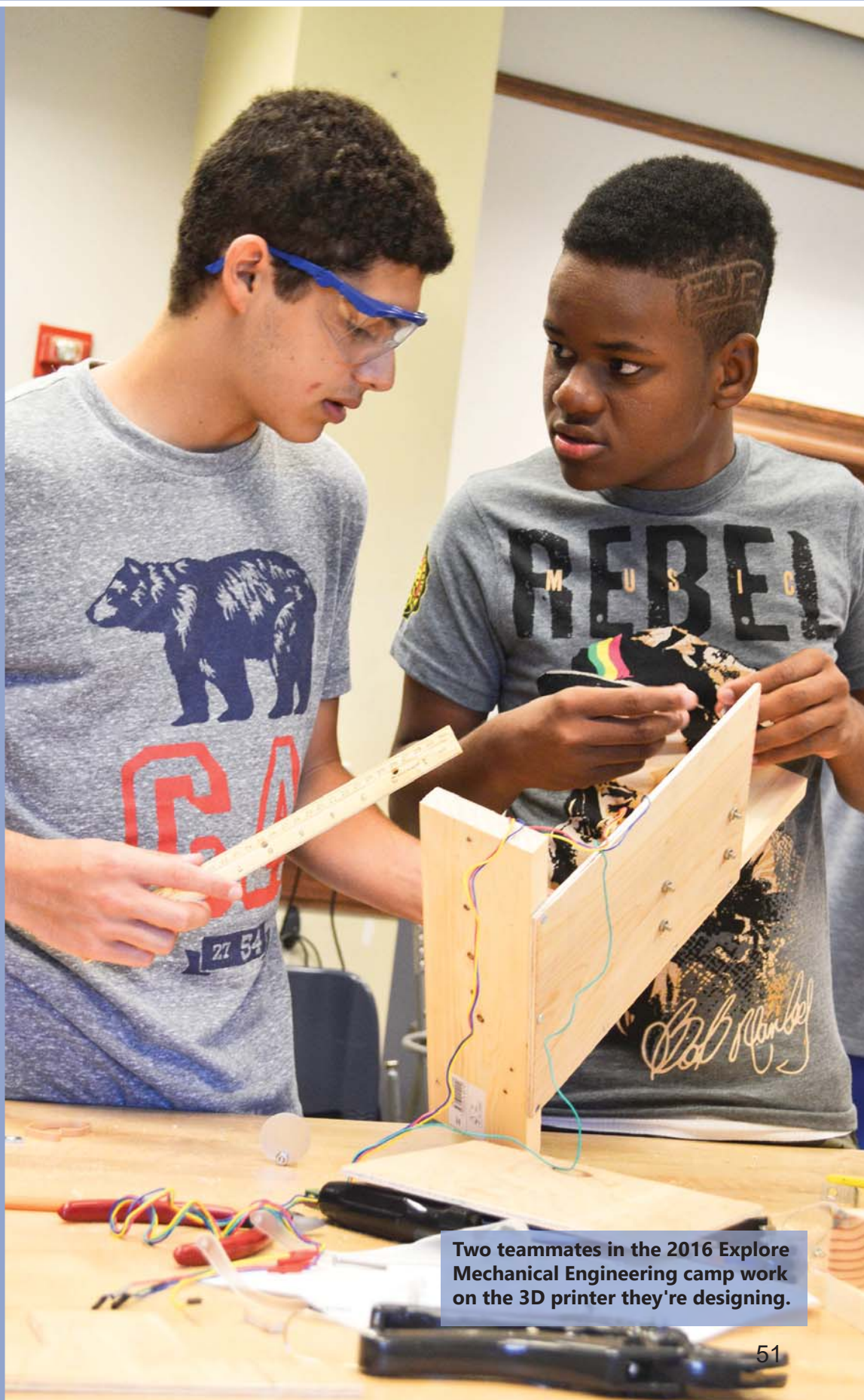
May 17, 2017

High school (even middle school) students looking for something fun to do once school is out need look no further than the numerous Engineering camps being offered at Illinois this summer. Most emphasize a specific engineering discipline, such as mechanical or materials engineering, while a few introduce the students to several disciplines. Some are for girls only; others are co-ed. Some are designed with specific age groups in mind, such as students who are close to graduation and grappling with choosing their careers. However, despite their differences, they're all alike in that they use fun demos, presentations, and hands-on activities to expose participants to engineering, and they give students a taste of what college life at Illinois is like.

Engineering's Outreach Coordinator, Sahid Rosado, is in charge of fourteen of its summer camps:

- GAMES: for high school girls
- WYSE: for high school guys and girls
- I CAN EXSEL: for Chicago Public School 9th graders
- GLAM-Mid: for middle school girls

Rosado is preparing for close to 400 kids this



Two teammates in the 2016 Explore Mechanical Engineering camp work on the 3D printer they're designing.

summer in the various camps. Although most are full, there are still a few openings left in the GAMES camps for high school girls, which has registered 174 out of a possible 190 campers.

Rosado says her goal in running the camps is to make sure students know what engineering is, and that it's a viable career option for them:

“I think it's very important to have a community, and have your next generation of students really know the opportunities that they can have.”

She clarifies that the goal isn't that they should all go into engineering:

“Because that's not the case, but having an informed community that knows that engineering exists even and that's an option that they could pursue if they wanted. I think that's why I do it.”

GAMES Camps

The eight GAMES (Girl's Adventures in Mathematics, Engineering, and Science) camps for high school girls each emphasize only one engineering discipline. One of the strengths of the camps is that many of the instructors and camp counselors are women, who can serve as role models to these girls.

Also, these are week-long residential camps, with participants staying in dorms, which gives them the opportunity to experience campus life. Half of the GAMES camps are scheduled for a week in June; the other half are in July. Holding several camps during the same week helps participants realize that there are other girls out there who are interested in STEM just like them and gives them the opportunity to meet and get to know some of them. Following is the summer 2017 GAMES camp schedule:

A camper works to extract DNA from strawberries during the 2016 Bioengineering camp.



June 18–24

- Chemical Engineering (9th–12th graders)
- GLEE (Girls Learn Electrical Engineering) (10th –12th graders)
- GLAM (Girls Learn About Materials; Materials Engineering; 10th –12th graders)
- G-BAM (Girls Building Awesome Machines; Mechanical Engineering)

July 9–15

- Aerospace Engineering (9th–12th graders)
- Bioengineering (9th–11th graders)
- Computer Science (9th–12th graders)
- Environmental Engineering & Sustainability (10th–12th graders)

Since the curricula for several of the camps were revamped last year, most of those will remain the same. However, girls who enroll in the Computer Science GAMES camp this summer are in for a treat. Because CS GAMES alternates between Scratch and Robotics every year, and this summer's camp is on the theme of robotics, camp directors Alandria Lark and Steve Zewleski have gotten whiz-bang, 3Pi robots (they're a step up from slower, non-programmable beginner robots)—which the girls will get to keep.

GAMES campers will also be doing some engineering-related activities in the evenings. For instance one of the girls' favorite activities every year includes a visit to Maker Girl where they will use TinkerCad to design then print 3D objects on 3D printers. According to Rosado, "The girls say at the end of the week that that's one of their favorite evening sessions."

Another evening activity "the girls really, really enjoyed" last summer will be repeated again this summer: Bruce Flashbart's tour of the Engineering Student Projects Lab. "The surveys said that was probably one of their favorite things to do," Rosado says.

While the students are at camp primarily to do activities about engineering, they won't constantly have their noses to the grindstone. For example, they'll be doing some just-for-fun evening activities such as movie night and bowling to get to know some of the other girls better.

WYSE Camps

Providing a chance for the guys to experience engineering too are the week-long, co-ed WYSE (Worldwide Youth in Science and Engineering) camps. These either address one individual discipline for the entire week (Bioengineering or



**Engineering Outreach
Coordinator Sahid Rosado**

Mechanical Engineering), or expose students to a number of different disciplines, usually spending half a day on each. The WYSE Camps (co-ed camps for high schoolers) are all full, with 156 campers.

Like GAMES, WYSE camps are also residential camps for high schoolers. But unlike GAMES, the WYSE camps split the age group into two camps: the Discover camps are for younger students (rising freshmen and sophomores) while the "Exploring" camps are for upperclassmen (juniors and seniors). Also, several camps, rather than concentrating on one discipline, expose campers to numerous engineering fields. Following are the WYSE camps, their dates, and the age groups they cater to.

June 11–17

- Exploring Your Options, Session 1 (11th–12th graders)
- Exploring Mechanical Science and Engineering (11th–12th graders)

June 25–July 1

- Discover Engineering (9th–10th graders)

July 16–22

- Discover Bioengineering (9th–10th graders)
- Exploring Your Options, Session 2 (11th–12th graders)

The Exploring Your Options curriculum has a few new opportunities this year. For instance, based on some observations of last year's camp, Rosado has implemented a new session dealing with professionalism in engineering. For

instance, last summer, faculty were noticing that student behavior was a little bit different, and team dynamics were a bit different than in years past, especially in regards to student attitudes toward working in teams and acting professionally. So Rosado did some asking around and discovered that Ann Whitmere teaches an ethics/team-building course, so she'll be doing a session on team dynamics and conducting one's self professionally.



“I think it’s important early on to talk to the students about why this is so important,” says Rosado.

Another new Exploring Your Options session being added is called, “Where the arts meet physics,” which is being taught by Physics Associate Professor Smitha Vishveshwara.

“The title says it all,” says Rosado. “How physics is present in nature, and how it displays itself in the arts and in nature. I think kids this age, they probably don’t realize how one thing is connected to the other, right? I think kids this age look at engineering as one thing, and then art or social sciences as a whole different thing. So I’m excited about this session because I think it’ll kind of get them thinking differently about, ‘Oh, there is an art aspect to Engineering.’ So hopefully it’ll kind of change their views on what engineering looks like.”

I CAN EXSEL Camp

In addition to all of the week-long camps, Engineering is also pioneering a new, free, half-week-long camp for CPS students as part of the I CAN EXSEL (Illinois-ChiS&E Alliance for Nurturing Excellence in STEM Education Leadership)

program. From July 24–26th, 20–25 incoming CPS 9th graders will be on campus to be exposed to engineering. Similar to WYSE camps, students will participate in a number of two-hour sessions introducing them to the different engineering disciplines. They’ll also get a taste of what college is like as they stay in dorms and get familiar with the campus via a variety of fun, evening activities.

GLAM-Mid

Engineering will be rolling out another new camp this year, a Materials Engineering camp similar to GLAM GAMES camp for high school girls, but it’s going to be for middle school girls. While GLAM-Mid will not officially be offered as a GAMES camp until next year, Rosado is doing the logistics.

What Rosado finds most rewarding is knowing that she has piqued the interest of some students:

“I think about all the students that have no idea about what it is, and then when you see a few, even if it’s just a handful of them, that you can really tell when their eyes open really big and they’re like, ‘Oh, that sounds really cool!’ That’s why I do it, really. For those very brief moments where you can see that you actually sparked an interest in someone. So, I think that’s what makes it worth it.”

Written by: Alexandra Anne Peltier

LOCAL 8TH GRADERS BUILD SOLAR CARS COURTESY OF NEW POETS' RET CURRICULUM

May 23, 2017

After spending weeks designing solar cars, teams of eighth graders at University Laboratory High School in Urbana and Next Generation School in Champaign tested their cars to see if they would move when exposed to bright light—then were either exultant or chagrined based on the results. The project was part of the POETS' RET program, during which a team of four local science teachers was tasked with creating a multi-week curriculum unit related to power, heat, and power density that was aligned with Illinois' Next Generation Science Standards (NGSS).

The teachers, Uni High's David Bergandine and Sharlene Denos, Next Generation School's Bryant Fritz, and Centennial's Jay Hooper, were part of a multi-year effort to create an extensive unit. According to Joe Muskin, Education Coordinator for the NSF-funded POETS (Power Optimization for Electro-Thermal Systems) Engineering Research Center, the spring 2017 classroom testing at the two schools represented the first tests of some of the unit. After testing it in Denos' class, modifications were made based on the outcomes, then it was re-tested in Fritz's class.

This summer, POETS' RET teachers (some returning, some new) "will refine the solar car module and add to it with new material as the entire multi-week curriculum is fleshed out," Muskin explains.

The goal of this project, according to Muskin, is to:

"Create a well-designed unit in which students problem solve, design, and engineer. We want the students to practice real analysis and to really think. We also want them to have fun and to see what engineering is really like—how it is a creative field where people invent new things to solve interesting problems!"



Two NGS students show off their solar car.

Muskin explains that as a result of completing the projects:

"Students gained a sense that they could design a solution to a problem and then successfully implement that design, seeing the results, and feeling that success as their cars worked with the available light."

However, to get to that point, the process didn't always go smoothly. For example, the motors didn't produce enough torque to propel their cars with the limited light in the classroom. To generate enough torque to get their cars to move, they had to design a gearing system and print it on 3D printers. "They had to run some tests and calculate the gearing ratio they would need, then design a system to give them the needed torque," Muskin explains.



Joe Muskin helps a student test her team's solar car.

Since the lesson was first tested at Denos' class at Uni High, while students learned a lot, some of what they learned was through failure.

"Overall, I believe the lesson taught at NGS was much better organized and efficient, based on a great deal of troubleshooting my students did," she acknowledges. "That is one of the many benefits of working with Uni High teachers and students. We have the flexibility in our curriculum to experiment with projects like this and our students understand that it may not always work out perfectly. In this case, I believe the students learned much more from all the ways in which the car didn't work. Students here are encouraged to take risks, which sometimes pay off, as with the multiple solar-panel limo, and sometimes do not, as with the cardboard, direct drive "racer."

In some of the comments Denos' students made regarding the lesson, they confirmed that while they had learned a lot, they also learned through failure. For instance, one students said:

"I learned what repetitive failure feels like, and I also learned how to operate the type of 3D printer that we used. I also learned more about friction, torque, and efficiency." The same student also indicates: "I think I learned many things while working on this project. I learned to be patient especially when my wheels kept on turning out to be unsuccessful, and I tried not getting mad at everything that didn't go my way—for example like the rubber bands weren't the right length."

A plan for further development and testing of the unit is in the works, to not only do it again in these schools, but to expand the development of the unit in the coming year to Champaign and Tuscola schools as teachers from those schools do the summer development then test in the coming school year.



An NGS eighth grader works on her team's solar car.



Uni High science teacher Sharlene Denos works with her students on their solar car.

Regarding the process and number of iterations students went through. Fritz admits, “We’re still going right now, with a few of them. I would say each group probably ran into a dozen problems that they had to fix, whether they were big things or small things. They had to go back and design the pulley; they had to change the sizes, reprint them, or try messing around with the spacing again. There were all sorts of possible things that could go wrong that they had to figure out.”

One of Fritz’s eighth graders, Hadi Ahmad, says the biggest challenge they encountered was

“attaching the rubber band to this motor here and then putting it on the wheel. Because it was hard to decide how tight the rubber band had to be so that we could make it roll. If it was too tight, it would pull the motor, and it wouldn’t move, so I’m getting it to move. We’re still trying to overcome that problem, trying to get the rubber band to move the wheels.”

Evan Kuntz shares some things he learned about engineering through the project: “We have a lot of renewable energy sources like sunlight and that we could probably 3D print cars if we need to, which is kind of what we’re doing right now. If we could just make it much larger scaled, we could 3D print cars and make it much more affordable.”

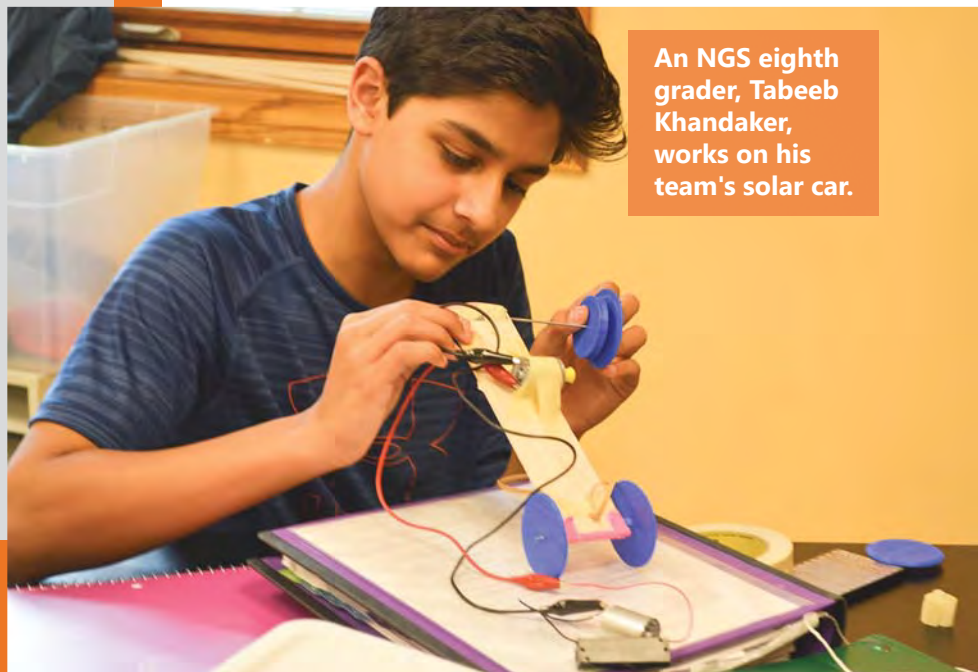
NGS eighth grader Abhinav Sattiraju reports encountering several challenging things. “After you put it all together, you have to decide after you test

Also, according to Muskin, teachers at POETS’ partner universities, Arkansas, Stanford, and Howard, will be helping to develop components for this extensive middle school curriculum.

One local teacher, Bryant Fritz, who is experienced at writing curriculum aligned to the Next Generation Science Standards, was excited about participating in the project. “I know there is not very much curriculum in existence that really follows the standards well. And then the idea of incorporating electrical engineering possibly in the science content practices also, we thought that was really neat.”

Fritz indicates that for his students, the unit provided:

“Just the right amount of challenge for them. They definitely learn throughout the entire time that engineering is a process of redesigning and refining and continuing to change things and solve problems as they go through the whole process. They definitely had their frustrations and they’ve learned that if they want to be successful with this, or in engineering in general, that they have to find ways to troubleshoot those things.”



An NGS eighth grader, Tabeeb Khandaker, works on his team’s solar car.

everything and see if it's not working. That's usually the case. You need to make several adjustments and you need to try different possibilities. After you finish it, that's the hardest part, because you need to make several adjustments to make it work."

He also shares what he learned about engineering through this project, "I learned about speed and torque and the relationship—like more speed, less torque; more torque, less speed— things like that. Some little physics here and there. It's a lot of fun."

Briana Bellard says she and her teammates, "learned a lot about how the gears function and how they work together. I feel like that was a big component of that. Learning about how to code and

program stuff was really big too." She learned to code in order to print in 3D. Bellard shares that as a result of this experience, she would most definitely pursue engineering.

According to Banan Garada, the most challenging part was "probably trying to find the right wheel that wouldn't fall off. Because a lot of the wheels kept falling off from it." While they 3D printed the gears, the wheels were already printed for them.

Garada shares something she learned about engineering:

"You can't get things right from the first time. You have to keep trying. Don't give up, keep trying and you'll eventually get it."

Bryant Fritz helps a student work on her car.

Anusha Muthekepalli says her team encountered numerous challenges: "There's too many to count. There's a lot of them. Some of them were easy to overcome, and some of them you have to fix the strength of rubber bands and there are a lot bigger problems that you need help on."

As with many of the other students, Muthekepalli learned that engineering requires persistence.

"It takes more than one try," she acknowledges. "You just need to keep on trying. It doesn't come easily. Sometimes you just have to ask for help, even if it hurts your pride a little bit." However, she evidently enjoyed it, because she says she will most likely end up pursuing engineering.

How'd the students do? According to Muskin:

"There were so many different, yet well-working designs that the students came up with. The students saw that there isn't just one answer, but as is often the case, so many interesting and creative solutions to a problem."



UNI HIGH STUDENTS RESEARCH HEAT PIPES AS PART OF POETS' RET CURRICULUM DEVELOPMENT

May 31, 2017

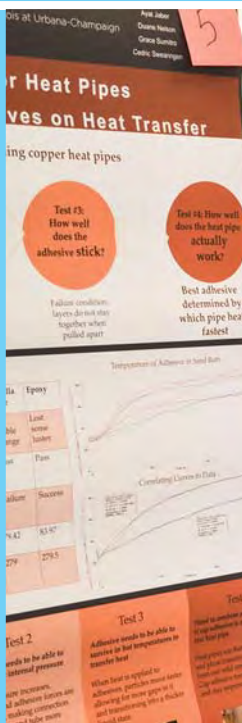
Although they might not have realized it, during the spring 2017 quarter, students in David Bergandine's three chemistry classes at University Laboratory High School (Uni High) did research projects about heat pipes that were part materials engineering, part physics, and part chemistry, along with a lot of science. While testing twelve different variables about heat pipes, they not only gained a lot of general knowledge related to heat flow and heat transfer, but gained some very in-depth knowledge about the specific area they researched. Plus, in addition to learning what research is like, his students got to present their research at POETS' 2017 High School Student Research Symposium on May 23rd.

Bergandines's heat pipes research lesson came about as a result of his participation in the NSF-funded POETS' (Center for Power Optimization of Electro-Thermal System) RET (Research Experience for Teachers) program the summer of 2016. A key aspect of the RET was that he

and three other local teachers were to develop curriculum during the summer which they would then implement during the school year. “Our goal,” Bergandine explains, “was to create some lessons that can be used at the middle school and high school level related to heat flow, heat transfer—heat problems that would perhaps show up in electronic circuitry or mechanical heat exchange.”

Bergandine says his students' research this spring was a spinoff of his summer focus on models that involved electricity and resistance: "So we were looking at things like how much heat would develop in a circuit depending on the wire size... The idea was to maybe have a lesson involving students modeling some sort of mechanism that they would build and then test to see if there was a heat flow problem somewhere within the circuit or within the mechanism."

The heat pipe lesson was born when Bergandine and Joe Muskin, POET's Education Coordinator, visited a professor who showed them a heat pipe being used to cool electronic circuitry, and he thought,



A student explains her team's research findings.



POETS' Jessica Perez (left) listens as a team of students discuss their research.





David Bergandine (right) discusses his heat pipes lesson with POETS' Jessica Perez.

variables they were most interested in, and which of five skills needed to complete the project they were good at: designing the experiment, conducting the experimentation, explaining their process and results scientifically, making a poster, and making a video.

"Then I tried to group people based on their interest in the topic, plus the skill set that they brought," he explains. "I think we ended up creating fairly effective groups," he says. There were twelve groups all total, four in each of his three classes.

Next, his students began testing a number of variables regarding heat pipes. These included length; width; diameter; conductivity of the material itself, depending on how much mass was present; whether a solid material would conduct better than a hollow pipe; different metals; different fluids on the inside; and using wicking materials on the inside. Bergandine indicates that his students also tested to see if the volume of liquid mattered, going from no liquid inside to 25%, 50%, 100%, to see if they still got a certain performance. His students also tried water versus ethanol, and then mixtures of water and ethanol.

Regarding the lesson's multidisciplinary nature, Bergandine calls it "really heavy-duty engineering in the sense that you have to build something that works, and that's not always what a scientist does. But, on the other hand, we were also doing science in the sense that we were just discovering how materials behave."

Also key to the lesson was the opportunity for students to present their research. The teams each

"Oh, that's interesting. Maybe we can try to build one and see if it would work?"

Since later in the summer, he actually built a model heat pipe—and it worked—he decided that heat pipes had enough inherent variables to provide a high school research project. "It turns out there are about a dozen different things that could be varied that students could test," he says. "So, we settled on that."

So as part of his curriculum development, Bergandine had his chemistry classes research relevant variables when designing a heat pipe, related to: "What are some things that are important to a heat pipe?"

First students developed a list of things they could vary. After observing and researching heat pipes, they came up with about a dozen factors that they could vary to test.

Next, Bergandine grouped his students based on their interests: which of the



One of Bergandine's students presents his team's research on wick structures in heat pipes.

created a poster and a video about their study, then presented them at an end-of-the-quarter poster session on campus on May 23, 2017. Because POETS is seeking to create short-term research opportunities and competitions for K-12 students, the poster session was also a competition. A group of POETS' graduate students served as judges, watching as each team of students presented their research via posters and videos, then judged the teams' work based on the quality of the research. Teams who won 1st, 2nd, and 3rd place got first pick of the numerous prizes that were available. However, every student received a certificate and got to choose a prize.

Jessica Perez, POETS' Associate Director of Education and Inclusivity, explains how Bergandine's project is related to the RET's curriculum development goal, calling it, "Research to see what variables are important. And then knowing this information, David is going to figure out 'How can I develop this into a piece of curriculum?'" She goes on to explain that the project isn't a formal curriculum, but more like a research project or research prompt. "This is actually a part of the curriculum development," she says. "The students helped do that because they are trying to figure out, 'What are the important questions to ask?' and 'What things matter and what things don't?'"



A grad student judge, Leon Dean (center), discusses a team's research project with them.

POETS' goal in fostering curriculum development through its RET, according to Perez, is:

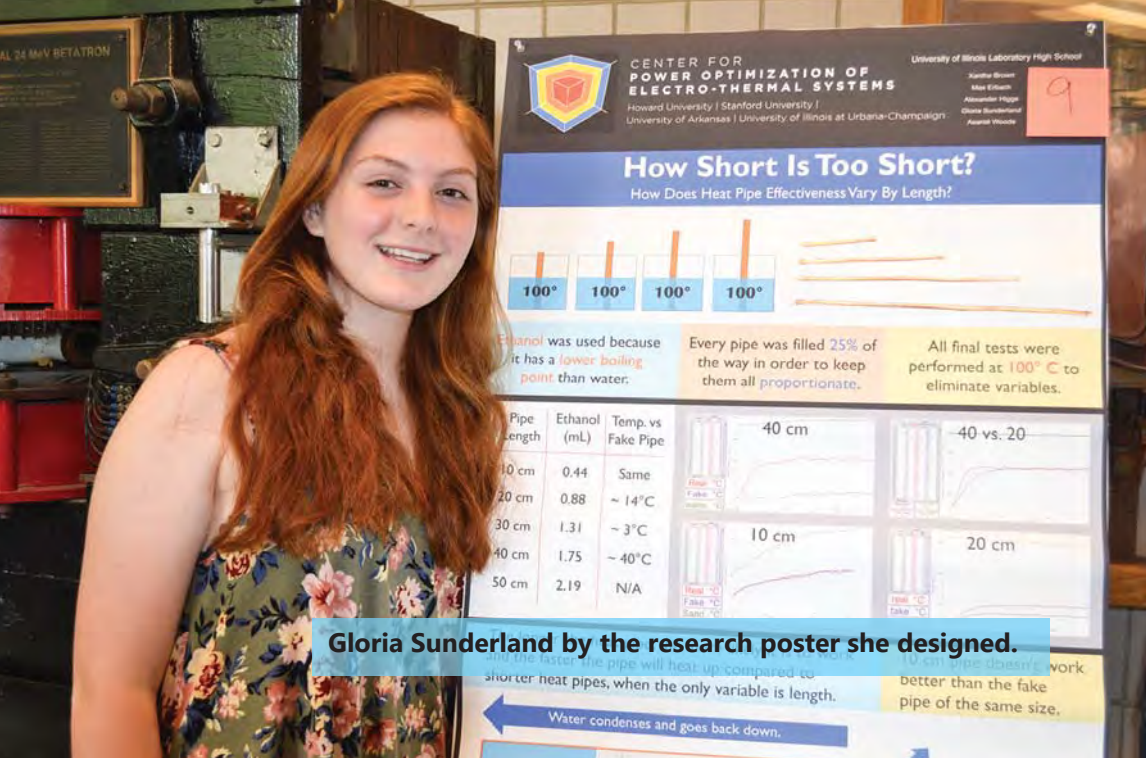
"to give students the opportunity to do project-based learning. So, by them doing these sorts of things, they learn how to run experiments, how to ask the right questions. The hope is that by them engaging in this, maybe they will start getting interested in science and engineering. They'll gain confidence through going through this process."

She adds that in addition to the impact on the students themselves, it's an opportunity to disseminate POETS research:

"Additionally, it's great from a RET perspective because that means that we are training RET teachers to bring POETS-related research into the classroom, and they are actually implementing it. The work that David Bergandine did during the summer is already impacting almost seventy different students. Their work is going to have an effect on even more people once the curriculum develops. So, that's sort of the impact that we want."

A Uni student explains his team's research findings.





Gloria Sunderland by the research poster she designed.

She reports that, they “had to do a lot of research like the laws of thermodynamics and just heat pipes in general to see how they worked. Then after we figured that out, then we actually had to make them and actually heat them up with the ethanol in the pipes and then cap them so that there would be pressure.”

Sunderland also gained some insights about research through the project:

Bergandine adds that his students also learned a lot of basic knowledge about thermal properties and materials and heat flow and phase change, plus they became specialists in one of those areas.

"Well, they start off knowing virtually nothing about a topic, and then they end up knowing a lot about their own area, plus they know enough that they can easily interact with any of these other groups and quickly understand what it is that they were doing... As individuals, they become sort of specialists in one area...capable of talking about it, presenting it, and so on."

One student who learned a lot through the project was Gloria Sunderland, a sophomore at Uni High, who indicates that her group did length of the pipe as their variable. While they had “sort of inconclusive results,”(she said their 10 cm. pipe “didn’t really work at all”), she acknowledges that, “We did see that as they got longer they tended to work more effectively.”

"I learned that you can build a lot of knowledge through research and through testing things in real life. Hands-on experience does help you learn and really internalize the knowledge that you’re working on."

Another student, Harmen Alleyne, a sophomore at Uni High, says his group tested the relative effectiveness of different metals when constructing heat pipes. Their results? Alleyne says copper is the best and stainless steel is the worst in terms of conducting heat. He also learned a lot about heat pipes through the project.



Kate Dahlke, a grad student judge (right), reviews the video a team of Uni High students made as part of their research project.

“When Mr. Bergandine started the project, we had no idea how to construct a heat pipe. He didn’t tell us or anything. So, we had to research how to make a heat pipe, research what kind of working fluids we can use and which ones we should use and how the different metals react and why they do that. We had to just research almost everything for this project. So, throughout the entirety of the project, we learned almost all of the workings of a heat pipe.”

Alleyne thought the project was fun and "a nice break because we have finals, and that's just studying, studying, studying. This took an entire quarter of work and spread out over a quarter it didn't feel like it was a pressing thing that we had to

do for a final grade...It was just kind of a fun project where you got to be with your friends.”

According to Alleyne, a lot of cross-group collaboration also took place, as people learned vicariously through the research being conducted in other groups. “People were talking across groups about how they did certain things,” he admits. “Like maybe someone would ask, ‘What working fluid are you using?’ and someone would say, ‘Oh, I’m using ethanol, because it has a lower boiling point than water,’ and then the other person says, ‘Oh, that makes sense. I should probably use that since my heat pipe is not working too well.’ So, things like that. I’m pretty sure everyone completed it. Several people didn’t like that their heat pipes weren’t working, but they asked around and eventually everyone got their heat pipe to work. If not, at least they figured out how the heat pipe should work.”

Another student, sophomore Tina Wayne, says she learned about heat pipes and how they conduct energy. She also learned how metals’ ability to conduct heat is related to their molecular structure. “I learned how metals’ valence electrons impact how they conduct heat. I learned why we use the things that we do within our house.” For example, she learned that copper pipes are used for the most part in houses and in electronics because they have the highest thermal conductivity, and that aluminum pipes are a close second, as are pure metals. “Pure metals should perform better due to having more free valence electrons versus alloys.”

Wayne says that during the project, she learned about materials engineering, but some economics too: “My part was explaining why the heat pipe performed as it did. So, I went through a lot of different sites that both sold the different types of metals, and I went through research at different universities. So, I got to see the different type of academic standpoints versus economic standpoints and the viability of both.”

Regarding copper being a good heat conductor, Wayne, agrees, but, based on the cost, suggests, “Or aluminum, which is a more affordable



Harmen Alleyne (just right of the poster) and his team of fellow Uni High student researchers.



Jessica Perez (right) awards some students their third-place certificate.

type of metal. But, the copper and aluminum were the best and steel and brass should not be used. Steel should definitely not be used as a heat pipe due to it being an alloy and having a low thermal conductivity.”

Wayne admits that she enjoyed the research.

“I like doing research, she admits. “I had many questions going into the project, and through doing the research, I was able to answer my own questions and explain it in my own terms so that I could explain it to another person.”

The students weren’t the only ones who learned some things; Bergandine did too: “I learned that kids are fairly adaptable, and they’re naturally curious. If you give them objects that they can truly experiment with, they really will.” Something else he learned? “You can do some pretty significant scientific research with things that you could walk to the hardware store and buy.”

Grateful for the support and the impetus POETS provided, Bergandine says POETS helped “supply us with some materials and really get us started, because that’s a sort of barrier that many schools might have. You just need some of those materials and maybe a little bit of insight just to get you started on a project.”

He also hopes to:

“Continue working with organizations like POETS and other groups on campus that would like to collaborate with us and give our students authentic research opportunities in the classroom, but also use those research opportunities to ensure that students are doing real science and learning what science is all about and not just learning about science.”

UNI HIGH 8TH GRADERS GROW BIG IDEA PROJECTS TO MAKE A DIFFERENCE IN LOCAL COMMUNITY GARDENS

June 12, 2017

This past semester Sharlene Denos planted the seed of innovation in her University Laboratory High School (Uni High) 8th grade science students.

In collaboration with local Champaign-Urbana community gardens, and funded by the Illinois Learning Sciences Design Initiative (ILSDI), her students unearthed problems encountered by managers of the gardens, then, based on science learned in school, as well as via research, got to work on how to effectively solve these problems. While the science aspect of their projects was important, the main focus was really on the design element.

Denos' goal was to have teams of students in her classes do science-related, user-oriented-design service projects for one of three community gardens: Randolph Street Community Garden run by Don Blackman; Prosperity Gardens run by Nicole Bridges; and Douglas Community Center Organic Garden run by Katie Hicks. So she wrote a proposal which was funded by ILSDI, an interdisciplinary, university-wide organization,

whose funding is derived from the overhead from NSF grants. "It's seed money that brings an interdisciplinary group together around interesting ideas and design education," Denos explains, "with the idea that they would then take that initial work and turn it into something bigger, an externally funded grant."

Denos came up with the idea for the class when she noticed that she hadn't really had any students in her previous classes who could use maker types of technology: electronics, CADing or 3D printing. Then she had an epiphany:

"You know it'd be great to front load some of that training so that when the kids go to think about prototyping their ideas, they think, 'Oh, you know what? I could easily laser cut these pieces,' and they know how to do it."

So she decided to write a proposal, Making a Difference (which she calls "kind of cheesy,") but she says was about:

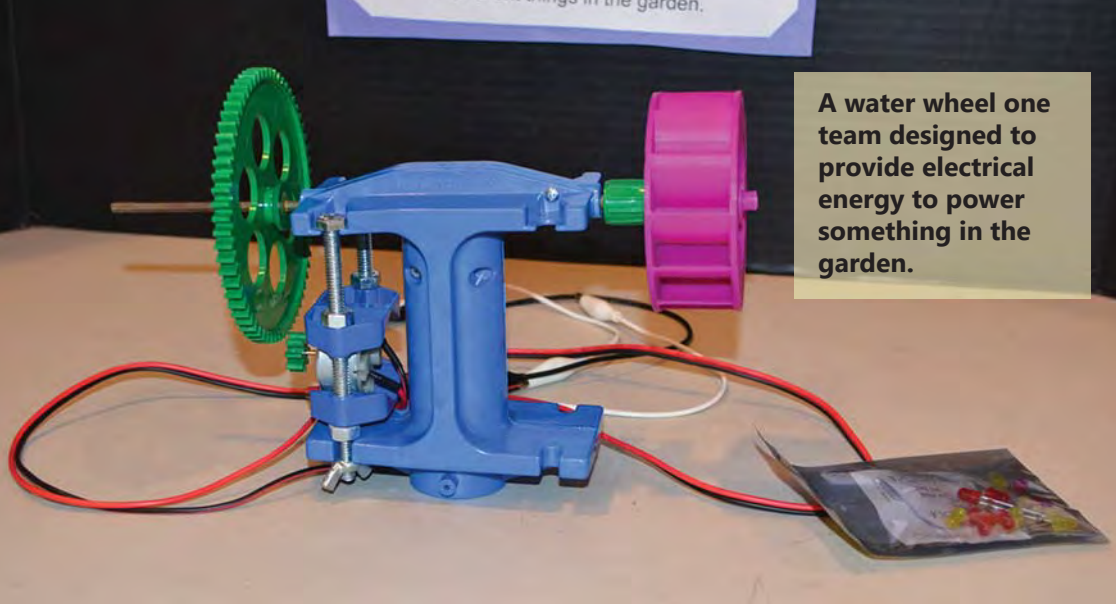
"How do you take these extracurricular, after-school, maker-type experiences kids can have and bring them into—not a technology class—but a science class. So you make it a really authentic science experience...When the kids are trying to make design decisions, they have to design and perform a control experiment. Then they have to learn about heat transfer, or they have to learn about hydrostatic pressure."

She reports that they're all learning about different things, depending on what their design concept is.

While the premise of the user-oriented design concept was to have her students consider their clients' needs and the usability of their design, she claims the projects were "really driven by the kids' ideas."



A team of students share about their project, "Portable Urban Gardening Bed with Circuit Moisture Sensor," with visitors.



A water wheel one team designed to provide electrical energy to power something in the garden.

“It needs to be driven by the kids’ ideas,” Denos stresses, “because I want to empower the kids.” By “empower” she means to raise her students’ confidence and critical thinking.

She’s hopeful their thought process is somewhat along the lines of, “Okay, I may not have a deep scientific background, but I can still think through a problem. Given a certain framework, I can think through it and come up with good ideas that I can then test using scientific processes. That’s the bottom line of what they do: they come up with an idea.”

Denos says there’s also a service component to the project, which is working with the directors of local community gardens to solve problems they’ve encountered: “You are working with a user; you’re doing that problem; you’re identifying that authentic problem.”

But while her students worked with the user to define their problem, she indicates they didn’t work with the user to develop the solution because they didn’t have time.

Do her kids come up with something that’s doable? “Usually it’s crazy,” Denos admits. “If we have time, we work with the user to narrow it down to something reasonable, but either way it’s fine.”

One of the key components to this process was that the students define “a really authentic problem.” So, to

help the eighth graders come up with an idea, Uni High juniors acted as mentors, helping the younger students develop surveys for the users (the garden directors), to identify problems they might want to solve. After an initial meeting, the garden directors then came to the school and gave presentations to the students. Denos also took her students on a field trip to the gardens, so they could measure things, take pictures, and talk to the garden directors. Student teams also communicated with the directors through email correspondence.

After identifying an authentic problem, the students then brainstormed different solutions on how to solve the problem. And just like any other real-world problem, one constraint students had was a limited budget. In fact, Denos shares that in an interaction with one client, “When we asked what our budget was, she said basically, \$0.’...All the garden directors told us...‘Oh, basically anything that you propose, I’m going to have to go and write a proposal!’... So we’re just operating with the idea that we want to make it cheap!” admits Denos. So her students learned to justify decisions they made based on their data and the budget.

What kind of projects did her kids come up with? For one project, titled, “Electrical Power Systems Through Rainwater Irrigation,” the team designed



A group of Uni High students explain their project to visitors.

a water wheel to be placed beneath gutters (designed by another team). The idea was that as rain water flows onto the waterwheel, it would cause it to spin, and the resultant energy would be transferred to a battery which would provide energy for the garden.

Another group did a passive refrigeration container for the Randall Street community garden in a project they called, "Thermodynamics in Underground Storage." They designed something similar to a cellar that could be lowered into the ground and be kept relatively cool with no use of machinery or energy. Denos explains their thought process:

"We've looked at thermal profiles of the soil," she says, "so they know if you go down a few feet that you can get a really standard 55-60 degrees pretty much all year round. So what they're imagining is

this box that you can just lower down, and then it has an insulated lid of just foam and then a reflective top so then it reflects the rays."

How did her student know the most effective way to achieve passive refrigeration?

"Well, this is a science class," Denos explains. She goes on to explain that they learned about the three different categories of heat transfer: convection, conduction, and radiation.

Using this knowledge, they determined that all three were relevant to their problem: "Because there's radiation from the sun, and they want to reflect the rays away; and then they have conduction through the earth, direct contact between the rocks and the earth; and then they have convection from the air above that's making contact with the top of the box. So they have to consider all of these things."

This group of students then went on to perform experiments where they simulated the air with hot water. Regarding the insulation, she says "And they try to see, depending on the thickness of the foam, how long it takes for the two temperatures to be the same." Based on these data, they then calculated which materials and how much materials were significantly effective to their passive refrigeration.

Another group of students who designed a greenhouse learned about optics. "So they have to think about, 'What do you want a greenhouse to do?'" Denos asks.

She goes on to explain that you would want a material that allows visible light, or photons through. but won't let the infrared light out.

"That would be perfect for a greenhouse," Denos continues, "because you're letting all the light in, and it's absorbed, then it's reemitted as infrared, but the window won't pass infrared and it reflects it back in so it keeps all the heat inside. And that's the greenhouse effect." So her students were testing different materials to find which one would do that best.

This entire process truly encapsulates the vision of Denos' and Emma Mercier Making a Difference proposal, where students do user-oriented-design service projects to learn science. Plus, Denos is teaching her students to not make rash decisions solely based off their ideas, but to analyze the data and learn more about the topic they're trying to solve in order to most efficiently and effectively solve their problem.



Susan Kelly and Sharlene Denos enjoy the poster session.



Uni High 8th graders demonstrate how their project, "Minimizing Microbial Contamination in Rainwater Collection and Storage" works.

Denos best sums up the big picture as "They're trying to take their idea and then find the science in their idea."

Also involved with the project was Susan Kelly, a Curriculum and Instruction doctoral student who helped with data collection. Kelly reports that she and the project PI, Emma Mercier, a Curriculum and Instruction Assistant Professor, were "interested in how a project based learning project played out in a classroom context."

Kelly, who helped with some aspects of the project coordination and with the field trip to the gardens, believes that the project helped build university-community partnership. "I think the project was a great connection to the local community and to the garden directors, and this relationship with continue to grow with future iterations of the project."

She goes on to share how the project was beneficial to the students:

"I think the project helped the students to see how engineering design principles could be applied in a local context to solve a community need. The students were exposed to ways that science and engineering play out in an authentic context, and they learned something about the process of 'doing science,' and that designing and experimenting is an iterative process. Thinking about the project through the eyes of the user, and designing with community needs in mind, was an important take away from the project."

ACES FAMILY ACADEMIES SHOWS YOUNGSTERS: "IT'S NOT YOUR PARENTS' (OR YOUR GRANDPARENTS') ACES ANYMORE!"

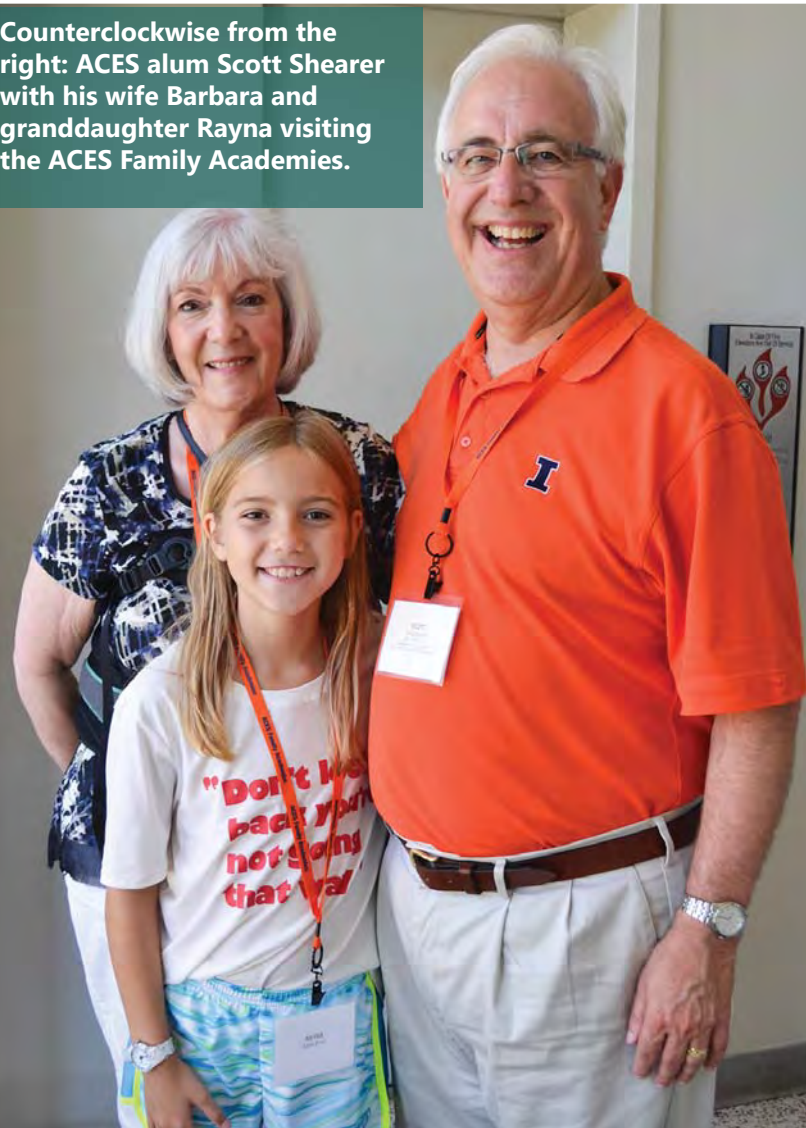
July 19, 2017

"To be able to tell our story, I think that's what's so important—so people can see all of these opportunities and see what ACES is today." – ACES Family Academies Director, Tina Veal

They came from near and far, back to their Alma Mater...back to ACES, where they got prepared for their careers and for life. The trip was nostalgic—visiting old haunts, reminiscing, and marveling at the many changes on campus. But as they returned with their children (or grandchildren) in tow, they had a greater purpose: to introduce the next generation to the center of learning that helped to make them who they are today, to bond with them while doing a variety of fun learning activities, and to possibly do a little recruiting to Illinois.

For instance, Scott Shearer came back with his wife and granddaughter. Shearer majored in agricultural economics and graduated from Illinois with a Bachelor's Degree in 1970 and a Master's in 1975. Shearer explains why he participated in ACES Academies.

Counterclockwise from the right: ACES alum Scott Shearer with his wife Barbara and granddaughter Rayna visiting the ACES Family Academies.

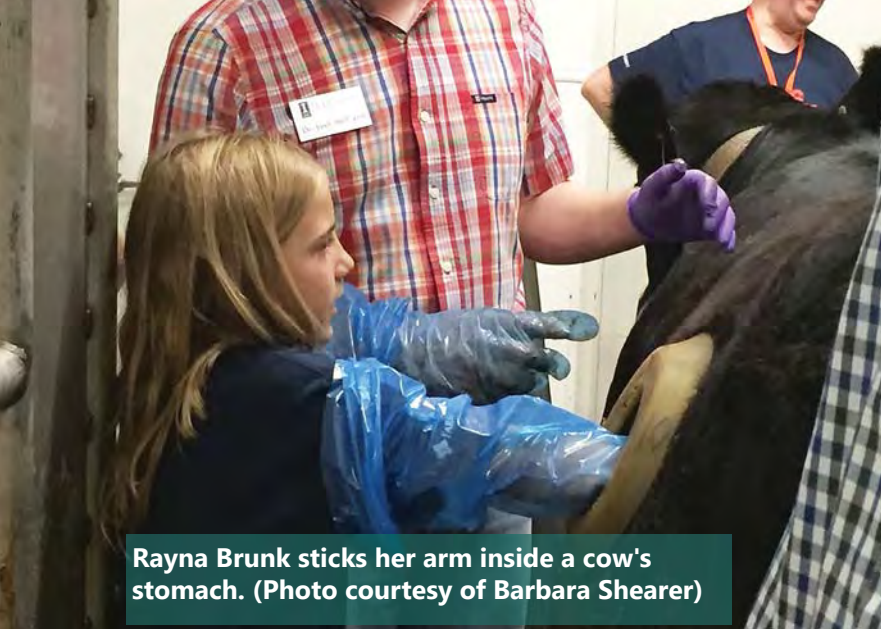


Shearer, pointing to a picture of himself on the Livestock Judging Team when he was a student at Illinois.



"Well, I thought it was a great program," he says, "especially for our granddaughter, to give her a chance to see what university life is like and all of the possibilities, subjects she could learn things about. So this is her second year back."

"There are so many new programs that are being offered [compared to] when I was here. But, it's a reflection of what the world's like, what the economy's like, and what students need to be prepared for. They prepare for their time in the workforce."



Rayna Brunk sticks her arm inside a cow's stomach. (Photo courtesy of Barbara Shearer)

Shearer, who appreciated being back on campus, shares the impact that going to school at Illinois had on his life.

"Well, I'd give the University of Illinois a great amount of credit for my professional career. It gave me a foundation for my career. It opened up opportunities for me. It was a great place for a solid education and lifelong friends and opened up possibilities for the world for me. So, I give the University of Illinois great credit for giving me a foundation for my career."

Accompanying Shearer, along with his wife Barbara, was his granddaughter, Rayna Brunk, who was having a blast. She says it was not only fun, but exposed her to some out-of-the-ordinary things: "So, my classes, you get to do things that you don't usually get to do. I'm from the city, so you don't get to do a lot of things back there with animals." Like sticking her arm inside a cow's stomach.

So did gramps' recruiting gambit work? Does Rayna think she might come to school here? "Actually, yes indeed," she affirms. "I've been trying to get very good grades, and I'm going to keep that up. So, I'll be able to get in here one day." To this reporter's caveat, "You know, it's a very, very good school." Rayna confidently acknowledges: "Yes!"

Another ACES alumna, Keri Richardson, reports that she and her

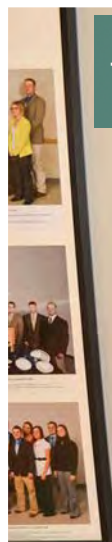
son Lane actually attended ACES Academies together for the first time last year. It was his birthday present. "He's just really into learning and doing different things," she explains. "When we got the email, we signed up, and we're back again this year."

Richardson appreciated being back on campus and acknowledged that while many things had changed, some were still the same as when she was here.

"It's different because there are so many changes and different buildings," she admits, "but Mumford still looks exactly the same... like the worn steps on Mumford. 'I told my son when we were walking up, 'The stairs were always worn,' because, I think, of years of use, and he noticed that too when we were walking up the stairs today.'"

Lane, who likes learning, would agree that, yes, he learned a lot. For one, he appreciated that there were more options for classes this year. He also enjoyed visiting the Japan house, possibly because he "really liked the candy that they brought out 'cause it tasted just like sugar." He and Mom went to "Maybe Money Can Grow (Not on Trees)," where they each made a piggy bank. And it sounds like Lane possibly became a convert to life-long saving.

"We learned about interest, and how to save. And if you save in the bank, interest will go up so you can make more money. And we learned that with one penny, if you save, save, save, the interest could go up to millions of dollars."



Lane and Keri Richardson show off the piggy banks they made at "Of Pigs and People."





A young ACES Academies participant uses a smoker on a beehive during "Feed the Bees."

director, Tina Veal, shares the goal of this activity (and many of the others), "As we look at this program, we're trying to make sure that people see that there is a true science behind agriculture and human science."

In "Where's the Beef: Getting to Know Cows Inside and Out," participants learned about cows and cattle nutrition. And part of learning about the insides of a cow was getting to put their arm inside of one!

Of course, since agriculture is about producing food, several sessions were about food... both for animals ("What's in My Food, Dude? Behind the Scenes in Pet Food") and people.

For example, "Food Challenge" was actually a cooking contest like on the Food Network. Kids got to choose from multiple ingredients, then made

Lane also enjoyed "Feed the Bees," a trip to the University's Pollinarium, where he got to do some things he'd never done before.

"I really like that we got to put a new pot on the beehive. I used a crowbar to [pry] up the lid. I really liked how she was saying the bees know when storms are coming, because they'll be flying around to protect. And I really like how the smoke will just calm them down and not hurt them."

In its third year, the 2017 edition of ACES Academies was a 2-day event for the first time this year. Providing a myriad of activities, all seven ACES departments hosted one or more 90-minute sessions of mostly hands-on activities which touched on the gamut of subjects dealt with in ACES.

For instance, some activities dealt with the birds and the bees. In "Bird's the Word: Exploring Avian Ecology and Conservation," the kids got to actually catch wild birds with a net so they could see the birds up close while they learned about them and some of the research being done.

In "Feed the Bees" (see above), participants suited up in protective gear and helped change a frame in an operating bee hive.

In one activity, "Man's Best Friend," participants learned about dog behavior, plus learned how to take care of their pet, and gleaned training tips. This reporter even learned something: to say "Hello" to a dog a non-threatening way: touch its nose with your fist from a kneeling or squatting position.

Sessions also dealt with larger animals. In "Of Pigs and People," participants examined piglet brains and watched a demonstration of how to study neurosciences. ACES Family Academies

A young ACES Academies participant uses the proper technique to say "Hello!" to a strange dog.



some kind of product that they then had to sell by getting up and talking about what they had made, why they had made it, what the ingredients were.

Other food-related sessions addressed products from animals, such as in one activity, “The Secrets of Sausage.” In the “Magical Milk Lab,” participants actually made butter. It only took about five minutes or so of vigorous shaking, then they got to sample it on crackers. And of course, they made another popular milk product...ice cream, which, according to Veal, “is always popular for the kids.”

Other offerings regarding agriculture included “Healthy Soils C.S.I. Challenge,” where participants looked at the health of soils through different soil samples. Then they were assigned to teams which designed and built a planter. So the emphasis of the activity was looking at how we care for the land, but also teamwork.

Other Human Development and Family Studies offerings were related to humans and human behavior: “Your Nose Talks to Your Tongue (and we are not the same),” “Living the Dream,” and “Being Mindful in a Busy World for Kids.”

The agricultural economics department did the “Maybe Money Can Grow (Not on Trees)” activity about economics and saving that Lane Richardson (see above) was excited about.

There were even opportunities to learn about playing...and to actually play! Human Development and Family Studies’ “Virtual Reality to Chutes and Ladders: How We Learn Through Play” activity compared video games to board games and addressed the impact of those on one’s health. Participants actually got to play too. In “Paper Planes and Drones in Ag,” participants made paper airplanes then added a motor that was controlled

A student celebrates exuberantly when the cream she's been shaking turns to butter.



via one’s smart phone. In “Fun with LEGO Mindstorm Robots,” mom and/or dad (or grandpa or grandma) actually got down on the floor with their offspring, building Lego robots.

Why did ACES begin the ACES Family Academies? According to director, Tina Veal, it was begun to reach out to alums who might not be participating in many of the College’s other events, to keep them connected and abreast of the changes in ACES.

“A lot of our alums remember what they did when they were on campus,” she explains. “They remember the type of education, classes, professors that they had on campus, so it was really an opportunity for us to be able to showcase the college, showcase how the curriculum has changed, the focus has changed within the college.”

Regarding the public perception that ACES and agriculture are only about food production via crops and animals, Veal speaks to the changes and diversification that have occurred in ACES over the years and the wide spectrum of fields it comprises.

A team of students with the judge who tasted their food in the Food Challenge session.





A young participant and her dad work to build their robot during the Lego Mindstorm session.

“We really have a strong belief in our family unit in the college. And it was an opportunity for our alumni to have that inter-generational experience—to bring grand-kids, kids, nieces and nephews, cousins (I’ve seen cousins come back to campus) and have that live-in, on-campus, educational, hands-on experience.”

Planners made sure there was time in the evening where families could walk around campus with their kids or grand-kids to show them the different buildings, dorms, classrooms, etc., they used to go to when they were on campus.

“We’re very science-based; we have a lot of students that will come here to go on to medical school, to go on to vet school, to go on to do other things outside of necessarily the ag field... Especially in our Human Development and Family Studies—I mean, they’re working in hospitals. It’s just such a wide range... We really do touch all spectrums.”

In addition to the medical field, Veal indicates that ACES also uses and teaches technology, such as computer science, GPS. She indicates that there's a new curriculum starting in crop sciences next year that's computer-science based.

“You look at all of the technology that goes into ag engineering and that goes into our crops—You know, we have tractors that drive themselves, that are GPS-based, drones are GPS-based. Agriculture is very much changing; I think that's something that's important for people to understand, and know that those type of career opportunities are available for kids within our college.”

In addition to introducing alums to the “new ACES,” Veal indicates that another goal was to provide family-oriented activities.

“It is so fun,” Veal explains, “because the kids are like ‘I saw where my grandma lived,’ so they really are having that inter-generational experience where they’re sharing the ACES story with their kids.”

Veal, who has experience working with youngsters via 4-H, says that's what got her interested in developing this program, with the goal of recruiting kids into STEM and into ACES.

“Because I had worked with that younger audience, I knew that there was an opportunity here to be able to showcase our college to a younger generation and hopefully get them excited about STEM, science, engineering, food, and to help them to be able to know that maybe this is a place that they would want to come when they graduate...when they want to go to college.”



Tina Veal, Director of ACES Family Academies.

CENTENNIAL HIGH AVID STUDENTS PRESENT IRISE ENGINEERING PROJECTS AT PYGMALION FESTIVAL

November 7, 2017

What do My Fair Lady, Pretty Woman, Family Guy, and Centennial High AVID students have in common? Pygmalion, a play created by George Bernard Shaw. The first three (or at least an episode or two) were based on the tale of Eliza Doolittle and Professor Henry Higgins, who wants to make Eliza into a proper high-society lady to illustrate the point that no matter the social standing or different way of speaking, all people are the same. Similarly, the Pygmalion Arts Festival, held at the Krannert Center for the Performing Arts from September 20–24, strives to convey a similar message by showcasing all that Champaign-Urbana has to offer, from local bands, to eateries, to innovators and entrepreneurs who work right around the corner. The AVID students who were part of the iRISE-Centennial High partnership fit into this category, and thus were invited to present their projects featuring motor-controlled wheelchairs at the Festival on September 21st.

According to the Festival website, “You can speak directly with innovators and entrepreneurs that build here.” That was the idea behind inviting the students—both the high schoolers and the iRISE graduate students (as well as their teachers and professors) to present their final projects to the public. A part of iRISE’s partnership with the AVID program at Centennial High School in Champaign, the previous semester, these high schoolers had built working models of motored wheelchairs for use in wheelchair basketball. This had been done under the mentorship of several University of Illinois engineering graduate students, who were introduced to the outreach opportunity by the iRISE program. They

had all taken iRISE course (ME598 course rubric), which engages grad students from across campus in conversations around issues of power, privilege, and identity as they pertain to STEM education and outreach, and were then given a chance to change the dialog by mentoring under-served students in Centennial High.

Joe Muskin, the MechSE Educational Outreach Coordinator, who was extremely excited for the general community to see what his students had accomplished, comments on the benefits for both the high schoolers and grad students:

“It’s been fantastic. It’s always great to get students interested in engineering. These students are feeling empowered. Even if they don’t go into engineering, they still gain the ability to do things that aren’t too hard for them... I think it’s great for the grad students because they can kind of give back and be that mentor that they probably had when they were coming up. Experiencing the mentorship firsthand always gets you going through the hard spots.”

MechSE’s Joe Muskin (upper left) looks on as a Centennial student explains about her team’s research during the IRISE 2017 Symposium last spring.



The students also had a more informal poster session at the end of the spring semester the year before. They presented to many other researchers as well as the wheelchair basketball team. The model wheelchairs were a big hit, as was the coding that the students had to work out to make the motors run. Brynne Kenner, a Centennial High School sophomore, explained, “We just coded motors and stuff to make the wheelchair move up and down; a reclining wheel chair. You had to code each motor so it would move a certain way...the most challenging thing was to get it to move up and down because we had two motors, and both motors had to be exactly the same. If something was off, it wouldn't work.”

Muskin explained that AVID and iRISE were invited to the event in order to show off how far the students had come in a short semester the year before. He remarked:

“They're now bringing it to the community. What's really cool is it went from graduate students to high school students, and now it's going from high school students to the general community. Now the high school students are the teachers...”

He felt very confident about the abilities of his students to present what they had learned.



DJ Jackson (right), Centennial sophomore, walks his mom, Antonia Jackson, through the project's code.

Tiari Hunter, another sophomore at Centennial High School, was certainly not worried about the prospect of presenting her project to the public. She reflected on her experience coding the robot:

“I'm not scared, I think it's an amazing opportunity that was given to me. I think I could show other people how cool it is and that they could do it too.”

Hunter still was not sure about her career path, but definitely wanted to continue coding as a hobby.

The grad students involved with the project through

iRISE were an amazing resource for these students. Many of them love working with high schoolers and exposing them to the sciences as a career path, without all the dull homework that school would provide. One grad student, Kazem Alidoost, said, “...I think it's important to support the community and support the kids who are there. They're super brilliant.” Professor Elif Ertekin, who works closely with the grad students, loved mentoring all the students she had contact with. She exclaimed:

“Every time I work with them, I find it really inspiring how enthusiastic and dedicated they are to what they're doing, and how they throw themselves into new activities and they're eager to learn... It's inspiring and motivating to be able to watch and see that.”



Tiari Hunter, a Centennial High School sophomore, checks her project's code.

Another professor, Professor Matthias Grosse Perdekamp, had a slightly different motivation to try to get these students involved in science. He said, "On the educational side, I think that my motivation is that wealth that we have in western societies can be used to solve significant problems that we are facing in the future. [Our ability to] Largely stems from our knowledge of science and technology." He continued on to say, "There is what I would call a strong disinterest in science and technology in young Americans." The most important part of these camps is to get young students in contact with science.

Professor Grosse Perdekamp loved teaching and getting to know all the students in his group. He complimented:

"We have very smart kids. I think all it takes is to somehow get them interested. I think they do well once their interest is sparked. They are certainly capable of doing it and doing it well."

He worked specifically with a student named Zip, who joined his physics research group studying particle and nuclear physics through the Physics Young Scholars program, which is under the umbrella of iRISE. Professor Grosse Perdekamp helped Zip present his findings at the festival, while also relating how the results helped the graduate students' research as well.

Antonia Jackson, parent of DJ Jackson, a sophomore at Centennial High School, had nothing

but praise for the program. She was extremely excited when DJ came home and told her that he would be programming robots for a project for iRISE. DJ had always been involved with robotics and coding and was excited to put his previous experiences to work in building the wheelchair. When asked to comment on how the iRISE program had helped her son, Jackson replied:

"I'm just really excited about iRISE and the way that it puts the kids in the path of a lot of great people. It allows them to run into people that they may not have run into before and really see what life after high school looks like."

The iRISE presentations at the Pygmalion Arts Festival were a resounding success. They allowed high school students who had become experts on the programming and testing of small motors to then present their findings and interest to the public. In an age where the advance of technology is so fast-paced, it is encouraging to see that teachers and older students can help younger students become true experts in the emerging technologies. Not all of these students will now necessarily go into the sciences or engineering. However, as Professor Grosse Perdekamp remarked:

"...I should say that it's not science or engineering only, it's the humanities and many other disciplines are important. So I think it's successful if a good fraction of our students end up being interested in science. That's what we really aim for."

It is up to the student to decide where their interests lie and what they want to make a career. iRISE's intention is simply to get students in contact with these sciences in order to better inform their choice.

Written by: Nick O'Connell

STEAM STUDIO USES SCIENCE, TECHNOLOGY, AND ART TO GO “VIRTUALLY SPELUNKING” IN CAVES—EXPLORING EVERYTHING FROM SPIDERS TO BATS TO 3D CAVE PAINTING TO GPS

November 16, 2017

It all started with a unit on insects. Then, not to overlook them, spiders were given equal coverage. Then one thing led to another, until recently, STEAM Studio, Next Generation School’s after-school program which incorporates art into STEM (Science, Technology, Engineering, ART, and Mathematics), just finished doing an entire unit on caves which incorporated everything from identifying types of caves and how they’re formed, to sonar (how bats navigate through caves), to 3D cave painting, to exploring the world’s caves through both GPS and virtual tours, and more.

STEAM Studio is an after-school program that specifically tries to instill into its students a love and appreciation for experimentation. Every unit it covers in class includes some a78 hands-on project that provides real context for the different topics the unit covers. For example, while talking about spiders, students created a habitat in which they thought a spider would be comfortable living. They were asked, “Ok, why did you make this choice? Why do you think a spider would prefer this to this?” The designs became silly fairly quickly, with miniature beds made from wood and cotton balls springing up alongside a carpet of leaves. Nevertheless, students took pride in the projects and couldn’t wait to work on them when coming in after school.

One of the best things about STEAM Studio is its innovation and creativity in how it draws students into the unit they are covering. There are not many caves in the Urbana-Champaign area, but teachers pulled out all stops to fully immerse the kids in the experience. They learned about equipment required for spelunking and how to stay safe, built headlamps in their makers’ lab, and even stepped into some amazing virtual reality caves. According to Angela Nelson, the director of STEAM Studio:



A STEAM studio youngster prepares to glue “eyeballs” to felt as he makes a bat during a bat-making hands-on activity.

“We might not be able to fully get there [visit a real cave], but at least we can give them all these different opportunities and experiences that relate to it.”



STEAM Studio director Angela Nelson instructs her students on how to make a spelunking headlamp (complete with a working LED light) during a cave unit hands-on activity.

Nelson originally started at STEAM Studio in 2014. In her four years of leadership, she has seen the classes at the program grow from a single class of 16 Zeptos (kindergarten to second graders) and 6 Terras (third graders to fifth graders) into three classes: Zepto and Nano (both serve K–2nd graders) and Tera (3rd–5th graders).

“STEAM Studio truly is my passion, and every year I feel like we grow that little bit more, and it becomes bigger and bigger,” she admits.

A teacher before coming to STEAM Studio, Nelson compares her previous teaching experiences to working with STEAM Studio:

“I’ve taught in schools, too and, unfortunately, you have the parameters of a curriculum and materials you have to cover, so there’s not always as much opportunity just to explore and discover and figure it out and question.”

At STEAM Studio, students are given the freedom to explore what interests them instead of being constrained to learn the curriculum a school board has chosen.

What is amazing about the Studio’s philosophy and pedagogy is how much the teachers listen to the kids and tailor the lessons based on the students’ interests. For example, if students are bored with insects, they can suggest another topic that they would like to learn about. An example would be when the students wanted to learn about tornadoes. Diving deep into a weather pattern that frequently appeared on news and weather stations was something the entire class was eager to explore, so

Nelson and her teachers created a camp day focused on weather to conduct experiments and participate in activities based on their questions and curiosities.

Another example of the amazing influence that students have over their learning curriculum is a very cool experiment that kicked off the cave unit at STEAM Studio. Students were asked how they thought caves and various formations in those caves form. After they answered, they were given an enormous salt block half a meter across and told to test their hypotheses. Nelson remarks on the students’ involvement,



STEAM studio instructor Matthew Bannon works with the children during a bat-making hands-on activity.



A STEAM studio youngster exhibits the bat she made during one hands-on activity.

“A big part of this is that we want the kids' voice[s] in it...”

She continues that a common theory regarding cave formation is that a constant drip of water can create different cave formations, such as stalactites and stalagmites. Since salt dissolves much faster than rock, students were able to set up an experiment with their salt blocks that tested whether and how these formations are created from water runoff.

An unusual facet of the cave unit is not just related to science, technology, engineering or math (STEM). That's where the "A" in

STEAM comes in: art. When one thinks of caves throughout history, cave paintings have always been a major reflection of a people's story. So students at STEAM Studio had an amazing opportunity in their curriculum to paint in 3D on cave walls via virtual reality.

The Illinois VR Lab they visited is part of CITL's (Center for Innovation in Teaching & Learning) iFLEX initiative to build active learning classrooms around campus. In the case of the cave unit, the technology allowed the kids to see their paintings come to life on cave walls, explore the world's caves via GPS, take a tour of a real cave via virtual reality, and 3D print some cave formations. Jim Wentworth, an eLearning professional supervising the lab and its Innovation Studio, worked with the students as they explored various caves throughout the world both through Google Earth and YouTube 360 videos using the TechHub portion of the Armory Innovation Spaces:

“We built these spaces with the idea for putting these technologies in the hands of students of all ages, and so it's fun to see young kids and undergrads alike coming in and figuring out how to use these technologies,” he explains.

Students even 3D printed some of the more complex cave formations they had been learning about. Jamie Nelson, a senior eLearning professional at the Armory Innovation Studio, helped the students design and 3-D print these

In one section of STEAM Caverns, visitors could see some of the stalactites and stalagmites the students created.





A STEAM studio youngster "explores" an actual cave via virtual reality at the CITL's Armory TechHub.

STEAM Studio might carry over into their later lives, Nelson says,

"A big component of STEAM Studio is we want to open up their eyes to all the possibilities out there."

She indicates that many of the jobs for which these kids will be applying don't even exist yet, and technology is advancing so quickly that most of the current, state-of-the-art tech out there will be obsolete in a few years. So perhaps the most important skills that students learn at the Studio are how to be curious and creatively solve problems.

formations, and also enjoyed guiding the kids through the process of painting in VR. He commented,

"This space, the benefit I imagine... for everyone is just early exposure to technology and how it impacts teaching and learning."

As one of the last parts of the unit on caves, students built their own cave out of cardboard and other building materials. Once the mammoth cave was constructed, photos of the paintings they had created in the VR Lab adorned its walls. Then, once the unit was completed, to celebrate all they had accomplished, guests (including parents) were invited to STEAM Studio on November 14 and 15 to view their beautiful cave while students explain the portions they had designed and painted.

For fifth graders leaving the program, many question what they want to do when they grow up. While discussing how the skills and lessons that students learn at the

When asked why she does all this for her students, Nelson replies,

"The big reason is to give students experiences in real life that they can start to take further than their own personal experiences and start to see the connections between the fields of science, technology, engineering, art, and math."

Written by: Nick O'Connell



At TechHub in the Armory, a TechHub worker, Lisette Chapa, watches as a STEAM studio youngster makes a cave painting via Virtual Reality.

YANKEE RIDGE AFTER-SCHOOL PROGRAM TAKES OFF UNDER GUIDANCE OF ILLINOIS AEROSPACE ENGINEERING STUDENTS

November 27, 2017

Know what thrust is? Lift? How about Drag? A group of 15 or so students at Yankee Ridge Elementary School now know a bit more about these forces that keep aircraft aloft, thanks to several Illinois Aerospace Engineering students. For four Wednesdays in a row (from October 18th through November 8th), these members of Illini Aerospace Outreach dropped by the After-School Enrichment Program at Yankee Ridge to impart some of their knowledge about flight to the students.

Each week, the excited K–5th grade students did a hands-on activity during which they built four different machines (week one: a glider; week two: a helicopter; week three: a parachute; and week four: a wind turbine), during which they also learned about the forces (thrust, lift, drag, and weight [gravity + mass]) that act upon these objects, causing them to fly (or crash), or in the case of the turbine, to turn and create energy.

Then, each week, after the youngsters had designed and built their projects, the Illinois students hooked up some box fans so the kids could test their designs to see how well they



Jenna Commisso demonstrates to students how to build a glider.

worked. The young participants then had the option of making some slight adjustments, then testing their project again, if time permitted. For instance, in the wind turbine activity on the last Wednesday, modifications, other than completely designing a new shape of blade, including respacing the blades, or modifying their angle in order to encounter more wind resistance.

Helping to teach the students some aeronautical engineering principles was Jenna Commisso, a junior in aerospace, whose dream job is to be an astronaut. Commisso volunteered to be involved in the Yankee Ridge outreach because she was very involved in the community at her old college, and when she transferred here, she wanted to get involved in this community as well. "I think it's nice to have that sense of community while also getting the kids engaged in aerospace-related topics," she explains, then adds, "It's really awesome that they have this resource of the university."

While she indicates that it was hard to explain some of the topics she



A Yankee Ridge student prepares his parachute for launch.

Commisso watches a group of students test their helicopters.



was trying to convey to youngsters at this young of an age, she says that at times during the hour-long outreach, she'd been pleasantly surprised.

"If I say something," she explains, "there's some of them that are like, 'Yep! That's it!' They know a lot of information, and it's really cool that they know this much at this age."

Regarding the benefit of doing a program like this with youngsters, Commisso says one positive impact is that they're being exposed to role models like herself and the other Illinois students.

"It's really important that they see people that they look up to doing these things," she stresses. "That way they know it's within reach."

She also believes that it's never too early to introduce kids to the idea that they, too can go to college.

"Even at this age, that can be a goal, like going to college. That's something they see, and they can have that in their head while they're going through school."

Regarding the impact the outreach had on her, Commisso says, "This

was a great opportunity, really fun, and I loved doing it."

According to Alexis Jones, the Coordinator of the Yankee Ridge's After-School Enrichment Program who organized the aerospace event, she indicates that the kinds of things they're trying to include for enrichment are activities that might be "related to school, but they're not things they'll get during the regular school day," she explains, adding that they intentionally chose this topic because it was related to engineering. "There are kids in the classroom who are really interested in how things work and why things work certain ways."

"The more STEM things we can get, the better," she adds, acknowledging that they also do non-STEM activities as well.

Jones adds that in her role as Coordinator, she tried to reach out to a lot of the university organizations that do outreach, and anyone that tries to do work in schools.

"The schools have work for them to do that the kids get really excited about," she explains, adding that, "Aerospace was one of the most popular classes this semester, and it had to turn down kids."

(Sadly, this reporter was quite aware of this. My grandson, who says he wants to be an engineer, was one of the kids who got turned down).

An IAO member instructs Yankee Ridge students on Aircraft Components.



LOCAL HIGH SCHOOLERS LEARN ABOUT BIOENGINEERING DURING BMES' BIOENGINEER YOUR IMPACT OUTREACH

November 30, 2017

Excited about discovering what studying Bioengineering at Illinois might be like, as well as exploring career options in the field, 20 high school students visited campus on Saturday, November 11 to participate in the second annual Bioengineer Your Impact outreach, hosted by BMES, Illinois' chapter of the Biomedical Engineering Society. During the event, the students participated in several activities designed to show them how fun and exciting the field can be, including a panel of current Illinois Bioengineering students, talks by reps from several local startup companies, and a challenging hands-on activity about the heart.

One highlight of the outreach was a student panel during which the young visitors eagerly fired questions at the Illinois students on the panel, who just as eagerly answered their questions, describing what it's like to be a student in Bioengineering, what they're specializing in, and what their career goals are. Because the students on the panel were preparing

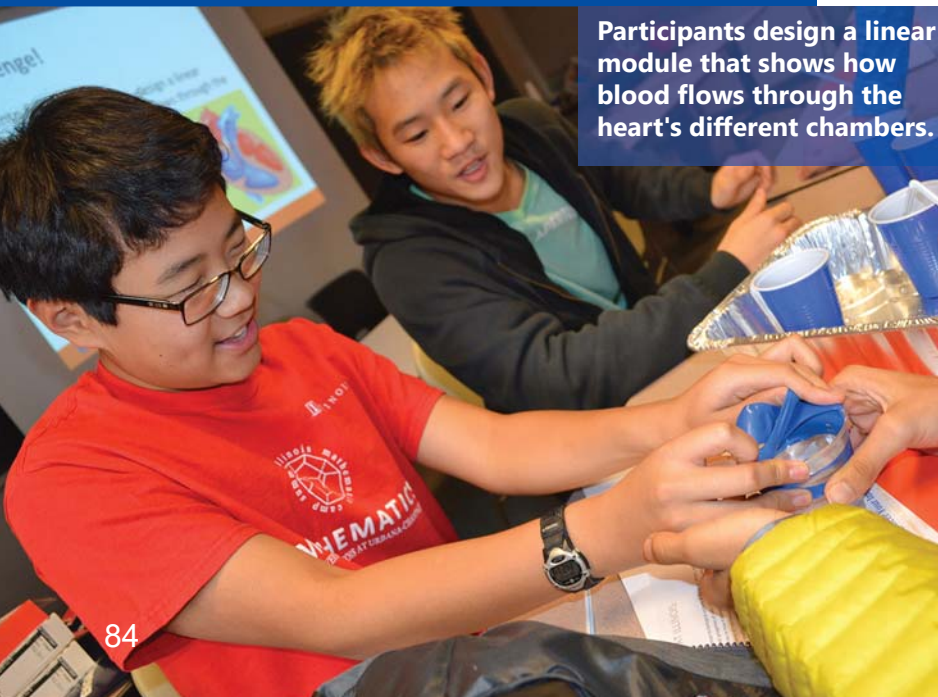


An Illinois Bioengineering freshman Sabeen Rahman (right) interacts with a "Bioengineer Your Impact" participant during the heart hands-on activity.

for careers in a wide range of areas, this gave the younger students a better idea of the range of diverse areas that comprise Bioengineering. Plus, the panelists also gave the high school students lots of unsolicited advice, such as what kinds of courses to take in preparation for college and how to make themselves (and their resumes) attractive to recruiters, both while applying to college and when job hunting.

Joy Chen, the Bioengineering freshman who organized the event, believes the student panel was extremely beneficial because the high schoolers were:

"Really able to talk to the Illinois students, and have the students answer their questions about bioengineering or what you can do with bioengineering. Because a lot of people don't know what you can do with it or what it incorporates. In reality, it incorporates a lot of different things."



Participants design a linear module that shows how blood flows through the heart's different chambers.

"So all the students we chose here today," she continues, "were from various tracks and want to pursue different things after college. I feel like that gave all the students a well-rounded view of what bioengineering does encompass."

Also helping to clarify exactly what bioengineering is were several guest speakers from Illinois Research Park startup companies: Psyonic, Jump, and PhantomCor. Psyonic builds low-cost prostheses, so even people in third-world countries can have access to the technology. Jump is a simulation company that also works with the new medical school that is starting here at Illinois. PhantomCor is startup that started with an EOH (Engineering Open House) project. Chen goes on to explain that BMES participates in EOH every year, and one of their projects was designing a phantom heart.

"What's really cool is seeing that project come to life into a start up," she says. "The people giving the talk were students here!"

Held at the Digital Computer Laboratory (DCL), home of Illinois' Bioengineering Department, Bioengineering Your Impact also included a tour

A team of high school students completes their hands-on activity.



of DCL labs. Plus, for the final activity of the day, students were divided into groups for a hands-on activity about the heart, where the students got an opportunity to practice teamwork while learning to think like bioengineers.

Chen reports that the goal of the outreach was "to reach out to high schoolers and teach them all about bioengineering."

To Chen's delight, a lot of kids at the event were from the local high school she attended, University Laboratory High School (Uni High). To be specific, Uni High is a bit more than just a local school; it's actually right next door—just to the east of the DCL. Chen found their participation in the event to be really exciting.

"I went to high school with them," she explains, "and now I can teach them about what I'm doing here in college... I used to be friends with a lot of these kids, and now I'm here in college with different experiences to share with them."

"I really love events like these where I get to interact with high schoolers coming into college and determining what they want to do," she adds.

Several Illinois students share during the student panel session.



VISITORS OF ALL AGES HAVE FUN WITH DNA, GENOMICS AT IGB'S GENOME DAY

November 30, 2017

Genes vs. genomes: it seems that one needs a biology degree to tell the difference. One thing is for sure, however—neither of them are made of denim! Hundreds of people attending this year's Genome Day, an event sponsored by the Carl R. Woese Institute for Genomic Biology (IGB), learned the difference through many fun and engaging activities supplied by over a hundred Illinois students, staff, and researchers throughout the afternoon of Saturday, November 11th. The purpose of the event? To educate the community, especially K–5th graders, on the topics of genes, genomes, and evolution. Participants could build 3D models of DNA, explore the Tree of Life to figure out how closely different species are related, and even extract strawberry DNA to make flavored candy necklaces.

Each child was given a “passport” when they walked in the door of the Orpheum Children's Science Museum in downtown Champaign for Genome Day. A message was encoded onto



Participants take a look at bacteria at the Colorful Bacteria activity using magnifying glasses.

the sheet of paper that was only revealed when participants completed all the activities scattered at different tables around the room. Although the activities were mainly aimed towards K–5th graders, the free event was an amazing opportunity for people of all ages to learn more about biology in general...as well as a great opportunity to grab candy! A few of the afternoon's activities are listed below:

1. Design a Superhero
2. Colorful Bacteria
3. Punnett Eggs
4. Create Your Own Fruit
5. Delicious DNA
6. Dancing Plants
7. How Are Mammals Related?

Genome Day was a great opportunity to expose students not only to genomics, but to the University of Illinois. For instance, Herbert Duane Burnett, a Masters student at EIU, took his Leadership Development Academy (LDA) class from JW Eater Junior High School to Genome Day in order to broaden their horizons. Burnett wanted his



A local youngster at the Create Your Own Fruit activity booth at Genome Day 2017.



Herbert Duane Burnett, Masters student at EIU, attended Genome Day with his class.

students to be exposed to all the advantages that living next to a Big 10 university offers.

"I feel there is such a disconnect between the community and the college," Burnett admitted. "And now that I'm back I just want to connect the dots. It takes a village, and it would be a tragedy for me to know that this awesome college is here, top in engineering and other areas, and the kids in its backyard don't know anything about it."

When asked about the benefit of bringing his students to Genome Day, he replied, "Let them see successful college people, professors, [and] teachers. And just to broaden their mindset."

Burnett was hopeful that the exposure to STEM would get some of his students interested in the sciences and perhaps give them the inspiration to pursue a career in one of the various fields.

Connecting the dots was a popular reason for both attending and volunteering at Genome Day. For instance, working at the "Colorful Bacteria" table was Preston Hills-Rieck, a second year grad student

working towards his Ph.D. in chemistry. He indicated:

"I love being able to teach the broader community about science and how it is helpful. It's nice to be able to connect the dots for people that don't work with it every day."

At his table, participants could view artificially colored cultures of bacteria up close with a magnifying glass.

The volunteers at Genome Day were very enthusiastic to show kids all the different ways DNA affects their daily lives, from the plants they hate to eat, to the animals they love to play with. They hoped to take the many topics of science that Genome Day covers and reduce them to their simplest forms so that science lovers of all ages could grasp the concepts.

Many volunteers were also motivated to donate their time and energy to Genome Day in order to do a little recruiting to their field—to get the next generation of scientists, researchers, professors and engineers interested in the sciences as early as possible.

This was the case with Kelley Guncalvis, a third year Microbiology Ph.D. student from Brazil who was working at the "Punnett Eggs" table. At the "Punnett Eggs" table, participants were encouraged to use Punnett squares to predict the traits of the offspring of the candy found in the egg they had picked up. (Candy appeared to be a pervasive theme throughout Genome Day.)



A group of youngsters show interest in different material displayed at the activity booth.



A group of youngsters make DNA structures out of candy at the Delicious DNA activity booth.

Staffing the “Punnett Eggs” table at Genome Day was Guncalvis’ first foray into outreach; she had had no previous experience volunteering and working with younger students.

“I’m trying to interact with small kids and make them learn and get fascinated about science and show my passion about science,” she admitted.

Guncalvis hopes to make a career of sharing her passion for science; when asked what her dream job would be, she responded, “If I could be a university professor with a lab, and teach at the same time, that’d be great.”

An undergraduate researcher working at the “How Are Mammals Related?” table, Aishwarya Raj, was very excited to volunteer at Genome Day because she had a lot of experience with outreach in her high school years.

“So I thought it’d be really interesting to teach kids about genomic research too,” Raj explains. “And when I was in high school, I used to teach a lot of kids and do programs at other high schools.”

As both Raj and Guncalvis show, volunteers can come from many different backgrounds to devote their time to educating the community. Raj has worked hard to get her position as an undergraduate researcher. She emailed many different professors whose work she was interested in and was able to secure a position as a researcher under her current professor, who then pointed her in the direction of Genome Day as an excellent opportunity to continue the outreach she had thrived on in high school.

One of the more popular activities at Genome Day was the table Raj was working, “How Are Mammals Related?” She showed attendees a simplified version of the Phylogenetic Tree, which shows how closely related to one another animals are in terms of their DNA. Humans are 99% similar to each other generally, with about a 1% difference creating all the diversity and uniqueness in our species. Using animal crackers, children and parents alike had fun figuring out their relationships with monkeys, giraffes, zebras, and elephants, oh my! A

Thanksgiving meal with this truly extended family might end with the turkey being stolen!

IGB’s Genome Day educated hundreds of people about genes, genomics, and DNA through many fun and engaging activities. Students, parents, and volunteers alike came to foster a love of science and biology in all participants, not just the K–5th graders the day was geared towards. The most important part of the learning? Having fun!

Story by: Nick O’Connell



Students and volunteer staff at Genome Day 2017.

MATTIA GAZZOLA'S PAPER2TREE: A 3-STEP PROGRAM TO GIVE BACK TO ONE'S COMMUNITY: PUBLISH A PAPER → PLANT A TREE → AND PERFORM A SCHOOL OUTREACH

December 1, 2017

While appreciating the beauty of nature on his 20-minute jaunt from his home in west Urbana to campus every day, Mechanical Science & Engineering (MechSE) Assistant Professor Mattia Gazzola decided that just gazing at trees and being refreshed in his soul wasn't enough. He felt he needed to counteract one of the negative effects of his job—publishing papers that, over the life of his career would, in all probability, take the lives of a number of trees. So he came up with Paper2Tree, a practical way for those in academia to not just take, but to give back by planting real trees to replace the ones destroyed while practicing their profession and working with schools to expose more youngsters to STEM.

Vis-à-vis his daily trek through Urbana's Carle Park, Gazzola admits, "It's nice, and there are a lot of trees...I spend a lot of time looking at trees. So at one point I was thinking maybe I could invest some time to do something useful. So I was thinking about maybe, from a scientific perspective, what I could do," then goes on to share his acorn of an idea:



Mattia Gazzola (bottom right), along with students from King School, next to the Swamp White Oak he planted in Carle Park as part of his Paper2Tree initiative.

Admittedly, Gazzola recognizes that as a researcher and professor who publishes papers for a living, he goes through a lot of the stuff:

"Some time ago, I realized that for every article I publish, I use many, many sheets of paper: writing, re-writing, reviewing, correcting...and I thought, 'What if we could reverse that? What if we could plant a tree every time a good paper comes out—and at the same time celebrate and share it with the wider public?'"



A City of Urbana arborist shows King fifth graders the "Under the Canopy" publication they developed about Illinois trees.

Regarding this prospective tree, Gazzola waxes poetic on his website, envisioning it as: "A tree that will grow together with the scientific reach of the research."

But he shoved the idea to the back burner until, on the Urbana Park District's website, he discovered that they had a tree-planting program—such as to celebrate a child's birthday. That's when he had his epiphany:



A BTW fourth grader poses with Champaign Mayor Deborah Feinen (center) and Professor Mattia Gazzola (right).

“Why not combine the research that is done here, and the outreach, so that you can have an outreach experience outside, and plant a tree, and use this tool to broadcast what happens here at the university?”

So Gazzola did his homework. He broached the idea with MechSE’s Educational Outreach Coordinator, Joe Muskin, and Julia Stackler, the Assistant Director of Communications in MechSE’s Media Office. Both liked the idea. So they approached the head of the department, who also liked it. Finally, they pitched the idea to the City of Champaign, the City of Urbana, plus the Champaign and Urbana park districts, who liked the idea too. So the Paper2Tree program germinated, sprouted, and began to push up through the ground.

One nice thing about Gazzola’s notion—compensating for paper used by planting a tree—was that he didn’t have to reinvent the wheel when it came to planting the trees... both local park districts have tree-planting programs in place. There is a fee (around \$200–\$300) to pay for the tree itself and to pay the park district for the manpower to not only plant the tree, but to care for it for the next 10 years. Plus, if it dies during the 10-year period, they’ll replace it.

“We just needed to use what they do already and then channel it in a different direction,” Gazzola explains.

So after doing his research and getting the go-ahead from all the partners involved, he bought and set up a website: <https://paper2tree.org/>. It will allow faculty to sign up for the program, pick a city (presumably their city of residence: Champaign or Urbana), pick a specific spot for the tree, then be redirected to the park district website to pay. A fun perk: anyone who plants a tree through the Paper2Tree program will actually be able to see it on the website via GPS—geolocated, visualized on a map, and organized in “science groves.” (As an indicator of the high-tech world in which we live: according to Gazzola, “For now there are no signs on the trees, but they all have a GPS signature so they can be seen on the map.”)

Then, on November 16, during the Paper2Tree kickoff event, Gazzola put his money where his mouth is. He had a Swamp White Oak tree planted in Urbana, next to Martin Luther King School. The paper? “It’s called, “Scaling Macroscopic Aquatic Locomotion,” he explains. “That’s the first paper to go to tree.”

Also compensating for his paper footprint was MechSE Assistant Professor Chenhui Shao, who had a tree planted in Champaign’s Douglass Park, not far from Booker T. Washington STEM Academy, in honor of his paper, “Dynamic Sampling Design for Characterizing Spatiotemporal Processes in Manufacturing.” (The Champaign Park District might want to rethink their tree selection process, however, given that this is Illini country. The tree they chose to plant was a Buckeye.)



King fifth graders cheer on a classmate who successfully completed Shao's cookie puzzle activity.

With the first two aspects of his three-step approach taken care of (writing a research paper then planting a tree), Gazzola then concentrated on the third part: fostering research-related outreach to local schools. So he contacted the Champaign and the Urbana school districts who are partnering with Paper2Tree in order to facilitate outreach events connected to the papers.

Why outreach events with schools? For one, Gazzola hopes to increase the diversity in STEM.

“One of the reasons I'm pushing so much for the outreach,” he admits, “is because you want to engage, for example, more and more women or minorities...Women are not usually introduced to these types of fields, and this is one way to introduce them to what technology and science is. And that they can actually make something useful and it can be fun and interesting.”



BTW fourth graders show off their completed gliders.

“There is this idea that this is very hard to do, unlike other subjects. But that's not true, you can do all of them. It's just seeing and trying it. This is a way to show them that it's not impossible. It's set up as kind of a game so they don't have pressure doing these things, but can still experience them.”



MechSE Assistant Professor Chenhui Shao interacts with a King fifth grader.

Gazzola also believes this third step—fostering outreach to local schools—provides the rationale for getting outreach-minded but not necessarily environmentally conscientious faculty to shell out \$300 to be involved in Paper2Tree.

“You have to offer some incentive to faculty to use this program,” he admits, “Because otherwise they say, ‘Why should I pay \$300 for no reason?’”

What better incentive than the bottom line? Gazzola figures the outreach aspect will appeal to faculty who are constantly writing proposals to funders like NSF, for whom outreach has become increasingly important: “

So we have pressure to come up with outreach programs,” he acknowledges, “and it makes sense to involve the community. People are always looking for opportunities to do that, and here is a low-barrier opportunity that we provide to faculty. They can say, ‘Okay, I published this paper. I can pay this fee and have a tree planted, and this Paper2Tree involves the park district, the school district, and the university, of course.’”

So he'd like to see kids exposed to a wide variety of STEM areas early on: “If you're exposed to several of these outreaches throughout your studies, you will have a broader view of what your options are or find something that you particularly like.”

Plus, he also hopes to dispel the myth kids often have that STEM is too difficult for them.



MechSE Assistant Professor Amy LaViers leads King fifth graders through several activities related to her research, including robotic movement and flocking.

So to announce the program and to demonstrate how outreach activities related to research papers could tie in to the program, during the Paper2Tree kickoff event, Gazzola and several MechSE colleagues provided outreach activities in local schools. For instance, at Shalonda Carr's fifth grade class at Urbana's Martin Luther King Jr. Elementary School, Assistant Professor Amy LaViers led several activities related to her research, robotic movement and flocking. Then Assistant Professor Chenhui Shao led Carr's students in a cookie puzzle activity. And to add to the fun, after the activity, they got to eat the cookies. Then, to top it all off, the students got to help plant Gazzola's swamp oak tree.

The afternoon's festivities took place at Champaign's Booker T. Washington STEM Academy courtesy of BTW's STEM Specialist Loren Johnson. BTW fourth graders were exposed to Gazzola's research during a robotic fish activity, and Assistant Professor Aimy Wissa and some of her students led fourth graders in building bio-inspired gliders which actually flew...some quite well. To cap off the afternoon activities, Shao's tree was planted as Champaign's mayor, Deborah Feinen, and other dignitaries looked on.

But Paper2Tree outreach has another, even deeper layer. Materials related to the outreach activities will be available on an activity module section of the website.

"Let's say a high school teacher wants to replicate the activity," Gazzola explains. "All the material and instructions are on the website. The activities are different; some are related to manufacturing, robotics, and simulations. But all these professors have to think about how to engage with students. It's gonna' be made available, so if someone likes it and finds it interesting, they can replicate it."

Were the Paper2Tree program to spread beyond the borders of Champaign-Urbana, Gazzola would thrilled.

"We are thinking of expanding it. If there's interest, we want to grow, first to our neighboring cities around here. But there is a friend of mine, he wants to in Ohio. It might become interesting. Ideally, it would be nice that you could put in your zip code and it tells you the park districts."

So Paper2Tree is a nice vehicle that is already set up for publishing professors to give back to the community. "Yeah. That's the idea," Gazzola acknowledges. "If you think about it, the papers—the minimum cost for a paper is one student working for one year. But that's never the case, it's more than that... \$300 is not very much compared to the actual investment in your paper."

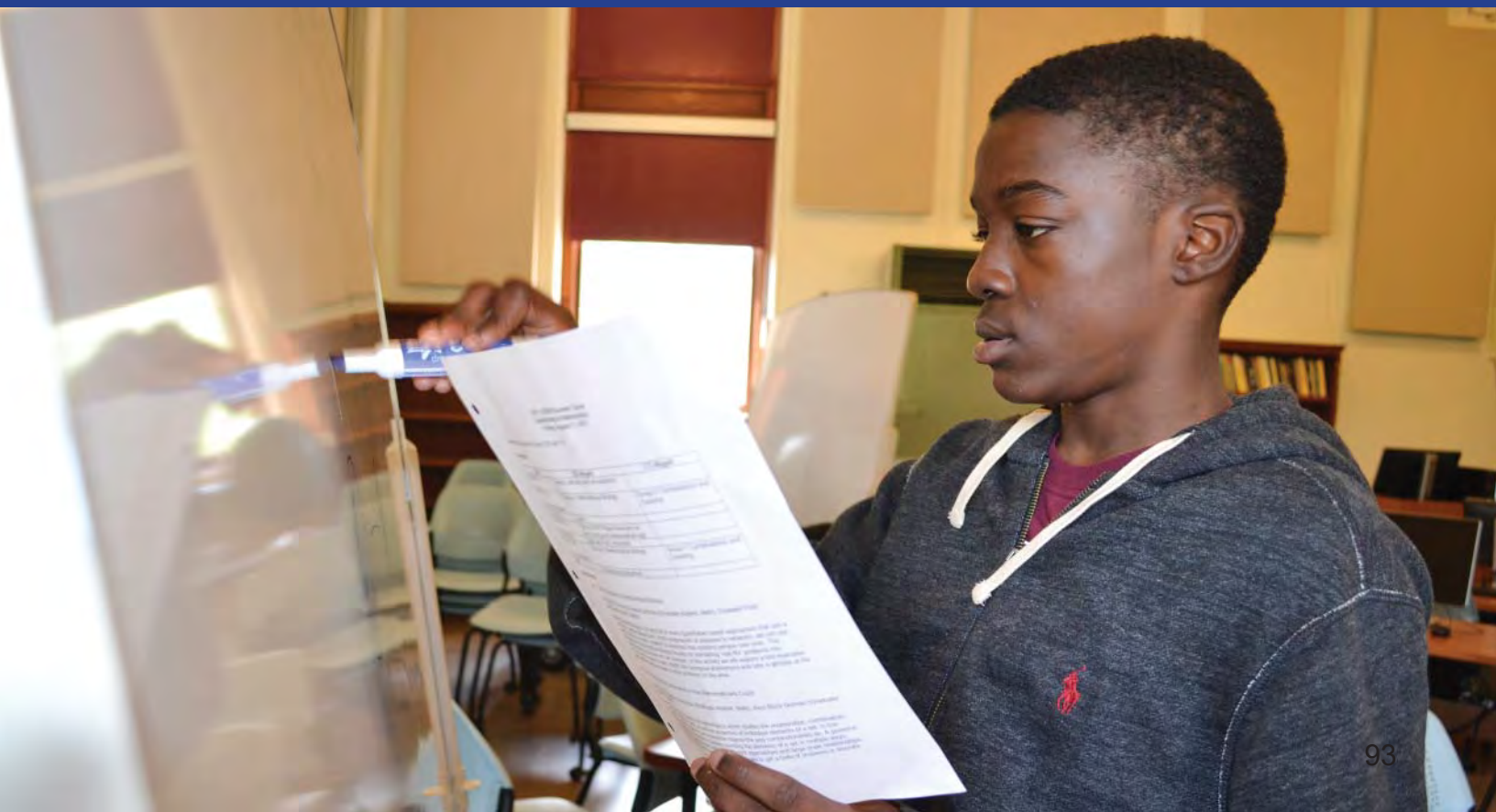
But the professors don't just give; they get something out of it too. Sure, there's some hoopla celebrating their publication, plus some free publicity. "In my mind, if you publish a nice paper, it's going to be at an outreach event; it's gonna be advertised on our website," Gazzola explains. "So my idea is to have little sections for each activity which you see the person that sponsors it and a summary of their life and activities." But even more importantly, publishing professors get the satisfaction of knowing that, in addition to adding some extra oxygen to the atmosphere and some extra shade to someone's path, they just might have inspired some youngster to follow in their footsteps.



Some of the many folks who helped plant the Swamp White Oak next to King School.



EDUCATION OUTREACH INITIATIVES TARGETING UNDERREPRESENTED STUDENTS



UHS SCHOLAR-ATHLETES DISCOVER “OMICS,” THE IGB, AT I-STEM’S DNA & HEALTH DAY

March 1, 2017

Taking a break from their regular classes...and the gym, on February 22nd, 63 scholar-athletes from the Urbana High School boys' and girls' basketball teams visited the Institute for Genomic Biology (IGB) on campus to learn about DNA sciences during I-STEM's DNA and Health Day. While learning about DNA and Health via a number of hands-on activities, they also got to interact with some Illinois researchers. During a tour of the IGB, they got hands-on experience with state-of-the-art microscopes and cutting-edge technology. And over a pizza lunch, they discovered some resources available for them should they choose to attend Illinois. What did the students take away from the event? Hopefully the notion that exploring the world of “Omics” is intriguing and fun and that they too could become scientists if they so choose.

According to Illinois researcher Bruce Fouke, DNA sciences have now been dubbed the “Omics.” What are “Omics?” Wiley's online library defines them as the universal detection of genes (genomics), mRNA (transcriptomics), proteins (proteomics) and metabolites (metabolomics) in a specific biological sample.

Why a DNA and Health Day? According to Fouke, Omics are “absolutely fundamental to every single aspect of our daily lives,” both now and in the future. “Everything from energy and the environment, to health care, and even space exploration are all fully dependent on the application of Omics sciences.”

But why would it be important to expose high-schoolers to the Omics? Fouke indicates that:

“Every future health care decision that these students will make, every future decision on food security and grocery shopping, every decision as a citizen scientist when they go to the polls and vote on climate change policies... everything depends on integrated sciences, and the Omics sciences are at the heart of all of this.”

So one purpose of the event was to expose the students to STEM via topics related to DNA and Health, plus Omics research at Illinois. The idea was that as students did fun, hands-on activities about DNA (building DNA models), DNA extraction (extracting DNA from strawberries), DNA to RNA to protein (making paper models of nitrogen bases), science equipment (making a centrifuge), emergence of life and DNA and mutations (using microscopes), cancer (cause, prevention, and treatment), and drug building (building models of molecules), they would not only learn about the subject matter, but begin to feel comfortable with the idea that they too can do science.

Another purpose of the event? To expose the students, many from underserved populations, to the idea that like many of the Illinois researchers at the event, they too could have a career in STEM.

For example, during his presentation, Bruce Fouke, an Illinois professor in both Geology and Microbiology, strongly advocated the notion that students are scholar-athletes, and that they should prepare for careers beyond sports.



A UHS student shows the DNA he extracted from strawberries during one of the DNA & Health Day hands-on activities.

"In our modern-day, globally-connected, sports-crazed society, so often the approach is to say that a student is a great athlete. Then, as an afterthought, it might be mentioned in passing that this same student is in school and that they should also achieve good grades. However, all emphasis and recognition is placed on the "athlete" aspect, and minimal-to-no emphasis is placed on the "scholar" aspect...Both academics and sports endeavors are vitally important, and neither can truly exist without the other....but to constantly short change and deemphasize the "scholar" is a tragic disservice to all students, which ends up threatening their future as well as that of society as a whole."

However, the meat of Fouke's message was an exhortation to students that their time as an athlete would most likely be transient, and that they needed to prepare for a career for the rest of their lives.

"The vast (99%) majority of students will never be professional athletes," explains Fouke, "and thus their livelihoods and future wellbeing absolutely depends on them being scholars first and athletes second. And even for those that do make it to the pros, their bodies will not work forever, and every pro athlete must at some time in their lives depend on the development of their scholarly



Illinois researcher Bruce Fouke speaking to the UHS students.



A UHS student enjoys virtual reality while looking at a honey bee's brain.



A UHS student shows the DNA model he and his teammates made.

life to succeed and survive in our society."

Fouke further emphasized that "both the "scholar" and the "athlete" aspects of a student's life require exactly the same skill set to be successful... dedication, commitment, hard work, diligence, heads-up recognition of everything that is happening around you, learning the rules and playing by the rules, teamwork, mutual respect and sportsmanship."

To help the scholar-athletes see themselves in a career in science, a main strategy of the DNA & Health Day was to expose them to some folks at Illinois. Chemistry undergrads dropped by to do a centrifuge activity; members of REACT also showed up to lead an activity about building molecules.. Plus, the high-schoolers also met some "Omics" researchers at Illinois, like Bruce Fouke. And serving as mentors at each table of students were outreach-minded Ph.D. students, many from MCB (School of Molecular & Cellular Biology) and members of the MCBees graduate student association.

One researcher who took a break from his lab to mentor was Max Baymiller. A Ph.D. student in Biochemistry, his research is in proteomics; he looks at how ancient and essential proteins that write the genetic code have been recently adapted for new functions in the cell.

One reason Baymiller participated was to help students discover that scientists are just regular people.

"I think the biggest benefit they get is just getting to meet scientists, and say 'Hey, these are just normal people like me.'" It lets students be more confident about pursuing STEM careers themselves," says Baymiller.



A UHS student uses a microscope to view some samples in the IGB's training lab.

Like Baymiller, another mentor, Mara Livezey, an MCB Ph.D. student and Outreach Coordinator of the MCBees, also participated in DNA/Health Day in hopes of getting some high-schoolers excited about science:

"I want to increase understanding of and excitement about science in young people. I think high schoolers are the perfect age group to target because they are just starting to think about going to college and what their future might hold. If I can in some way influence them to consider studying a STEM field or get them thinking about a career in STEM, then I have done what I have set out to do. Jobs in STEM have been historically important and will continue to be important for continuing progress worldwide."

He also hoped to promote dialogue: "With so much opposition to science from prominent public figures going on today, I feel like there has never been a more important time to talk to non-scientists about how we know what we know in science."

Baymiller clearly enjoyed interacting with the UHS students. "When I got the directions to an activity wrong," he explains, "and the students in my group corrected me, I was like 'Where are you guys when I'm messing stuff up in lab? We should trade jobs!'"

According to Baymiller, the high-schoolers particularly enjoyed a couple of activities:

"Extracting DNA is always enjoyable," he admits, "because it's messy and gives you this tangible product for a previously hard-to-visualize idea. But, the amazing honey bee brain virtual reality system the IGB has can't be beat; so cool to see real research results be communicated so well!"

Baymiller was referring to an activity students did during the IGB tour that was perfect for today's electronics-savvy teens. Decked out in virtual reality goggles and armed with a game-type controller, students explored images of a honey bee's brain. Another highlight on the tour? Kids got their hands on another state-of-the-art technology— microscopes. At IGB's Training Lab, students got an up-close look at samples from some of Fouke's research through microscopes: rocks from Yellowstone, coral from the Caribbean, and human kidney stones. Also, a few students got to actually operate a SEM (Scanning Electron Microscope), which uses electrons instead of light to form an image.

Plus, Livezey also saw it as a great opportunity to recruit underrepresented students into STEM fields: "I was excited about working with these students in particular because I am very passionate about increasing diversity in STEM. For me, this means reaching out to underrepresented minorities and women and getting them curious about what I do in a lab every day. Science is done better when diverse minds work together, so I want to do whatever I can to recruit diversity to STEM."

Livezey believes that one of the more important benefits for the students was the one-on-one interaction with the grad student mentors. Like Baymiller, she also hoped to enable the students to discover that scientists are just regular folk.

A Microbiology Ph.D. student (center) helps UHS students build a DNA model.





A UHS student explores a honey bee's brain via a virtual reality system while an IGB researcher gives her instructions.

Daniel Wong from the Graduate College's Educational Equity Programs office spoke about the importance of mentors in helping students figure out the "hidden curriculum" in college. He also encouraged students to not only go to college, but to go on for a Ph.D. once they'd gotten their Bachelor's degree.

Wong, whose office has numerous programs, gave students his email and challenged them to contact him—once they got into college, because SROP (Summer Research Opportunities Program) could be helpful when considering grad school, because programs like the SPI (Summer Pre-Doctoral Institute) could help them achieve those goals. Finally, he challenged them to contact him even before that—as early as next week!

I-STEM expresses its appreciation to the IGB for helping to host the event. In fact, according to Fouke, it was apropos that an event featuring the Omics should be held at the IGB. "Ground-zero for all of the explosive OMICS Sciences revolution all began at Illinois with the pioneering work of Professor Carl R. Woese The Carl R. Woese Institute for Genomic Biology is therefore a spectacularly fitting venue within which to bring students to learn about how every aspect of our lives are being impacted by the exposition of Omics sciences, and it all started right here at Illinois."

What kind of impact did the DNA & Health Day have? According to Fouke, it fostered a great deal of excitement.

"I have seen many of the Urbana High School students around town since the event was held. Without exception, their first statement has been 'When is the next event?...I learned so much, and I can't wait!'"

"I think it is important for high school students to realize that scientists are normal people, just like them," she admits. "My hope is that when they see this, they realize that they could be successful going to college for STEM and even pursuing an advanced degree in STEM."

Livezey was enthusiastic about the different hands-on activities at the event. "The students loved the virtual reality goggles and exploring the honey bee brain. This age group really engages with technology, so I think that activity was great! The students also enjoyed building the 3D DNA model and seemed to be really into it when they started competing with other tables to build the biggest model. I think the students enjoyed this particular activity because they took ownership over building something from nothing, while figuring out how the parts go together and how an accurate 3D DNA model should look. Similarly, I think the students really enjoyed building 3D drug molecules..."

In addition to encouraging students that they too could go to college to study science, students were apprised of Illinois resources available to help them achieve that goal.

During lunch, representatives from several offices on campus dropped by to give talks about resources to help students navigate challenges they might encounter in getting a college education. Curtis Blanden, from the Office of Minority Student Affairs, presented about how Illinois' TRIO Programs (Academic Talent Search, Upward Bound, Student Support Services, Ronald E. McNair Scholars Programs) could help them transition from high school to college/career.

Also on hand to present during lunch was Alejandra Stenger, a Merit Program Coordinator, who discussed how her program is a resource for students in biology, chemistry, and math.



A UHS student shows the DNA sample she extracted.

SCIENCE POLICY GROUP HOSTS BROWN BAG LUNCHEON ABOUT DIVERSITY INITIATIVES IN STEM

May 3, 2017

On April 19th, a number of University folk interested in increasing diversity in STEM attended a brown bag luncheon, "Diversity Initiatives in STEM." The featured speakers at the event were Ellen Wang Althaus, Director of Graduate Diversity in the Chemistry Department, and Jennifer Greene, a Professor in Educational Psychology. Sponsoring the event was a new RSO (Registered Student Organization), the Science Policy Group, which began in fall of 2016.

Before beginning the dialog about diversity, Cecilia Gentle, a Chemistry graduate student in charge of the event shared about the Group's three committees and their goals:

- Inform (informs people about what science policy is)
- Professional Development (equips students with skills to affect change)
- Advocacy (advocates for change in science policies)

She also shared about their recent January 21st panel, "What does the Trump Administration Mean for Science," and their April 10th "Call-A-Representative Day." Upcoming events include a

visit by Senator Scott Bennett in June and Reading Workshop in the fall on Diversity Policy in STEM.

According to Gentle, the goals of the event were to:

"Introduce policies that help promote diversity in STEM; understand why these policies exist and how they came about; and think critically about their effectiveness to actually recruit underrepresented groups into STEM fields."

The two speakers began by sharing a bit about themselves and how they got involved in promoting diversity in STEM.


Althaus shared that she is "passionate about supporting women and underrepresented groups and those who are marginalized to really reach their potential. I'm excited about that, and that's why I keep doing what I'm doing." She also acknowledged, "I don't have a degree in social policy and educational policy; I think a lot of it I've kind of learned along the way through experience."

Greene reported growing up in a liberal culture.

"There were some revolutionary times in the 1960s," she said. "One week was a yellow arm band; the next week was a red one; and the next one a green one; it was all very exciting. But the big one was protesting the Vietnam War."

Greene said her involvement during this time period had a significant impact on her belief system. "You develop some sensibilities about what's right and what's wrong with the direction of the country when you're in the midst of something like that," she admits. "I grew up with a liberal, progressive sensibility about what's right and what's wrong,"

Greene's beliefs also helped to shape her career choice:



Ellen Wang Althaus, Director of Graduate Diversity in the Chemistry Department, chats with a brown bag luncheon participant following the meeting.



Jennifer Greene shares about her experiences with NSF's Broadening Participation initiatives.

"This interest in the ways in which our educational system serves everybody well is part of why I'm in the field of educational psychology" she admits. "I'm a strong believer in the power of education to move mountains. But it doesn't move mountains; it doesn't even move grains of sand for a lot of people, so that commitment's been with me for a long time."

Althaus shared about why diversity policy exists and why it matters. She indicates that the push for diversity "really has to do with global competitiveness—our nation's ability to compete in a global economy, to drive innovation through science and technology." She adds the caveat that "In the STEM fields, there's been a growing dependence on international students to do the research at our institutions."

As part of her presentation, Althaus presented data from the National Science Foundation (NSF) regarding the percentage of people from the various racial/ethnic groups in the US population vs. the percentages of the racial/ethnic groups in science and engineering careers.

"NSF's goal is to mirror the population," Althaus explained. She reported attending an NSF-sponsored workshop where, "The conversation evolved from the moral, social good that it should represent the population to the educational benefits to the business case."

However, there are also significant financial ramifications: "The demographic is changing," she claimed, "and even from an economic standpoint, the market demand is going to change too. How are we going to make new products that meet the demand?"

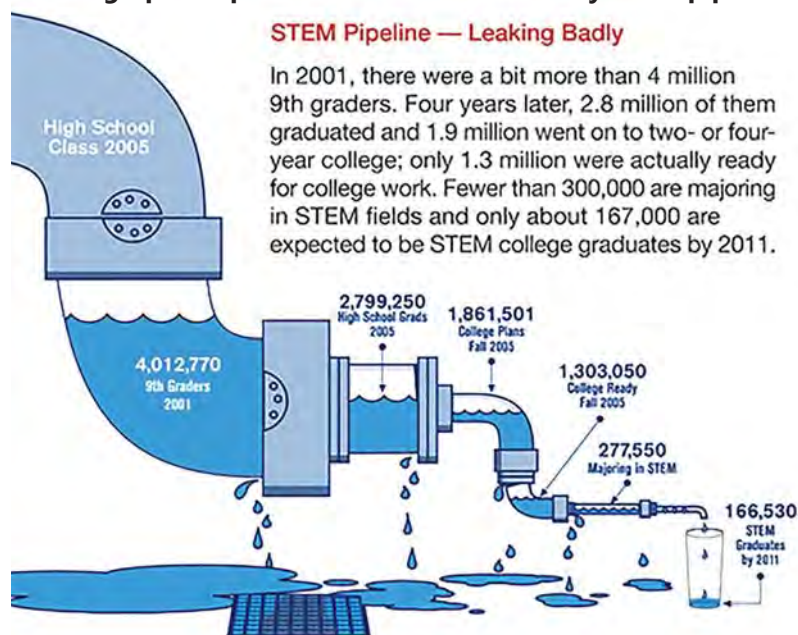
But one of primary reasons to increase diversity in STEM is for diversity of thought. "Not just because we need to have diversity for the sake of diversity" Althaus explained:

"Diversity is not just the color of your skin; it's really your personal experiences; how they shape your way of thinking; how they shape your way of problem solving."

So to promote diversity in STEM, the U.S. needs to increase the number of underrepresented students who enter STEM careers. Greene explained that the NSF classifies the following groups as underrepresented in STEM: women (in most sciences, except for biology), African Americans, Latinos/as, Native Americans, Alaskan Natives, Pacific Islanders, and people with disabilities.

To increase diversity in STEM, one strategy discussed was to plug the leaks in the STEM pipeline. While it is crucial to do so from the undergraduate to the graduate school level, Althaus noted that, "Not enough kids are getting into college; not enough kids are graduating high school; leaks are happening before this."

A graphic representation of the US's leaky STEM pipeline.



Source: NCES Digest of Education Statistics; Science & Engineering Indicators, 2008

During the meeting, Greene alluded to a 2008 NCES Digest of Education Statistics graphic depicting 4 million US ninth graders in 2001 making their way through a leaky pipeline until only a few drops are left to enter the “STEM career” container. However, there was agreement that leaks begin even earlier than that.

But according to Greene, the NSF is seeking to stop them; for instance, all grants dealing with K–12 and higher education, both educational grants, as well as research grants, require a Broadening-Participation component. NSF also has funding that particularly encourages the involvement of HBCUs (Historically Black Colleges and Universities).

“You won’t get the money if you don’t have a serious effort to extend whatever innovation or curriculum you’re offering to people from the groups I just listed; and not only extend, but actively recruit,” said Greene. “NSF is serious about this, although there’s no real consequences when you don’t do it. That’s a problem.”

This lack of consequences, or lack of accountability, is another issue that cropped up repeatedly during the meeting. In response to a question regarding how we can foster accountability, Marlon Mitchell, an I-STEM evaluator, gave an example about creating a space where minorities feel welcomed:

“The University of Illinois is a primarily white institution, right? So if I’m coming from a small HBCU, and I come into this space, and I’m being recruited for this campus, and I’m going into these labs, this is all foreign to me. But

A participant shares about her experiences with diversity during the meeting.



Brenda Andrade (second from the right) and other graduate students on hand to participate in the dialogue on diversity in STEM.

one of the things we talked about is how comfortable, not just dealing with the content knowledge I’m able to pick up, but how comfortable socially are you making me feel?”

He then addressed the crux of the issue—how well underrepresented students in the STEM fields are being supported, whether it’s by an advisor, a mentor, or programs. Are they taking into consideration the cultural differences? “Those are things that we look at with a critical lens in evaluation to say, ‘So if I am able to keep up with whatever the research is, how am I being supported outside of that?’ So those are things that NSF doesn’t look at.”

For example, Greene, who has worked as an evaluator with higher education educational initiatives with broadening participation components, said that “neither the PIs nor NSF consistently hold them to account for that. Some do, but not always.”

But Greene reported that it is possible for these types of support to happen, and cites NSF’s long-standing (40–50 year-old) LSAMP (Louis Stokes Alliance for Minority Participation in science) program for undergraduates, which provides peer support, counseling, mentoring, and opportunities to make alliances. “So it’s possible for these things to happen,” said Greene, “and at the undergraduate level, I think that’s a very successful project.”

Brenda Andrade, a Hispanic Ph.D. student in Chemistry, reported participating in an undergraduate program similar to LSAMP which provided professional development, mentoring,



and prepared students to be competitive to apply for graduate school.

“So I come from that model, and I was lucky, very lucky, to have gotten into that program. So I don’t see why a school like this that has the research here couldn’t develop something like that for the undergraduate level, which is probably where you’re losing a lot of students in the minorities.”

So one solution the group came up with was for the University to form some sort of alliance to promote diversity in STEM that is designed to help undergraduate students get into graduate school by providing resources that target underrepresented students and mentor the students through that process.

Greene shared about how much of an impact programs such as LSAMP, which she called “really powerfully supportive and motivating,” can be, especially in providing role models. She shared an anecdote about a recent evaluation of an LSAMP program she did at the University of Minnesota.

“The students talk about going to the Society for Black Engineers,” she shared, “and here they are in the

middle of a room full of professional people who all look like them. That’s one of the comments that they made about how powerful that can be. And you can imagine. Same with Latinos; same with Native Americans.”

In addition to LSAMP, participants discussed some of NSF’s other Broadening-Participation programs, such as AGEP (Alliances for Graduate Education and the Professoriate), and ADVANCE (Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers).

In addition to NSF programs, the group also discussed other federal funders, such as NIH, and USDA, etc., and grants/programs they have that are promoting diversity.

There was also discussion about support for the LGBTQ community, along with disabled veterans and others who are underrepresented. For example, one participant, who maintains the graduate fellowships database for the grad college, indicates that funders are broadening their definitions regarding diversity and the underserved to include more than race or ethnic identity, but socio-economic status, first generation, gender orientation, or students struggling with disabilities. “So they’re becoming more aware, major funders, but also smaller funders, that there’s a different way of looking at what brings diversity,” she shared. “It’s slow, but it’s happening.”

Regarding the conversation about creating a comfortable environment, another participant asked whether there were policies in place to help universities or other organizations create that comfortable space, train them in what that looks like, and if so, are there any at this university.

According to Marlon Mitchell, there are. He cited the campus REUs (Research Experience for Undergraduates) that he evaluates. Many collaborate with the Graduate College’s SROP (Summer Research Opportunities) program, which provides resources



Ph.D. student Marlon Mitchell and Professor Jennifer Greene, both from the College of Education.

for the undergraduates, many of whom are underrepresented students.

Mitchell also mentioned that the mentoring model in these programs often involves graduate students mentoring undergrads. “With those dynamics and those relationships,” he said, “that’s kind of where the mismatch is a lot of times. Hopefully we will get better at that, but that’s one of the conversations, just studying intercultural relationships, and how does that look on a mentoring model?...I would like to see more of it, but somebody has to pick up that charge, and I think it’s the University’s responsibility to really take a closer look at that.”

It was also mentioned (accompanied by ripples of laughter), that not just grad students, but faculty need training regarding intercultural relationships and diversity—that things need to change at the departmental level in terms of culture. “A government agency cannot micromanage a university, Althaus explained. She then shared about the National Diversity Equity Workshop she’s attending, the goal of which is to educate department heads to educate their faculty.” She said they address things like, “unconscious bias and some of the challenges about recruiting and

retention and even provide a PowerPoint about how to talk to your department about some of these issues.”

Acknowledging that some units on campus are better at fostering diversity than others, but that it’s a work in progress, Green said she feels lucky to be in the College of Education, and couldn’t help but boast a bit:

“There was a photo of last graduation, spring of 2016, of a couple of faculty and twelve African-American women getting their Ph.D.s in Education that year. It was like, ‘Woah!’” So the critical mass does matter, or coming together. We think sometimes just getting more people here is not the answer, and it isn’t. But it’s part of the answer. You need allies; you need cohorts; you need presence. So these all seem incremental, and they are, but hopefully they add up over time to enough voice that things start to happen.”



Left to right: Several members of the Science Policy Group: Aastha Sharma, Sudharsan "Suds" Dwaraknath, David Stevens, and Courtney Ford.

ENGINEERING GRAD STUDENTS INTRODUCE HIGH SCHOOLERS TO ENGINEERING VIA IRISE

May 10, 2017

In spring 2017, IRISE (the Illinois partnership for Respecting the Identities of Students in Engineering) connected Illinois Engineering graduate students in the ME598EO course with local ninth-graders from Centennial High School's AVID program. The goal was to use engineering to provide a solution to a problem in our local community. So the students sought to address obstacles athletes in the Illini Wheelchair Basketball Program encounter while training, competing, or just in everyday life. Not only did the grad students learn a lot about outreach; the high school students learned a bit about what engineers do, and a few even discovered that they might like to become one.

Taught by Mechanical Science & Engineering (MechSE) Visiting Faculty, Sharlene Denos,



A Centennial High student and her grad student mentor present during the IRISE Symposium poster session.

Assistant Professor Elif Ertekin, and MechSE Education Outreach Coordinator, Joe Muskin, ME598, Sustainable Engineering Outreach, 1) exposed 16 Engineering grad students (plus two volunteers) to the benefits, challenges, and rewards of engineering educational outreach; 2) made them aware of issues of power, privilege, and identity related to STEM education and outreach; then 3) gave them the opportunity to put into practice what they'd learned with some local high school students. Revamped from an IRISE ME598 course taught by Denos several years ago, the course was funded through Elif Ertekin's NSF Career grant. The curriculum for the course was based on a curriculum that Denos and a colleague, Dominique Arnold, who teaches a course on Race, Power, and Identity in Educational Psychology, developed for an interdisciplinary unit on race and racism at Uni High.

In addition to grad students, IRISE also targeted K–12 students: Lindsay Aikman's AVID classes at Centennial High School in Champaign. AVID



Two Centennial students interact with an Illinois researcher during the symposium.

(Advancement Via Individual Determination) is a global, nonprofit organization whose mission is to “close the achievement gap by preparing all students for college readiness and success in a global society.”

To celebrate the achievements of Centennial's IRISE Engineering Scholars, the IRISE 2017 Symposium was held at NCSA on May 9th. A lunch reception and the students' poster presentations were followed by a video highlighting IRISE's program in 2017, a keynote by Illinois Wheelchair Basketball Coach Matt Buchi, and recognition of Centennial's IRISE Engineering Scholars.

Key to IRISE's outreach to the high schoolers were the Engineering grad students, for whom Ertekin had high praise, calling them “amazing...really dedicated and really committed.” But while the grad students gave a lot through the program, they also gained a lot in return. For instance, Ertekin believes they discovered the importance of becoming engaged in their community.

“I think it's really important for the graduate students to be a part of that outreach in ways that are really meaningful and impactful,” Ertekin explains. “And I think that the graduate students have had the opportunity to be able to see that everybody in the community can be excited about STEM-related work. You work together as a team on projects, and make complex engineering accessible to young students, everybody gets excited. And I think that's been a very valuable lesson for the graduate students.”

Take ME598 scholar Elle Wroblewski, an Aerospace Engineering grad student. No rookie when it comes to outreach, she's heavily involved with the Illini Aerospace Outreach, which mostly works with elementary students. Wroblewski had two very specific goals in taking the course:

“This class was an opportunity to 1) work with high schoolers, which is an age range we don't normally reach, and 2) to learn about why outreach is so important as opposed



A Centennial student paints her teacher's nails with thermochromic paint they used in their project (image courtesy of Joe Muskin).

to my preconceived notions as to why it's important. So that's been really valuable, getting to understand outreach and education from the perspective of educators, because I'm not; I'm an engineer. So I don't know anything about education.”

What did she learn in the course? “I learned a lot about culture,” she admits, “and how that applies to education...like why it's important for me to know history, and understand psychology, and understand a lot of stuff beyond engineering in order to teach engineering, and I think that's been the biggest take-away.”

Another grad student, Malia Kawamura, who's involved with the ENVISION grad student outreach group, shares why she took the class: “I really enjoy doing outreach, and I wanted to learn how I could do it better.”



Aerospace Engineering grad student Elle Wroblewski (left) and one of the Centennial High students she worked with.

get into a deficit mindset thinking about achievement gap, but the focus should really be on how the outreach we're doing and the education can better connect with those populations rather than trying to change the students to fit within what might be considered a standard education classroom."

While the grad students learned a lot through their class, the high school students learned a lot too. For example, Ertekin believes that the opportunity helped the high schoolers learn what engineering really is.

Kawamura says she learned a lot. "I learned that the personal connection and the relationships you build can lead to the largest impact," she says. Something else she learned? "Making sure that the type of outreach you're doing is relevant to the populations you're working with is very important."

Kawamura also learned about how different social justice issues are related to engineering and education in general: "Urban planning, and how that affects education, and undocumented immigrants, and race and racism, and how all those things factor in...the students you might be working with—that's part of their lives. Knowing more about people wholistically helps you do a better job connecting with them."

She also learned why increasing diversity in STEM is such a hot topic:

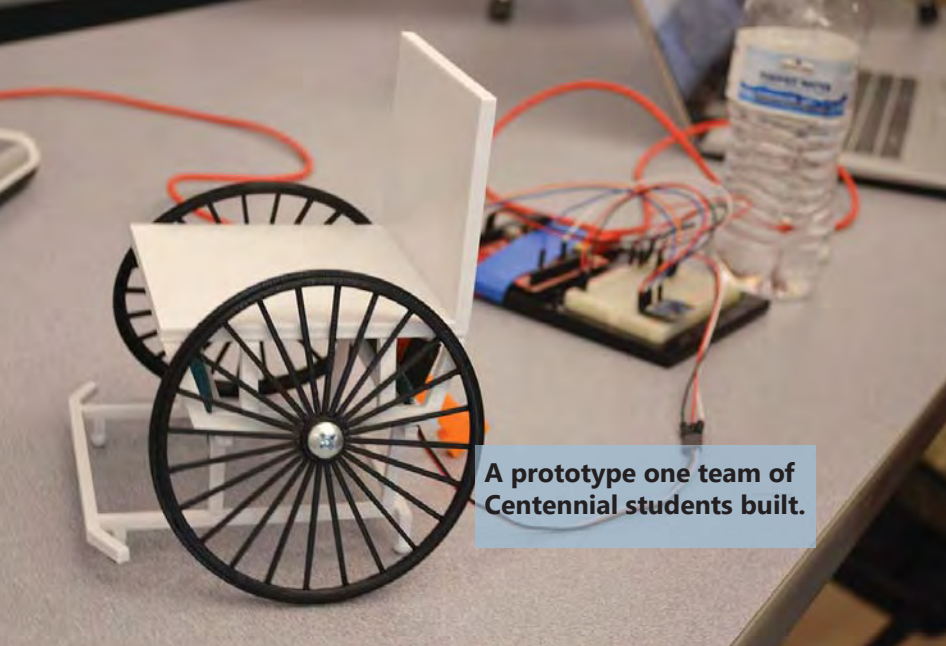
"The types of engineering and science problems we're trying to solve now are getting more and more complex, and we really need more diverse students and more diverse people involved... So we've done it the same way with the same people included for a while now, and we can do better."

She also learned that changing the way things are taught can have an impact. "People can

"I believe that every one of those kids has an engineer inside, and whatever they choose to do in their lives, they'll be very successful at. And I hope that this has opened some of their eyes to what it is that engineers actually do, because I think that can be sometimes mysterious to younger kids, and it's really valuable to be able to kind of demystify that and show them concretely, 'Hey, this is the way that engineers have impact in the world,' and then make them feel like they're part of that process."



A team of Centennial students pose with the certificates they have just received during the symposium (image courtesy of Joe Muskin).



A prototype one team of Centennial students built.

mentoring grow in confidence and learn that they could indeed do engineering:

"So it was really fun watching them be hesitant to start, and then as soon as they started, they picked everything up so fast! It was so fun working with them and watching them learn so quickly. And I had to keep bringing in more challenging things, because the more challenging it was, the more engaged they were learning new things."

Wroblewski says she thinks the high schoolers also learned that engineers are real people, just like them.

"I think that their biggest take-away has been seeing engineers, and understanding that it's an option, and getting to engage with us as people. I feel like some kids, maybe they think that they have to be super, extra good at math. And I think it helps for them to meet us and to engage with us over the course of the semester, to really make it be more like, 'Everybody can do it. You can do it.' It makes it more personal, I guess."

Kawamura shares an anecdote about the first time she brought an arduino in:

"One of my students was like, 'I don't know how to do this! I don't know how to build a sensor to make this work!' Then I was like, 'Ok, just give it a try. I'll help you.' Oh, she just jumped right into it, and she figured it out so fast! And when she built the sensor, she was like, 'Miss Aikman! Miss Aikman!' She wanted to show her."

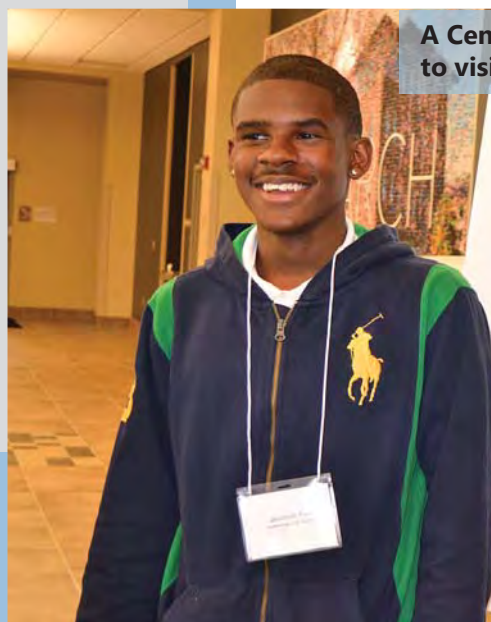
Kawamura reports how rewarding it was to see the students she was

Lindsay Aikman, Centennial's 9th grade AVID teacher, is trained as an English teacher, but there she was, helping her kids through the engineering project. Did she learn some stuff about engineering too during the program?

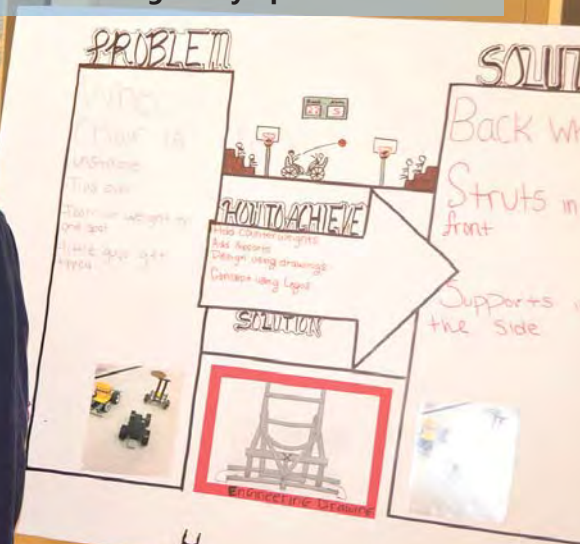
"I did, and I wish I would have had this opportunity when I was their age, because perhaps I could have considered this field."

Aikman believes her students learned a lot about engineering through the program:

"You know, I think this has done a good job of demystifying the engineering field, and showing that it can be a lot more accessible than people realize. It's really about designing a product and developing a solution to a problem that you see in the world and developing that solution."



A Centennial student presents his research to visitors during the symposium.





Engineering grad student Malia Kuwamura (right) and two of the Centennial students she mentored.

One of Aikman's students for whom the IRISE engineering class had a significant impact was freshman Khayriyah Mitchell.

"It was a great experience," she reports. "AVID just gives me an earlier view, because I'm a freshman, of college, and how college works, and I appreciate that. And the IRISE program, it opens me up to engineering and it gives me a better understanding of what engineering is. I didn't really see myself as an engineer, but I actually do now."


Does Aikman believe the program influenced some of her students to seriously consider careers in engineering? "Oh, yes," she reports, "and in surprising ways! I have a student who has all along said she wanted to go as an OBGYN, and now, through this, it has been revealed that she has an intuition for programming. So we're going to try to get her into summer programming camp on the engineering campus. I have other students who have never considered engineering at all, and are now attending engineering summer camps for a week in the summer."

In fact, Khayriyah plans to go to two camps this summer—one will be MechSE's engineering camp for high school girls: G-BAM GAMES camp.

"Building our apps, making our posters, meeting new people on campus gave me a better look on how college works," she continues, "and it excites me to actually be an engineer!"

A group photo of the spring 2017 I-RISE participants (image courtesy of Joe Muskin).



A close-up photograph of a woman with dark hair and a blue top, wearing a yellow and silver necklace, assisting a young woman with dark hair and a grey hoodie. The young woman is wearing a light blue patterned shirt under her hoodie and a gold necklace. They are both looking down at a small electronic circuit board held by a soldering iron. The circuit board is yellow and has several components on it. The woman is using the soldering iron to solder the components. A magnifying glass is visible on the table in the foreground.

Sahid Rosado interacts with an ICANEXSEL camper during an ECE session on soldering circuits.

DURING ICANEXSEL CAMP, CPS STUDENTS DISCOVER WHAT ENGINEERING, STUDYING AT ILLINOIS MIGHT BE LIKE

July 31, 2017

An ICANEXSEL camper learns about surface tension and how pieces of cork bond during a Materials Science session.

Twelve soon-to-be 9th graders in Chicago Public Schools (CPS) this fall haven't even taken one class in high school, but they've already found out what college life could be like—thanks to the brand new STEM camp, ICANEXSEL. The half-week, residential camp, held from July 24–26th, introduced rising CPS freshmen to several different engineering disciplines via hands-on activities and demonstrations. The camp also introduced them to some Illinois professors and students who led the activities and served as camp counsellors. Plus, the students, also got a taste of what college life (and dorm food) is like while staying at the Illinois Street Residence Halls.

The brain-child of Engineering's summer camp guru, Outreach Coordinator Sahid Rosado, the camp is part of ICANEXEL (Illinois-ChiS&E Alliance for Nurturing EXcellence in STEM Education Leadership), which for the last couple of years has been giving Illinois students opportunities to do STEM outreach with CPS students. However, while the academic year program involved Illinois students traveling to Chicago to do outreach, the summer camp brought the CPS students down to campus to get an idea of what college would be like.

The camp exposed the students to several engineering disciplines. From MatSE (Material Science and Engineering), Professor Qian Chen and her team of students introduced the high schoolers to surface tension on water, "demonstrating self-organization of building blocks under disturbance of the air-liquid interface," according to Chen. A team of Aerospace students from Professor Phil Ansell's lab taught students about aerodynamics, following which the high school students built, then launched rockets. In



ECE's Lynford Goddard shows a camper how to solder during the ECE session on circuits.

addition, members of Physics Van exposed the students to some fun demos, including liquid nitrogen blowing the lid off of a plastic trash can, and a bubble volcano. The participants also learned about soldering and built their own circuit, taught by ECE's Lynford Goddard, and a team of students.

In addition, two Illinois students in STEM fields served as counselors. Both are passionate about STEM outreach and reaching the underserved in STEM.

For instance, Shelana Martin, a rising senior with a double major in astronomy and educational learning studies is Rosado's "girl Friday" and has helped with numerous GAMES, IAI, and WYSE camps. She feels the camp will help to increase the number of underrepresented students in STEM fields.

"The benefit of bringing these kids down," she explains, "is because most of them are definitely from communities and areas that are underrepresented in STEM fields, so getting them exposed to science now and getting them in connection with the university, it's just helping broaden that interest of STEM throughout specifically Chicago and schools that are in that area."

The other camp counselor, Will Helgren, is a rising junior in Physics at Illinois. He's been involved with ICANEXSEL since his freshman year, when he got started doing outreach in Chicago for four Saturdays out of the semester.

"We would take the bus up to Chicago and get to work with a bunch of kids in junior high level, teaching them basic math, science, and engineering," he explains.

In his sophomore year, Rosado enlisted him to be the onsite manager for the program, so it was only natural that he would participate as a counselor for the camp.

Helgren stresses that the camp is helping to provide equity when it comes to STEM experiences. He calls the camp and its mission:

"Imperative...because certain people have different opportunities based on where they live. People excel when they have the opportunities given to them, regardless of what level they're at. "

He continues, stressing not only the STEM opportunities, but the importance of the camp being residential:

"Something like this, taking kids from places where they don't necessarily have all those opportunities all the time, and having them have the experience at such a young age of exposure to different types of engineering, and science, and opportunities on a college campus, and being able to experience living on a college campus for a few days, I think it's really important to expose them to something they may never have even have thought of, let alone been able to see for themselves."

Rosado agrees that bringing students to campus is important; in fact, this was her primary objective in creating the camp:

"I think it makes such a big difference when you bring them to campus, and they have the whole college experience. Some of them, their parents didn't go to college. So they have no frame of reference when it comes to, 'What is college living like? So we've been thinking about doing this for a while now just because we acknowledge how important it is for them to have this experience."

An ICANEXSEL camper solders her circuit while Illinois Physics undergrad Will Helgren offers her encouragement.



The idea is to expose the students to what it could be like for them a few years down the road and make it more familiar to them. She wants their mindset to be:

"Okay, this is something pretty cool, and it's something that I could do."

She believes that when they consider going to college in the future:

"They're not as scared to make that jump. So I think that's why it's so important to have these kids here on campus for a few days."

According to Rosado, most of the twelve would be first-generation college students. She adds that their parents, who didn't have the opportunity to go to college themselves, are really pushing them to do it. However, she admits that, for first-generation students, considering college can be intimidating, "When you don't have a parent who's like, 'Oh, college is so fun!' When you don't have that person to tell you those things."

Rosado envisions this camp as a kind of watershed experience that many students will look back to, once they begin to consider their plans for the future.

"I think it kind of makes them see themselves in it. So when it comes time to think if they're going to college or if they're going to do something else, they can refer back to this experience and say, 'Oh, I did it for a few days.' Hopefully, they can refer back to this experience and say, 'Oh, I actually really enjoyed that,' or 'I did it for a few days, and I was good at it,' or 'It wasn't as bad as I thought; it wasn't as scary as I thought.' So hopefully they'll think about that when it comes time for them to decide what they want to do."

The students themselves agreed that their motivation for attending the camp: besides experiencing the STEM activities, was to see what college might be like. For

example, Maia Penn, a rising freshman at Deyette Performing Arts in Chicago, shares why she participated:

"I liked all the activities that we do, and I wanted to experience living on campus."

What was the experience like? "It's pretty good," she admits. "It's just the dorms."

Regarding her passion for STEM, Penn admits "I really like math." Her career aspirations are high; she says, "I'm thinking about being a doctor, but I'm just picking what type I want to be."

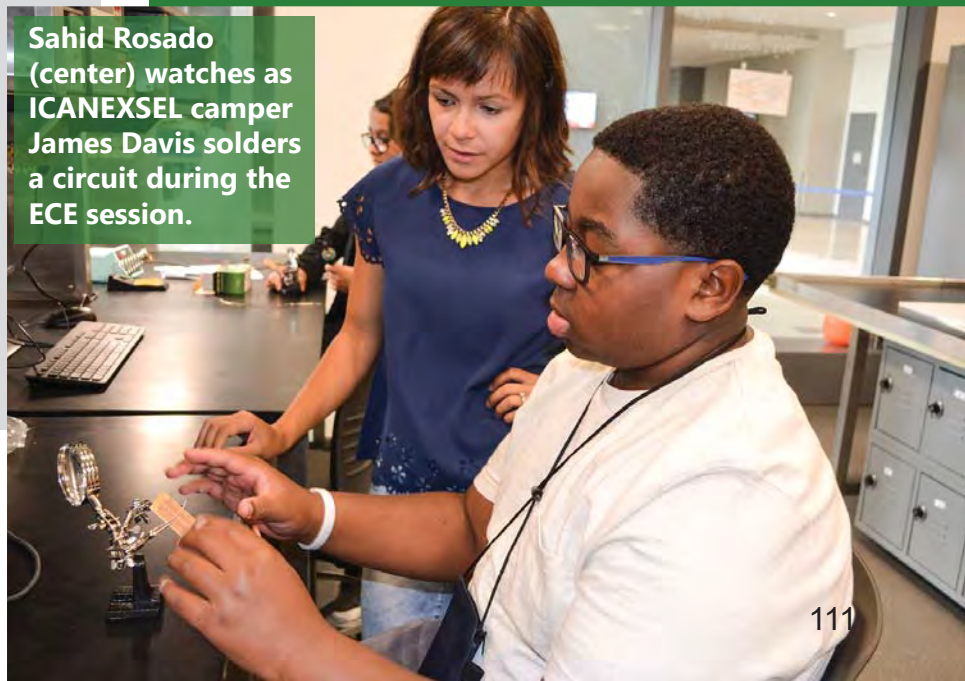
James Davis, a rising freshman at Morgan Park High School, says he came to the camp:

"Because I really like this program, and maybe engineering is not my thing, but I like the activities and stuff that we do. We're soldering now, and last year in our camp, we did soldering for breadboards." Davis says his favorite activity was soldering, but also, "Building the rocket was cool. We used different materials."

His first residential camp away from home, he reports: "It's fun staying in a residential camp away from home. The dorms are small. The food is good."

Despite the small size of the dorm rooms, nothing's going to deter him: "I'm definitely going to college," he declares.

Sahid Rosado (center) watches as ICANEXSEL camper James Davis solders a circuit during the ECE session.



I-STEM SUMMER CAMP EXPOSES URBANA HIGH SCHOOL ATHLETES TO MULTI-DISCIPLINARY STEM

August 7, 2017

From August 7–18, twenty-seven Urbana High School (UHS) athletes, mostly underrepresented minorities, participated in the first-ever I-STEM Summer Camp. The goals of this multidisciplinary summer program were to 1) expose participants to various STEM fields so they know what their options are when choosing their career/ college path; 2) to build teamwork and lab skills in different STEM disciplines; and 3) to allow students to experience what STEM research is about. Ten different STEM departments and units on campus were each responsible for one day of activities during the two-week camp.

According to I-STEM Interim Director Luisa Rosu, the long-term goal of the program is to build a foundation for a stronger STEM partnership between the campus and local schools with the potential to support the pipeline for future research capacity in the participating departments. Of particular emphasis in the partnership is underrepresented groups in STEM.

Rosu shares why the program is important:

"Students, high school students in particular, are looking for college experiences. They need this kind of experience, to come on our campus, to see what it means to be a student, to see what it means to stay in a class for a longer time—not just for a couple of hours, not just for a lab visit, but an entire college day experience over two weeks."

Multi-Disciplinary STEM Activities

Each day of the camp addressed a different STEM discipline. Faculty, students, and other personnel from ten different Illinois departments, units, or groups participated in the camp. Following are key personnel who presented, plus a brief description of the types of instruction and/or hands-on activities to which they exposed the students:



A UHS student proudly exhibits the glowing LED light during a hands-on activity on ECE Day.

MCBees. On Monday, August 7th, members of the MCB (School of Molecular and Cellular Biology) graduate student organization used a fun scenario, a crime scene involving a "dead graduate student," to structure their activities. For the "Whodunit?" students were to discover which of two suspects did it: an undergrad who wanted the grad student's spot and/or funding, or the professor who was upset with the grad student because he wasn't working hard in the lab.

The job of the high schoolers was to take DNA samples from the crime scene, extract DNA from the cells found there, then perform a Polymerase Chain Reaction to amplify the part of the DNA that they were interested in, producing millions of copies of that DNA. Then they were to take that DNA and separate it on a gel, a thick jello-like substance that they could run the DNA through. Based on size, a different pattern would appear, that they would then need to match to the pattern found on the murder weapon.

The reason the MCBees chose this experiment, explains MCBees Outreach Coordinator Mara Livesey, is because it was a real research experience. "It's like a real, start-to-finish experiment, and a lot of the techniques we use today are things that I use in lab every day."

"I think something like this where we can make a fun scenario for the kids to follow along with is more interesting. It can maybe grab their excitement a little bit more and motivate them to maybe consider science in their future. I want them to have a real experience, like this is really what we do every day in lab. And if they can understand that, then maybe they'll be interested, hopefully."

MNTL/Nano@IL RET. On Tuesday, August 8, MNTL Day, I-STEM campers visited MNTL (the Micro and Nanotechnology Lab), for "A Primer on Semiconductors." In preparation for creating their own poster about their I-STEM camp experience, students listened to nano@illinois RET teachers' poster presentations about their research this past summer. In addition, students used a rubric to

evaluate each teacher's presentation according to the following four criteria: organization, use of graphics, effectiveness, and responsiveness, giving each a grade from 1 to 3. In the afternoon, Dr. Mark McCollum led students on a tour of MNTL's cleanroom laboratory.

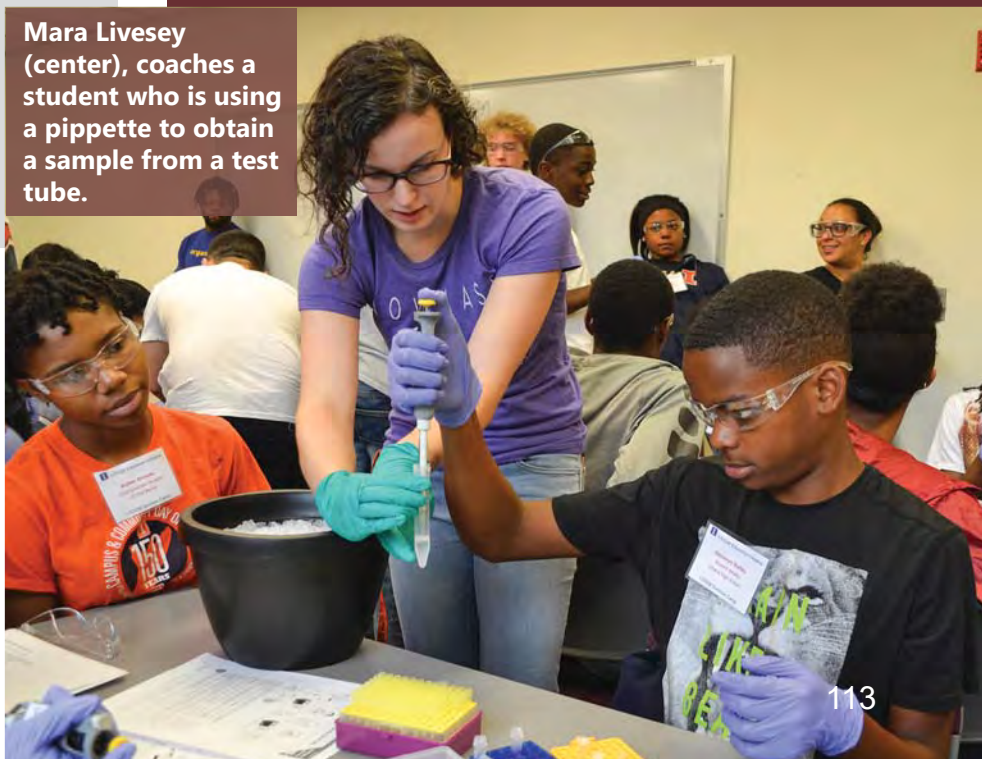
One Nano@Illinois RET participant, J. D. Graham, who teaches biological sciences to grades 9-12 at Sullivan High School in Sullivan, Illinois, shares why the I-STEM camp was a good experience for the UHS students.

"It's just exposure," Graham acknowledges. "It's like learning another language; it's like going to another country. You can hear that those things exist, but to actually see somebody speak a language, it takes the mystery away that it's not something somebody else does, it's something you can do."

Civil and Environmental Engineering (CEE). CEE Assistant Professor Ange-Therese Akono, along with some students in her lab, exposed the high-schoolers to a nanomechanics workshop on Wednesday, August 9.

Students performed indentation tests on various materials; did a polishing activity similar to what Akono's students do prior to testing materials, built bridges with popsicle sticks, and in the afternoon, took a tour of the Newmark Lab's Crane Bay.

Mara Livesey (center), coaches a student who is using a pipette to obtain a sample from a test tube.



According to Akono, events like this help high school students “just get excited about science!”

"They get to discover an aspect of science they wouldn't have thought about," she continues. "In this case we're looking at civil engineering. They get to understand what it is to be a civil engineer, what kind of questions we're asking, and how this is both exciting but also applicable in real life." Akono asserts that students experience civil engineering every day, "but maybe they've never thought about all the people actually designing it." She says their other goal was "to inspire them so that later, they would select these careers and be the future engineers that we need for this country."

Electrical and Computer Engineering (ECE). On Thursday, August 10, ECE Day, Lynford Goddard and his students taught the campers about how to design research experiments, how to solder, then had them build a circuit.

One of the graduate students from his lab, Lonna Edwards, who was involved in four camps this past summer, indicates that she participates in outreach events like I-STEM's camp because it's something she didn't have access to at that age.

"I love doing outreach. It's something I wish that I'd had when I was younger. I wasn't aware. I didn't know what an engineer was until I was starting college, and I learned about what they do, so I just picked it as a major, not really knowing much about it. It was a struggle in the sense that I had to maintain a certain GPA, so I was stressed out a lot of the time. But I made it, so I made it a goal to expose people earlier."

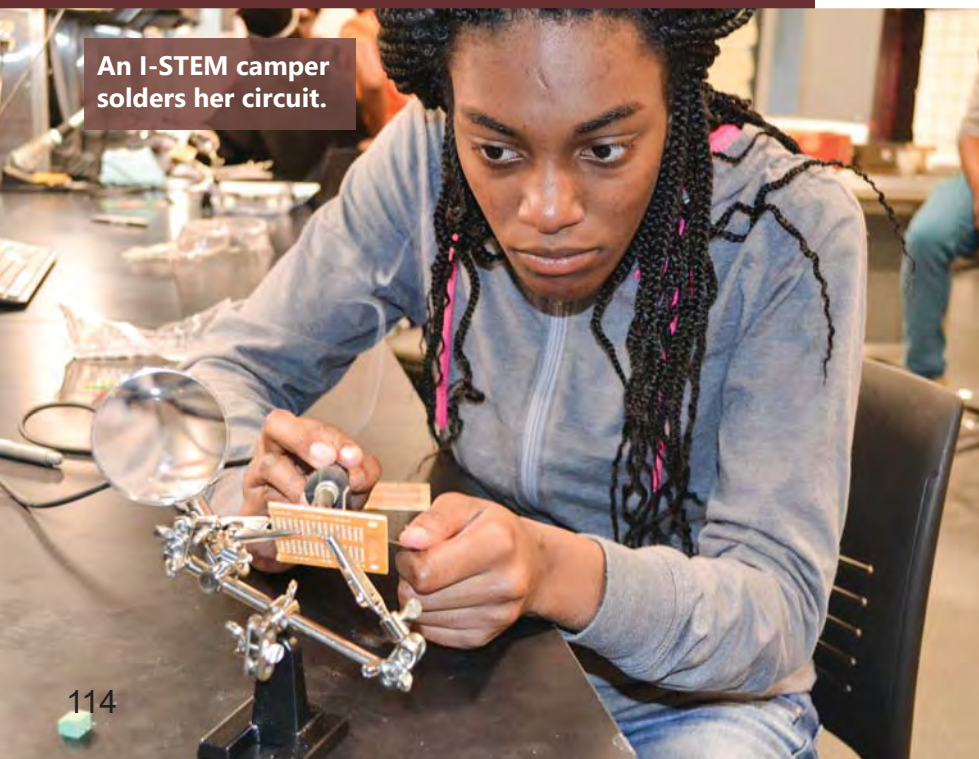
Edwards says it's a good idea to bring high school kids into a lab early. "The earlier the better," she says. "But kids who get to experience this are at an advantage, because they're learning about things I didn't learn until I got to college. I tell them not to feel bad if they feel like they're not getting something...they're still ahead of the game."

"The earlier you get exposed, the better you'll be at it," she adds, "because it won't be as stressful, and because it's something you've seen before. You'll be able to learn it and be confident. So I wanted to reach out to kids who are younger so they get that exposure, especially kids that are under-represented in the field."

Mathematics. On Friday, August 11, Mathematics Department Head, Matt Ando, welcomed the students and discussed the importance of math. Later, Assistant Professor Phillip Hieronymi introduced students to mathematical logic via a “brain teaser” about Alan Turing. In addition, several math Ph.D. students, Alexi Taylor Block Gorman, Colleen Elizabeth Robichaux, Elizabeth Field, and Vanessa Rivera-Quinones, led the highschoolers in hands-on activities related to their math research.

For instance, Vanessa Rivera-Quinones, a fifth year math Ph.D. student, did a fun event with the students related to disease modeling. In her research, she uses mathematical models to try to understand how disease spreads, in particular in a lake ecosystem.

An I-STEM camper solders her circuit.



Rivera-Quinones participated in I-STEM's camp because she believes "math should be painted in a fun light." While she says the math in school is interesting, she admits:

"It doesn't tell you the complete picture. I always want try to motivate other students to see how math is used in non-traditional settings or how the math in high school could be pushed to explain some real-life phenomenon."

So, she gave the students an exciting exercise related to real life and to her work in epidemiology (the spread of infectious diseases). In a website game, called VAX, students were given a limited number of "quarantines" (breaking a link from one person to another) to try to stop a disease from spreading. Once the disease got started, however, it spread rapidly from person to person. The students were quite engaged as they scrambled to try stop the spread of the disease—with varying degrees of success.

Regarding the impact I-STEM's camp had on the students, Rivera-Quinones reports, "Since this program is trying to paint the picture of what a researcher looks like, hopefully they can see that it's not just one picture; across different disciplines, we do different types of things, and all of them are research."

According to Rivera-Quinones, her main goal was for the students to gain confidence: "My hope for them is that they understand that there's not one definition of being a mathematician," she explains. "They can also be mathematicians even though they're not pursuing a PhD in math. As long as they have interest in how things work and how patterns are formed, they can also be mathematicians."

Aerospace Engineering. On Monday, August 14, I-STEM campers learned a bit about the engineering and physics behind how airplanes and rockets fly courtesy of the Illini Aerospace Outreach, Aerospace Engineering's student organization, who organized the event. The high schoolers learned about flight mechanics and jet

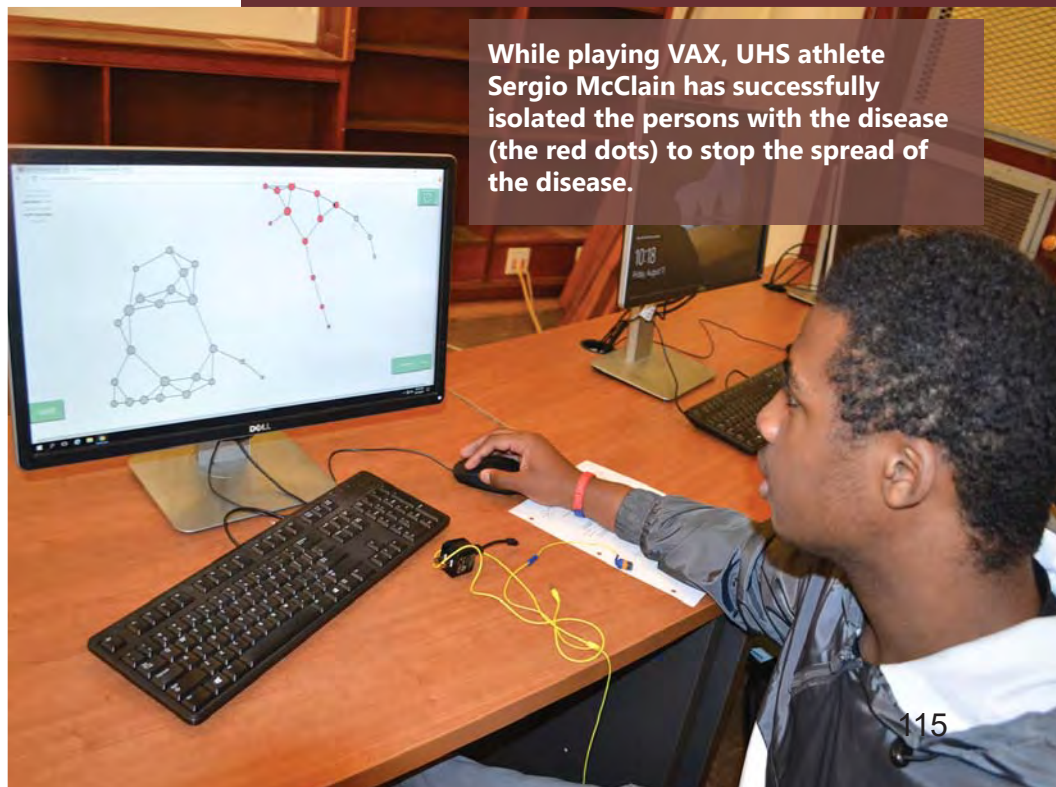
engines, got a demonstration of the wind tunnel, learned rocketry basics, then designed, built, and got to launch balsa wood gliders and model rockets they built.

Elle Wroblewski, an Aerospace Ph.D. student who helped with the camp shares why events like the camp are important for high school students.

"When I was in high school," she explains, "my impression of engineering was only based off of what older people would tell me; I didn't have any first-hand experiences as to what that meant. An event like this shows students more in depth and gives them a better grasp as to what engineering is and shows them a practical application in math and science, whereas beforehand, I feel like it's a little more theoretical, or it's a bit more science fiction based."

In fact, Wroblewski says that much of what kids believe about space flight is based on what they've seen in movies and on TV and "not so much on the technical details," she admits. "An event like this makes it more realistic, so that when they're thinking about careers, they have a better grasp as to what it actually is."

More importantly, Wroblewski says these types of events show them that they have what it takes to be engineers, refuting "pre-conceived notions like:



While playing VAX, UHS athlete Sergio McClain has successfully isolated the persons with the disease (the red dots) to stop the spread of the disease.

'I can't do that because I'm not smart enough,' because they've experienced that they are smart enough to do it. It's exciting and fun that they can achieve something as opposed to not knowing whether or not they could.'

Chemistry. On Tuesday, August 15, Chemistry's Tina Huang, and her lab assistant, Stephanie Legare, helped campers learn about chemistry via several hands-on activities. After learning about lab safety, students suited up in lab coats, goggles, and gloves then did activities in saponification (making soap), forensic chemistry (extracting pen ink and candy dye using chromatography), and how temperature can change the physical and chemical properties of matter.

According to Huang, activities like I-STEM camp's Chemistry Day are important to help students overcome their fear of certain STEM subjects:

"We hear from the students that in order for them to get interested, they need to start as early as possible," Huang explains. "Many students have a fear of STEM. Even though they want to major in it, they're sometimes afraid when they get to the college level. They view certain topics as really hard and difficult to master. I think if we get the attitude out and give them something

fun that they can do, that they'll know it's not impossible and that learning also takes time. So then, we can have that attitude when they get to college that it's going to be hard, but it's not impossible."

Computer Science (CS). On Wednesday, August 16, students learned about Computer Science and coding. After a presentation by I-STEM camp mentor and ECE major Kushal Goenka about what it means to code, students visited a CS computer lab and made Scratch (an online program for programming stories, games, and animations) projects of their own. Students also heard from a CS PhD student, Everett Hildenbrandt about CS formal methods, did a Magnet/Copper activity, and learned that computer science is everywhere.

Mechanical Science and Engineering (MechSE). On Thursday, August 17, a team of professors and students from MechSE, including Elif Ertekin, Mariana Kersh, Kazem Alidoost, Jason Kim, and John Shanley, exposed the campers to some current research in their field. The hands-on activity they did involved making a prosthetic device: an arm for an amputee that operated using pressurized air from an air tank and included a hand with fingers that could pick up a pair of sunglasses.

According to Assistant Professor Elif Ertekin, one of their goals was to help the high school students see themselves doing engineering.



Ertekin poses with the team that won the Prosthetic Device competition.

“A lot of the modern research shows that in order to be able to choose a certain career path, you have to be able to envision yourself being that person and doing that job in the future. So right now, by trying to give the young people hands-on experience, working directly with graduate student researchers and faculty, I think that really helps them imagine themselves doing this as a part of their careers in the future.”

MechSE’s Mariana Kersh says events like the camp are important to high school students to “kind of provide that sort of light at the end of the tunnel” and to help them “learn that there is this bigger picture.”

While high school students “may know that they’re good in math or that they like science... they don’t really know where that’s going to take them.” She envisions the event as helping to show them the possible routes early, and help keep them on track. She admits that students need to have a vision. She explains that:

“It’s not about the degree per se, it’s about what you’re going to do with it in order to help” that can help them to get through the distractions and getting discouraged when they don’t do well

on a test, because they’ve learned that “there’s this bigger picture that I really learned about and that’s what is driving me.”

National Center for Supercomputing

Applications (NCSA): On Friday, August 18, campers learned about research going on at NCSA, including a peek at some of the Advanced Visualization Laboratory’s (AVL’s) high-resolution, cinematic-quality data visualizations for public outreach. Students also attended a panel featuring AVL research programmer Kalina Borkiewicz; Eliu Huerta, a Physics and Astronomy Research Scientist in the Relativity Group; Dan Lapine from the Scientific Computing Services Group; and Adam Slagell of NCSA’s Cybersecurity Group. Finally, students toured the National Petascale Computing Facility, home of the Blue Waters Super Computer.

Barbara Jewett, a managing editor at NCSA, shares why events like I-STEM’s camp are important:

“Because you never know what is going to change someone’s life. And it is very important that we encourage young people to explore careers and the other opportunities that are available to them in the areas of math and science. And by exposing them to what is available on campus, we can stimulate their interest.”

Three female UHS athletes enjoy the Tour of the Blue Waters at the NPCF.



As an example, Jewett shares an anecdote about her daughter, a chemistry Ph.D. student. “She got her interest in chemistry from freshman chemistry the very first day,” Jewett explains, “when the instructor poured two solutions together, and they turned pink!”

“You just never know,” she continues. “There are so many opportunities and things you can do with science. Plus, let’s face it, science affects our daily lives. All the food we eat; all the products we use; the air we breathe; the science that grows things. So science is in everything. So just the exposure to it and getting people involved in science is really important.”

Learning Opportunities for Developing Soft Skills

Besides exposing under-represented minority HS student-athletes to various STEM research experiences and helping them to make informed decisions when choosing their career/college path, this pioneering multidisciplinary program also offered learning opportunities for developing soft skills, like teamwork, communication, assertiveness, and adaptability.

UHS students worked in groups, under ISTEM mentors' supervision, to incorporate their two-week experience into a poster activity. Students were given the assignment to make the connection between the best experience they had during the camp and their current career choice. As a final culminating event, at some point in fall, UHS will hold a poster event where students will present about their ISTEM summer experiences to their UHS colleagues and teachers.

Mentors. Part of the conceptualization, planning, and organizing of the program, and in addition to exposure to more than 100s Illinois faculty, students and other personnel from the participating departments, units, or organizations, I-STEM incorporated an additional component: Illinois students served as mentors to the high schoolers. These mentors not only helped to guide and motivate students during activities, but provided the opportunity for relationship-building with Illinois students. The idea was that the campers might more easily identify with the Illinois undergrads because they were closer in age to the high school students, plus they had recently been through the college/career decision-making process themselves.

Regarding the camp's impact on the high schoolers, one of I-STEM's mentors, Amber Shields, a junior in Human Development and Family Studies, reports:

"My group has been very engaged... Someone wants to be an engineer, so he's asking a lot of questions...I like the experience they're getting. I like to see their happy faces; I like to see them engaged, asking me questions."

Shield's mentees weren't the only ones benefitting from the camp. In addition to mentoring her students, Shields was jumping in with both feet

during the various multi-disciplinary activities. "I'd like to thank you for me," says Shields, "because I learned a lot of things throughout this camp. I learned new buildings that I've never seen before, never gone inside before because some buildings are restricted. You have to be an engineer or a STEM student to get inside them. It's a very new experience, and it's very appreciated. I learned something new."

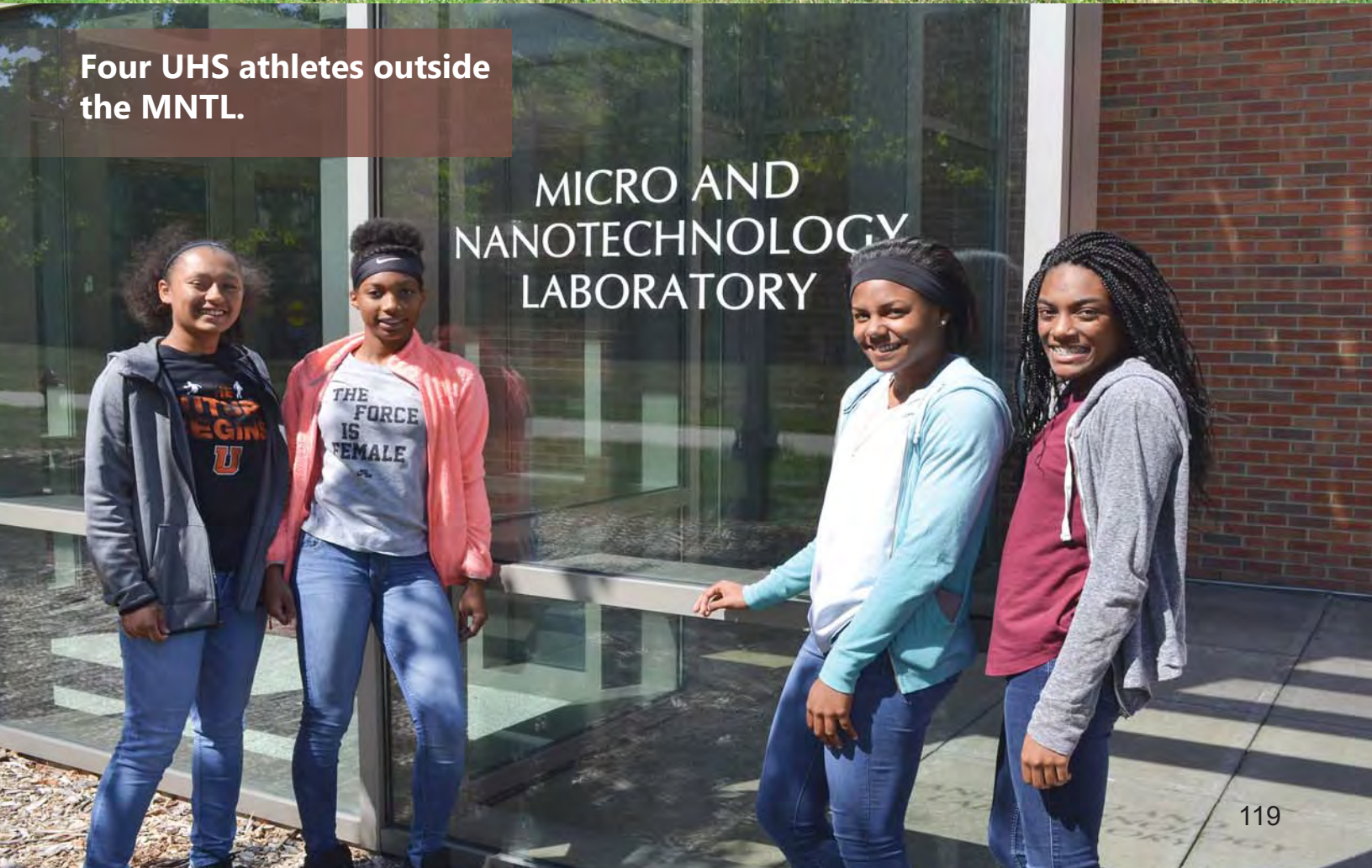
The mentor leader, Kadeem Fuller, shares that he got involved with the camp in order to get to know kids. "Having the time to engage with students that are younger than me, people that only a couple years ago, I was in their shoes," he admits. "So anytime I can give them a type of guidance or something to do other than just sitting at home during the summer time."

I-STEM Interim Director Luisa Rosu believes the camp had just such an impact on the students: it gave them confidence to consider a career in STEM:

"I would say the biggest impact is that students became aware of their potential. Most of the students attended our Health Day in spring. I remember that first hour when they entered the IGB conference room, you could see in their eyes, it was like, 'This is not my place. Why am I here? Why did they bring me here? What's this about?' And during that day in spring, they started to feel more comfortable. The first day of our summer camp program, we started with the MCBees, a familiar experience and familiar faces, and it clearly gave students this comfortable feeling. 'I can be a college student. I have this potential; it's just up to me what I choose.' And I think this is the best thing about that first day of their summer program experience—it was a shift from just being comfortable with college to starting to think, 'Which STEM discipline do I like the most?'"



I-STEM Summer Camp participants, mentors, and leaders.



Four UHS athletes outside the MNTL.

**MICRO AND
NANOTECHNOLOGY
LABORATORY**

MCBEES USE “WHODUNIT?” TO PIQUE UHS STUDENTS’ INTEREST IN SCIENCE DURING I-STEM SUMMER CAMP

August 7, 2017

A grad student is dead. Who did it? An undergrad who wanted the grad student’s spot and/or funding? The professor who was upset with the student because he wasn’t working hard enough in the lab?

This “Whodunit?” was the scenario members of the MCBees came up with to get 27 Urbana High School (UHS) students excited about STEM, specifically DNA research. The MCBees, the MCB (School of Molecular and Cellular Biology) graduate student organization, provided the hands-on activities for day one of the first-ever, I-STEM Summer Camp, a multidisciplinary summer program from August 7–18, which focused on exposing underrepresented minorities to the many different STEM fields and career opportunities, building teamwork and lab skills in the students, and showing them what STEM research is like.

To capture the students’ interest, the MCBees used the fun murder mystery scenario to structure their hands-on activities. Students were to use DNA research— similar to what’s done in forensic laboratories and to what many of them do day-in,

day-out in the lab—to discover which of the two suspects did it.

The high schoolers were to take DNA samples from the crime scene, extract DNA from the cells found there, then perform a Polymerase Chain Reaction to amplify the part of the DNA that they were interested in, thus producing millions of copies of that DNA. Then they were to take that DNA and separated it on a gel, a thick jello-like substance that they could run the DNA through. Based on size, a different pattern would appear, that they would then need to match to the pattern found on the murder weapon.

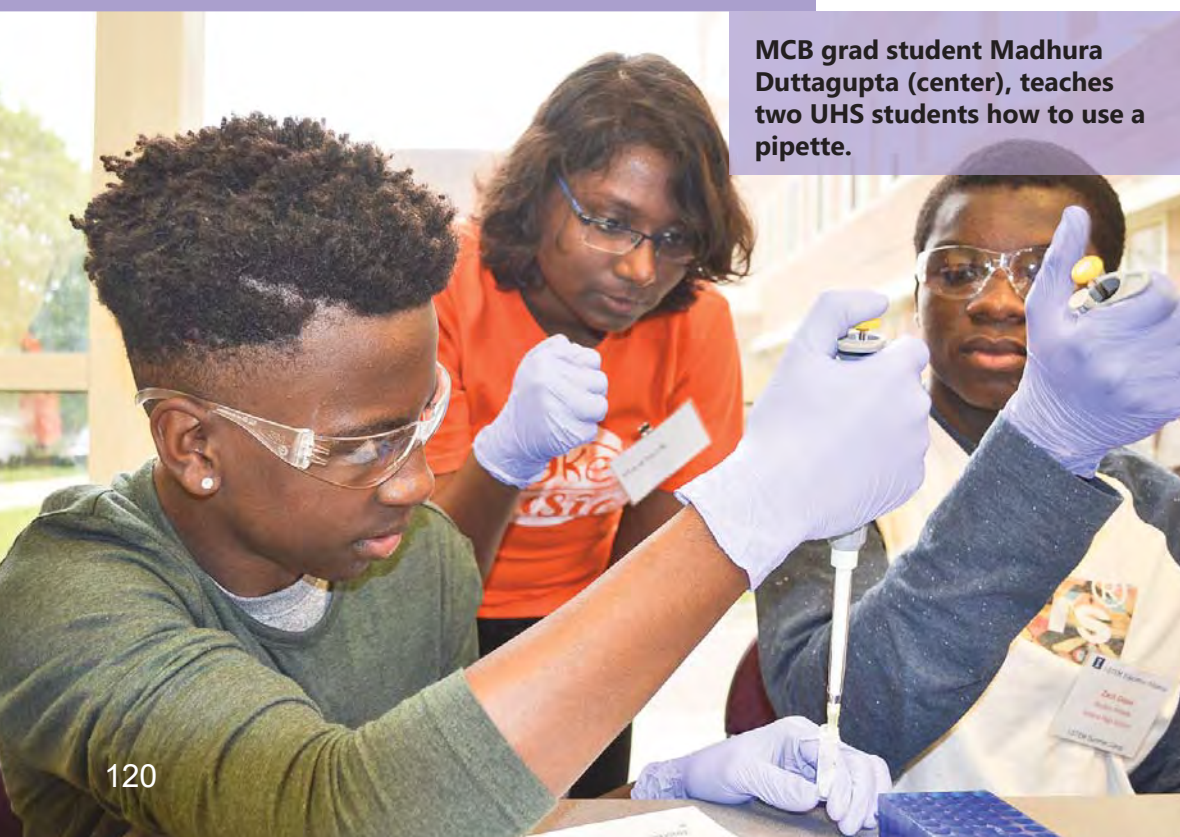
The reason the MCBees chose this experiment, explains **Outreach Coordinator Mara Livezey**, is because it was a real research experience.

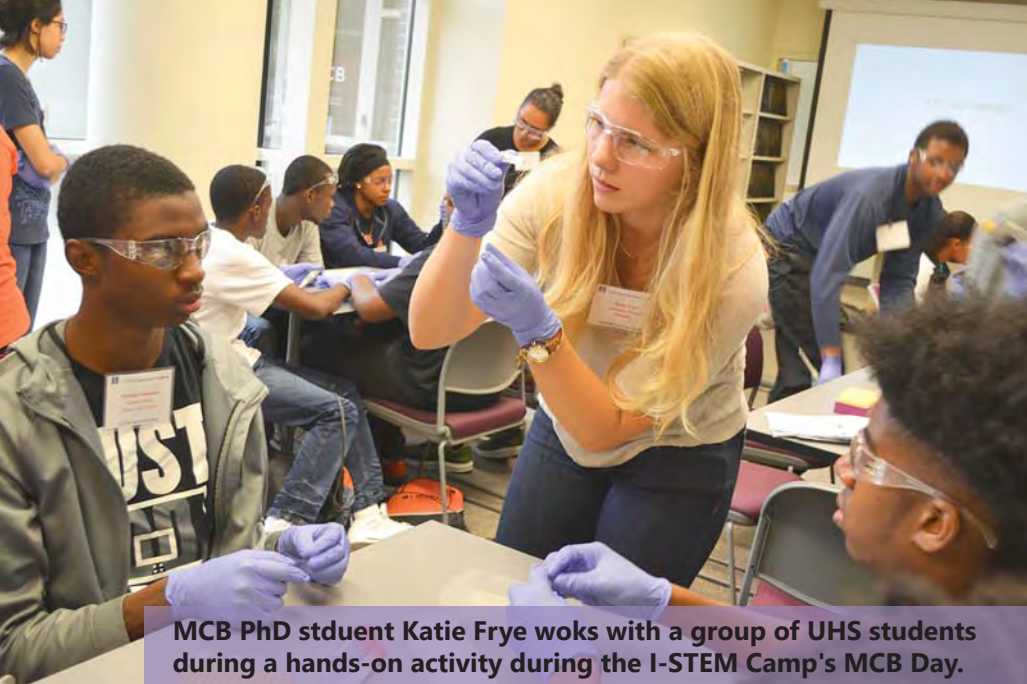
“It’s like a real, start-to-finish experiment, and a lot of the techniques we use today are things that I use in lab every day. So this is a real research experience.”

She adds that it’s not until even further along in a student’s career where they’re taking something from start to finish and answering a question. “Something like this,” Livezey continues, “where they’re really following an experiment from start to finish, is something that you don’t get in high school. The first time you’re really exposed to something like this is in undergrad, in maybe your biochemistry class.”

She hopes to expose them to the kinds of things scientists in her field do in hopes of piquing their interest in science.

MCB grad student Madhura Duttagupta (center), teaches two UHS students how to use a pipette.





MCB PhD student Katie Frye works with a group of UHS students during a hands-on activity during the I-STEM Camp's MCB Day.

showing them a crime or how to solve the crime, it maybe makes it relevant or more interesting.”

Is this something that a forensic scientist would actually do?

“Yes, definitely,” she says. She qualifies that in this activity, students were only looking at one aspect, whereas in the FBI, for instance, they usually look at maybe 13 different factors. Plus they use specialized software to compare the DNA to a whole database of DNA. “But it actually is stuff that forensic scientists use,” she says.

For Anshika Gupta, currently in the 2nd year of her MCB graduate program, this was her first time ever participating in such an event. She reports:

“I think something like this where we can make a fun scenario for the kids to follow along with is more interesting. It can maybe grab their excitement a little bit more and motivate them to maybe consider science in their future. I want them to have a real experience, like this is really what we do every day in lab. And if they can understand that, then maybe they'll be interested, hopefully.”

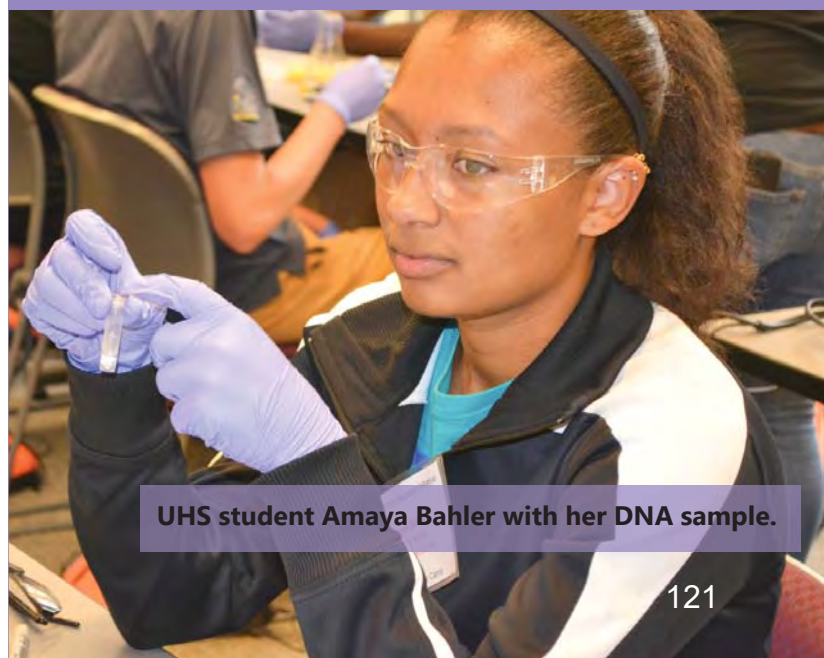
“I was keen on seeing how enthusiastic are high schoolers about science, and if I can do anything to motivate them more...Also, I was keen on trying to explain science to someone who is not familiar with the kind of science terminology we scientists use. So, trying to explain them in ways which they could understand and correlate from their daily life, was something I was very excited to try my hand at.”

Another MCBee member, MCB Ph.D. student **Paola Estrada**, who's majoring in biochemistry, participated in the camp because she enjoys working with students. Also, Estrada hopes to get them interested in science.


“I like to volunteer, do something else, get out of the lab,” she admits. “It seems like a good thing to get people into science, especially high school students.”

Her goal for the day? To expose the high school students to real science:

“To get them interested a little bit, to see what it actually looks like. I feel like in high school, you do a lot of book stuff, and you think that maybe it's all not real. But I guess what we show here is actual, real science. What we're doing today, PCR gel electrophoresis, this is stuff that we do every day. Especially the way we're doing it,



UHS student Amaya Bahler with her DNA sample.



Mara Livezey (right) watches as a student places their sample in the equipment in order to perform a Polymerase Chain Reaction (PCR).

not have taken up engineering in college or explored much more about biology than learning its basics. But nevertheless, here I am, doing something which I really like. A practical experience like this makes it so much more interesting to learn something and know what people like the forensics actually do.”

Regarding MCB Day's impact on the students, Gupta thinks most really enjoyed it.

“These kinds of activities bring their curiosity out, which I could observe by the kind of questions they asked. I think in this playful game they ended up learning something new and cool which they wouldn't have experienced otherwise.”

Jeremiah Heredia, a 4th-year MCB PhD student whose research is on how to develop a vaccine against HIV-1, says he participated in the I-STEM camp because he wanted to give back to the community. In fact, he got to where he is today because of a couple of similar programs, MARC and RISE, which train minority students for entering a PhD program.

“I owe my career to these programs, because before I joined, I did not believe science was for me, because no scientist looked like me,” he acknowledges. I had this preconceived notion that research scientists were all just naturally gifted and that they did not like sports or to socialize. I wanted to show these students a different perspective of science than the one I had as a teen. I wanted to show that science is fun and, more importantly, meant for everyone.”

Gupta, who works in Dr. James Imlay's lab, is researching DNA repair enzymes important under oxidative stress, in particular, enzymes which play a major role in E.coli.

Gupta, who never got to see this part of biological sciences as a youngster, says these kinds of events “open up a vast world of opportunities for high schoolers.” She claims that in high school, she only saw a few anatomical structures of some animals more related to the field of medicine, which never interested her.

“But there is a huge field of biology at the cellular level which no one taught us, which I find really interesting. Had someone exposed me to this branch of biology in high school, I might

As a member of an underrepresented group in STEM, Heredia is cognizant of the importance of programs such as I-STEM's camp, which can help steer minorities into the STEM pipeline.



UHS student Tyran Pickett examines containing some DNA.

“There are a lack of women and minorities in the science field,” he says. “It isn’t because these groups are less capable of doing science; instead, it’s simply that they are not exposed/ encouraged to do science. I-STEM’s camp is great because it exposes students to science while they are still in high school.”

Regarding the camp’s impact, Heredia says he tried to connect with the students and believes he might have gotten a few interested in science.

“I wanted to get to know the students. I asked them several questions about their goals, and I laughed with them. When I gave my 10-minute research talk about developing a vaccine against HIV-1, I had several questions from the students. I hope by doing all of this, I sparked an interest in the students, while at the same time making them feel comfortable with science.”

Rising sophomore, **Alarea Jackson**, who plays basketball at UHS, reports that she participated in the camp to learn more about science.

“Because I wanted to get a better knowledge on science and the stuff that we are doing, and hopefully it will help me with my high school studies and probably college.”



MCB grad student, Jeremiah Heredia, works with UHS student, Akierra Bufford, who is learning how to use pipette in order to do the DNA hands-on activity.

In light of her possible future career choice (Jackson hopes to become an anesthesiologist and to major in chemistry in college), the MCB’s lab activities were very apropos, and she gained some important skills: “I have never used a pipette before, and it was my first time using it.”

Who did she think did it? “I think the undergrad did it,” she admits.

MNTL DAY EXPOSES UHS STUDENTS TO NANOTECHNOLOGY RESEARCH DURING I-STEM'S SUMMER MULTIDISCIPLINARY CAMP

August 8, 2017

On Tuesday, August 8, MNTL Day, the 27 Urbana High School (UHS) student athletes who participated in I-STEM's pilot summer camp, a multidisciplinary STEM program, visited MNTL (the Micro and Nanotechnology Lab) for "A Primer on Semiconductors." Students had the opportunity to hear from each of the eleven P-20 STEM teachers who participated in the nano@illinois Research Experience for Teachers (RET), funded by the National Science Foundation where they did cutting-edge research in nanotechnology under some of Illinois' premier researchers in the field. In the afternoon, Dr. Mark McCollum led students on a tour of MNTL's cleanroom laboratory.

In addition to hearing about the research done by the eleven nano@illinois RET teachers, the goal was for them to closely evaluate the poster presentations teachers did about their research this past summer, in preparation for creating their own poster about their I-STEM camp experience. Students used a rubric to evaluate each teacher's presentation according to the following four criteria: organization, use of graphics, effectiveness, and responsiveness, giving each a grade from 1 to 3.

For instance, one Nano@Illinois RET participant, J. D. Graham, who teaches biological sciences to grades 9-12 at Sullivan High School in Sullivan, Illinois, shared a poster about his research, which involved using a nanoSIMS machine to separate out atoms or ions according to their mass by sputtering (hitting a cell and exploding an area over and over), thus removing layer by layer, nano-meter by nano-meter, to create a 3D model of where all of those atoms were, then label them and associate them with certain organelles, enabling researchers to learn their composition and their position, which has never been done before at this resolution.

Graham shares why the I-STEM camp was a good experience for the UHS students.

"It's just exposure," he acknowledges. "It's like learning another language; it's like going to another country. You can hear that those things exist, but to actually see somebody speak a language, it takes the mystery away that it's not something somebody else does, it's something you can do."



UHS students during a tour of the MNTL.

Another teacher who shared his poster with the high-schoolers was Antonio Gamboa, who teaches Chemistry, Biology, and AP classes in Pomona, CA. While he also worked with cells and neurons during his research this summer, one significant accomplishment that relates to his high school students was the creation of a solar panel. "So the students will be able to create a solar panel in the classroom," he says, "and it's really fast, easy, inexpensive; the lesson is all written and available for teachers; so it's really exciting."

Regarding why the high school students should be exposed to research, Gamboa says:

"It's essential. I mean high school students—anybody should participate. I think they should be exposed to the fact of being able to try to find out something new. Just to learn something you didn't know and to question, I think is fantastic. That's a great opportunity."

Regarding the positive impact participating in the I-STEM camp and attending their poster presentation had on the local high schoolers, Gamboa shares why it was good for the students to come to something like this:

nano@illinois teacher, Antonio Gamboa, presents his research



Dr. Mark McCollum, principal research engineer at MNTL, speaks to the campers

"It opens up their eyes," he says. "It's very difficult in high school to be able to see the opportunities. You can tell them, talk to them, show them, but there's nothing like walking on a campus, seeing the buildings, talking to people, seeing the posters, seeing everything. It all becomes real."

And according to Gamboa, after students participate in programs like this, there's a noticeable change.

"You notice it when they come back, they are different. What I notice is that they come back and they're ready to go to college. They're excited, motivated, and now they see that it's real. So many of the communities don't have this exposure. They don't have doctors or lawyers; they don't have anybody. You tell them and it seems to be open in the air, like maybe it's for someone else. But once they come, they realize that, 'Maybe, this is something for me!' And that is life changing."

In addition to listening to and evaluating the presentations, the students also spent time with Dr. Mark McCollum, a principal research engineer at MNTL, who explained how semiconductors work and why cleanrooms are important to research.



Dr. Mark McCollum explains why cleanrooms are important to research going on at MNTL.

going on at MNTL. He also discussed a number of instruments that MNTL researchers use. To cap off the day, the students then suited up for a tour of the cleanrooms.

Regarding why it was important to bring high school kids on campus in an event like I-STEM camp, Shawn Hampton, UHS Academic Coach explains:

“I feel it's important because inspiration. I feel children need to be inspired and they also need to be exposed. I feel a lot of the things I do now are the things I did in high school or grade school. And so it's important for them to be exposed at a young of age as possible to possibly find something that they love.”

In his role as academic coach, he says one important aspect of the program is exposure, which is why the I-STEM camp was important. In fact, Hampton expects that in the future, they'll see results. He shares an anecdote:

“So one of the philosophies that we uphold is the principle of the bamboo seed. When you plant a bamboo seed, it takes 5 years before growth. You have to nurture it, you have to feed it, you have to water it. After year one you get nothing. After year 2 you get nothing. After year 3 you're still looking at

a piece of ground that has no growth. Year 4, and in year 5 that bamboo seedling actually grows 90 feet.”

Regarding the impact of events like the I-STEM camp, he says it may take a while. And the way we look at our children is that they're all bamboo seedlings,” he continues.

“Even though we're pouring into them, we're exposing them, we're giving them different opportunities, we're not seeing the result like we expect to see the result. But what I want to let people know, is that it's happening. And it's going to come out, and it's going to come out really fast, but it's going to come out much later. And so, I may not see how I've impacted these kids this year, or even next year. But what I know is that in 10 years, there's going to be something that they really grab hold of. And that's really what it's about.”

Does he expect to get a call in, say, 10 years saying “Hey coach, that was so important!”?

Yep, and then he says he expects to hear something like, “I just built this missile,” or “I just made this code!”

AKONO AND COMPANY TEACH UHS STUDENTS ABOUT CIVIL ENGINEERING AND STRENGTH OF MATERIALS DURING I-STEM'S MULTIDISCIPLINARY SUMMER CAMP

August 9, 2017

Concerned about bridges or other structures cracking? Civil & Environmental Engineering (CEE)

Assistant Professor Ange-Therese Akono is. So on Wednesday, August 9, during I-STEM's multi-disciplinary summer camp, she introduced 27 Urbana High School (UHS) students to her niche: determining the strength of various materials in order to build stronger structures. Plus, along with several hands-on activities related to Akono's Design for Toughness research philosophy, the students not only discovered what research is like, but got to interact with college students and to experience being on a college campus.

During the CEE Day activities, Akono and her students introduced the high-schoolers to jargon they use every day— concepts like the mechanics and physics of fracture and the connection between a material's microstructure, composition, and fracture resistance. After each brief teaching, students performed a related hands-on activity. For instance, they did an indentation test to measure the strength of various materials, using metal balls to make indentations in a foam block, a limestone



Akono explains a principle of civil engineering to the UHS students.

slab, and a piece of composite or plastic, then measuring the indentations in each.

To experience how researchers prepare stones for indentation tests, the high schoolers learned how to polish specimens. Using a four-part polishing process, they polished for two minutes using a very rough piece of sandpaper, repeating the step with progressively finer and finer sand paper, until the stones' surfaces were no longer cloudy and rough but so smooth and polished that an image of the building visible in the windows behind them was reflected on the face stone.

This procedure wasn't busy work that Akono and company came up with the keep the students occupied; it's what Akono's students do in the lab every day in order to test materials. In fact, undergrad Anleng Cao insists:

"I've done all the stuff that they're doing, so it's real lab work that they're doing. They're using real materials that were extracted from New York; they use big machines to get these rocks out. And they're using the real polishing heads that I also use in the labs. So, this is all exactly the same stuff. So that's pretty cool."



During CEE Day, a UHS student sands a specimen to be used in an indentation test.

The high schoolers also learned some principles about building sturdy structures, then were challenged to see which group could build the sturdiest popsicle-stick bridge, which they tested at the end of the day.

Plus, in the afternoon, students toured a couple of Newmark's Labs. In the indentation lab, they saw how the stones like the ones they had polished are used in indentation testing. They got to see a small drill in action: first it was pressed into a specimen, then a computer program that determines a specimen's strength measured the microscopic indentation it had made. They also experienced Newmark Lab's huge Crane Bay.

According to Akono, events like this help high school students "get excited about science. They get to discover an aspect of science they wouldn't have thought about. In this case, we're looking at civil engineering. They get to understand what it is to be a civil engineer, what kind of questions we're asking, and how this is both exciting but also applicable in real life."

Akono also wants students to understand how her field is related to their everyday lives. She says students experience civil engineering every day, "but maybe they've never thought about all the people actually designing it."

Her long-term goal is that some of the high schoolers might decide to become civil engineers themselves. She hopes to

"Inspire them so that later, they would select these careers and be the future engineers we need for this country."

While holding an event for high schoolers is extra work for Akono and her team, she believes they also benefit from the students' enthusiasm and different perspectives. "I like the breadth of the questions that they have, the diversity of questions that they have, and a lot of times, actually, I'm taken aback by an aspect that I actually hadn't thought

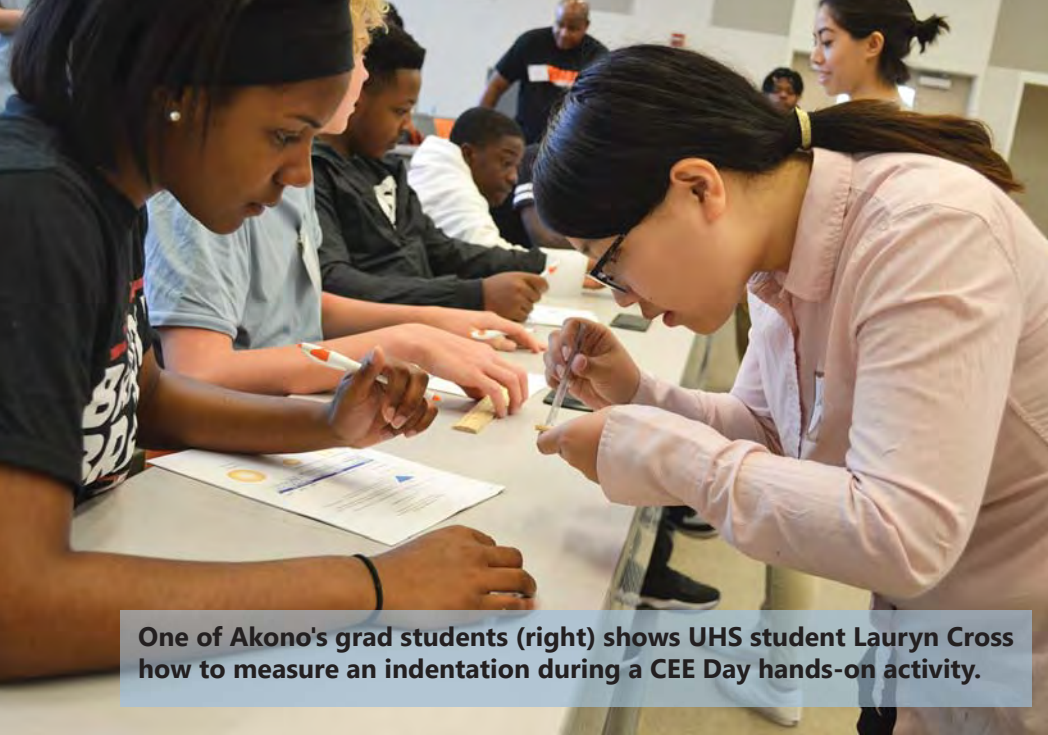


UHS student does calculations during a hands-on activity.

about, so it's actually very exciting," she admits. "I'm actually looking forward, because later, in the afternoon, they are going to go into the lab, and I want to see what types of questions they will ask."

One of the challenges Akono encountered was to communicate her research in a way that high school students could understand. She says it's very different teaching this age group compared to the college students she's used to teaching.

"I think, to some extent, it is a little harder," she admits. "It is easier because I have to be rigorous, but I just need to make the material more accessible. But this becomes more of a challenge



One of Akono's grad students (right) shows UHS student Lauryn Cross how to measure an indentation during a CEE Day hands-on activity.

She admits that, for her, a lot of challenge lies in trying to find the correct balance in terms of how challenging to make the material.

"I want the activity to be interesting for them and challenging, but not too challenging. College students, I'm teaching them every day. But it's been a long time since I graduated from high school and I didn't actually do my high school here in the US. So I have to kind of ask myself, is this the correct level? Is it not too hard, not too easy? Also because we don't want them to think that we're treating them as if they are kindergartners."

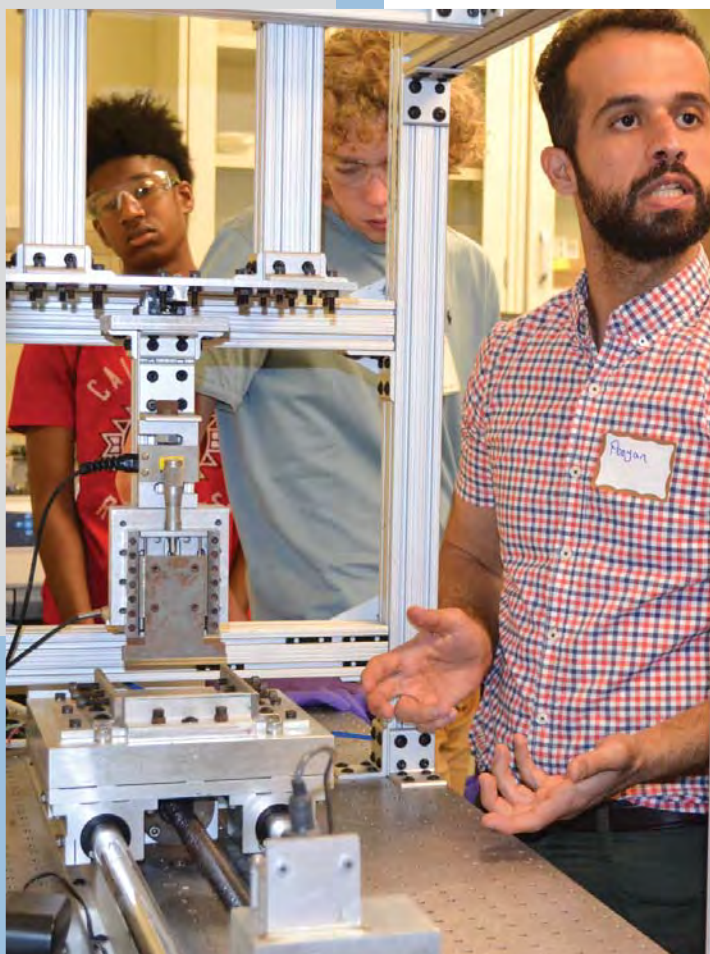
because there are a lot of notions for me that are very obvious. I tend to be even oblivious to those terms that have a very obvious definition. For me, it's just common sense, but I need to find a way to explain it."

Another challenge is not just communicating to a different age level, but taking into consideration the students' interests and passions. "How do I make it relevant to their day-to-day lives?" she asks.

Amrita Kataruka, a PhD student in Akono's lab, took part in the camp "because I kind of like to interact with kids. So when Professor Akono told me there's going to be an outreach, I was actually excited about the idea. So I told her, 'Sure, why not?'"

"How do I make civil engineering relevant to a 15-year-old? How do I connect it to an iPhone? There's definitely a lot of overlap, but just having to constantly be thinking about it, that is actually why there is that level of challenge."

In fact, at one point, to connect with the students, she did pull out a cell phone to use as an illustration when discussing materials.



Civil Engineering PhD student Pooyan Kabir shows the high school students some indentation lab equipment.





Akono looks at a specimen to see if it's been polished enough to perform an indentation test.

adds. “So it's always good to bring in some new fresh high school people and then they know what they want to do in the future and that way they have an idea of what they're getting into in the future.”

Kabir, who did his undergrad in Iran and his Master's at Texas, is now going for his PhD at *Illinois*. When he was in high school, did he ever think he would end up in one of the best civil engineering schools in the world? “Probably not,” he says.

“My dad wouldn't have thought that either. It's a pleasure to be here. I love doing this, and I'll keep doing this as long as I'm in this environment.”

Kabir loves working with high school kids and doing outreach; that's why participated in the outreach:

“I had a company back home when I was young, when I was like 20 years old, and I always worked with younger people and the younger generation. I always like to inspire them and teach them something and also have fun with them. It's important to have fun as well when you're teaching them. That's what inspires me.”

Regarding the benefit for high school students of an activity like this, Kataruka says that:

“As a high schooler, they have a lot of questions in their minds about what future aspects they have or what should they choose later on. If they start doing such kind of activities, they kind of get a feel of what they're enjoying more or if this is something they want to do or not. So it basically, I think it helps them decide what they want to do later in their lives.”

Another PhD students in Akono's lab, Pooyan Kabir agrees with Kataruka regarding the importance of bringing high school kids to events on campus in order to help them in their decision making regarding their career.

“I remember when I was in high school, I didn't know what I wanted to do!” he recalls. So his dad, a mechanical engineer, and his brother, who was studying electrical engineering, took him to the university. “They showed me what each group goes through, and then I saw what they're working on and then so I had an idea.” And based on that input, “I decided to do civil engineering,” he



A UHS student tests the strength of a foam block during the indentation study.

ECE DAY AT I-STEM'S MULTIDISCIPLINARY SUMMER CAMP: SOLDERING, CIRCUITS, AND SOFTWARE

August 10, 2017

The earlier you get exposed, the better you'll be at it... because it's something you've seen before." —ECE Graduate Student Lonna Edwards

What is Electrical and Computer Engineering (ECE) anyway? On Thursday, August 10, 27 Urbana High School (UHS) student athletes found out a little about it at the I-STEM Summer Camp's ECE Day, when ECE's Lynford Goddard and several students from his lab exposed the campers to some activities related to ECE. Students learned about then did hands-on activities about research experiment design, how to solder, and how to build circuits. In addition to learning about the field, students also interacted with several ECE graduate students and discovered a bit about what being an engineering student might be like.

Goddard began the day by teaching the UHS students what makes a good research experiment and how to design one. He even threw them a curve ball with an LED light research activity where only half of the LEDs would light up to challenge them to trouble shoot. Then, after learning some things about circuits, such as their role and



An I-STEM camper builds a circuit during ECE Day.

to build one, the students then proceeded to build one of their own.

Key to the circuit-making process was soldering; while a few of the high schoolers had had previous experience soldering, for most, this was the first time they had ever tried it. But after a brief lecture about the specifics, they all eagerly began the activity, and through trial and error, they got the hang of it. According to Aditi Udupa, one of the graduate students in Goddard's lab,

"Most of them are new, but they picked it up very fast. Initially, they were very confused, but considering they didn't have any experience, they were pretty fast to learn it."



A UHS student learns how to solder.

Goddard and his team also exposed the high school students to the other half of ECE: Computer Engineering. So learning to write code to test their circuits was also on the agenda. . In order to make sure their circuits worked, they were taken up to a computer lab. Goddard led the students step by step to create code



Arunita Kar, an ECE grad student, helps a UHS student doing a hands-on activity.

“Because they may not know what engineering is about, and they may not know that they can do something like this.” She believes the camp could give them something to get interested in and get started with.

Udupa claims she also got involved because her mentor, Goddard, is really passionate about outreach, “So I think I took some of that, and I like to teach specifically, so this is a good way to get some experience.”

Another of Goddard’s graduate students, Arunita Kar, who’s just finishing up her Masters’ and will soon begin her PhD, reports that the benefit of bringing high school kids into a lab like this is “mainly the exposure.” She indicates that when she was growing up, anytime someone said electrical engineering, she thought of not just circuits, but trains and things like that.

“But here, she explains, “not only do you get circuits, but you get photonics and optics, and you get to see the whole convergence of all of those many different things that all rely on electricity and electrical engineering and electronics. So it’s really nice.”

Regarding the day’s hands-on activities, Kar says,

“Getting an early start like the things they’re doing in these projects like soldering and programming are really useful later on in life, and I wish I had had these opportunities.”

that would test whether or not their circuits were connected and soldered correctly. Then he used the program to test a few of the circuits they’d just built. Each student also received a copy of the program to take home and experiment with.

Why do Goddard and his students take time away from their research to work with high school students? Udupa says outreach events like this one might encourage students to consider college...and to show them that they too can do engineering. She claims the activities can “Get them interested and give them motivation to go to college.” She also says the camp could get them interested in engineering.



Aditi Udupa, an ECE grad student, coaches a camper through the process of building a circuit.

Another grad student from Goddard's lab, Lonna Edwards, (who was also involved in four other camps this past summer), indicates that, like Kar, she participates in outreach events like ECE Day because it's something she didn't have access to at that age.

"I love doing outreach. It's something I wish that I'd had when I was younger. I wasn't aware. I didn't know what an engineer was until I was starting college, and I learned about what they do, so I just picked it as a major, not really knowing much about it. It was a struggle in the sense that I had to maintain a certain GPA, so I was stressed out a lot of the time. But I made it, so I made it a goal to expose people earlier."

Edwards says it's a good idea to bring high school kids into a lab early. "The earlier the better," she says. "But kids who get to experience this are at an advantage, because they're learning about things I didn't learn until I got to college. I tell them not to feel bad if they feel like they're not getting something, I tell them that they're still ahead of the game."

"The earlier you get exposed, the better you'll be at it, because it won't be as stressful, and because it's something you've seen before," she adds. "You'll be able to learn it and be confident. So I wanted to reach out to kids who are younger so they get that exposure, especially kids that are underrepresented in the field. That's my main reason for doing it."

In addition to exposing underrepresented students, Edwards likes to participate in events like I-STEM's camp because she just plain likes teaching.

"I feel like a lot of people think that engineering, math, and physics are hard. They're difficult, but I think that it's all in how someone teaches them to you. Somebody can explain it to you in simple terms, because anything can be broken down into simple terms. Then, you see that it's not too hard, and it makes you want to do it. I kind of want to motivate kids and say that 'It's not too bad. It's hard to the outside world, but really, I know this trick!'



Aditi Udupa talks to the UHS students during their visit.

MATH DAY AT I-STEM'S MULTIDISCIPLINARY SUMMER CAMP ADDS UP TO FUN

"Math should be painted in a fun light!" – Mathematics PhD student Vanessa Rivera-Quinones.

August 11, 2017

And that's what the folks from Illinois' math department did when 27 Urbana High School (UHS) athletes, mostly underrepresented minorities, participated in Math Day as part of the first-ever I-STEM Summer Camp. "This is math?" is a question that cropped up while, grinning from ear to ear, they raced against time to stop the spread of an epidemic on the VAX website, or wrestled with a challenging combinatorics activity, or struggled to get their mind around mathematical logic as Philip Hieronymi presented some virtually unsolvable brain teasers. So while participating in a variety of challenging, hands-on activities that showed them that math is useful in real-life situations and can be quite different from what they learn in school, they also learned to think outside the box where math is concerned and discovered that math can be fun.

Math Day on Friday, August 11, introduced the high schoolers to a number of Illinois' mathematicians, who made the students feel welcome and introduced them to some of the work that they do.

Mathematics Department Head, Matt Ando, welcomed the students and discussed the importance of math. Assistant Professor Phillip Hieronymi introduced students to mathematical logic via a "brain teaser" about Alan Turing. Plus, several math Ph.D. students, Elizabeth Field, Alexi Gorman, Vanessa Rivera-Quinones, and Colleen Robichaux led the high schoolers in hands-on activities related to math research.

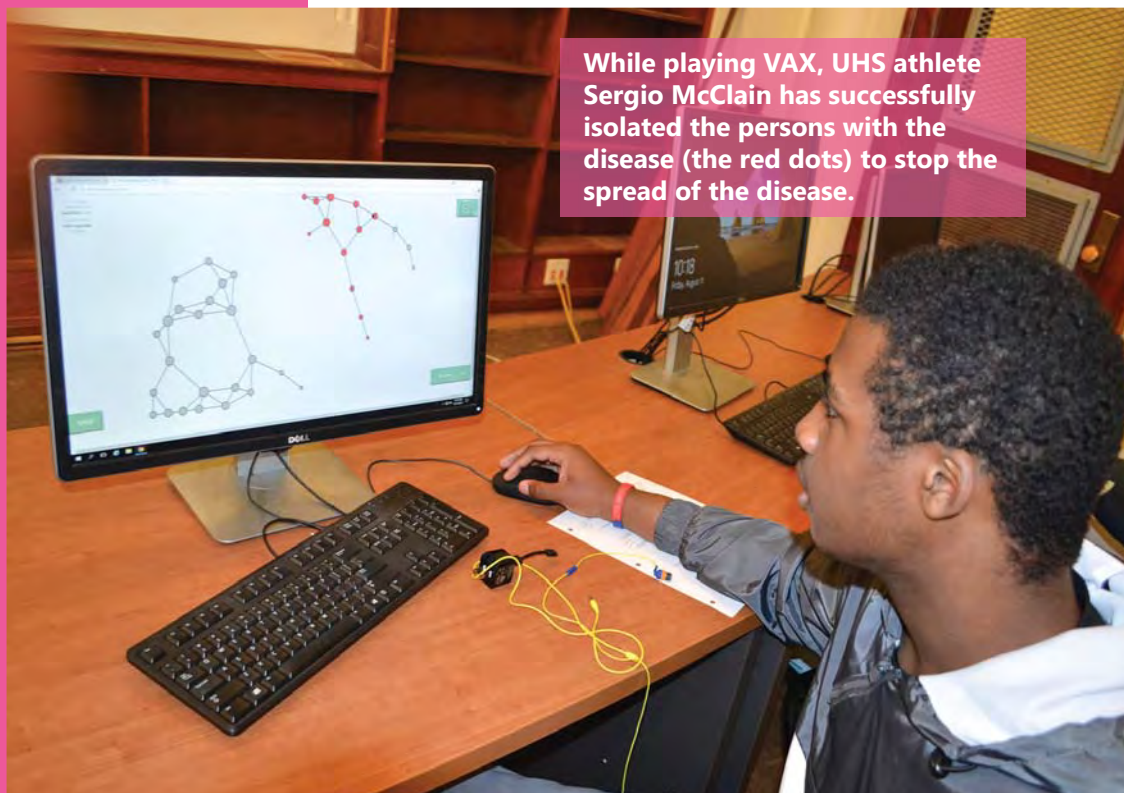
For instance, Vanessa Rivera-Quinones, a fifth year math Ph.D. student, uses mathematical models

in her research to try to understand how disease spreads. In collaboration with a researcher in bioengineering who studies specific parasites, she makes mathematical models to explain what happens during an epidemic in a lake ecosystem. To give students a glimpse into her work, she did a fun event with the students related to disease modeling, leading the students in an exciting exercise related to real life and to her work in epidemiology (the spread of infectious diseases).

In a website game, called VAX, students were to stop an infectious disease epidemic and were given a limited number of "quarantines" (breaking a link from one person to another) to try to stop the spread of the disease. However, once the disease got started, it spread rapidly from person to person, and the students were quite engaged as they scrambled to try stop it from spreading—with varying degrees of success.

For instance, how'd I-STEM mentor Kushal Goenka, an ECE major, do on the VAX game? He crashed and burned.

"The easy part was pretty simple, but the medium, I did quite bad. Everyone died in the game," he confesses.



While playing VAX, UHS athlete Sergio McClain has successfully isolated the persons with the disease (the red dots) to stop the spread of the disease.

But despite the varying degrees of success the students—even the mentors—had, they had a great time. And Rivera-Quinones believes “math should be painted in a fun light,” and that’s why she participated in I-STEM’s camp. While admitting that math in school is interesting, she claims,

“It doesn’t tell you the complete picture. I always want try to motivate other students to see how math is used in non-traditional settings or how the math in high school could be pushed to explain some real-life phenomenon.”

Regarding the impact I-STEM’s camp had on the students, Rivera-Quinones reports, “Since this program is trying to paint the picture of what a researcher looks like, hopefully they can see that it’s not just one picture; across different disciplines, we do different types of things, and all of them are research.”

According to Rivera-Quinones, her main goal was for the students to gain confidence: “My hope for them is that they understand that there’s not one definition of being a mathematician,” she explains. “They can also be mathematicians even though they’re not pursuing a PhD in math. As long as they have interest in how things work and how patterns are formed, they can also be mathematicians.”

She also hopes that the experience during the camp leads the students down the path of self-discovery and they gain some insight into how they



Professor Phillip Hieronymi introduces students to mathematical logic.

might make their own unique contribution to the world.

“I think it’s important that they’re doing this program and that they get to see what it’s like to be a scientist, or a mathematician, and really think about what that means for themselves...So I’m hoping this allows them to identify things about themselves and what they want to maybe pursue and hopefully, later on, contribute to the world.”

Elizabeth Field, another Math grad student, got involved with the camp because in high school, students don’t really see how the math they’re learning is used. “They don’t necessarily see that it’s something they can actually study for a job. They see it more as a means to an end,” she says.



Elizabeth Field coaches a UHS student through an activity.

“I think it’s great for high schoolers to see that math and science are very different from what they’re necessarily learning in high school. It’s very cool for them to be able to see that it’s something they can actually do or they’re interested in.”



Math PhD students Colleen Robichaux and Alexi Gorman.

Colleen Robichaux, a second-year math PhD student interested in Algebraic Combinatorics says she participated in Math Day because she's passionate about education. She says her undergraduate degree was math with a concentration in secondary education. "So I'm passionate about education and enjoy working with students. I was excited to show them concepts they had never seen before in a digestible way."

Robichaux says it's important to bring high school students onto campus for an event like the I-STEM camp's Math Day so they might see math as a potential career.

Regarding the impact Math Day had on the students, she says:

"I hope that it's allowed them to see that math can be used in ways that they haven't necessarily thought about. Who would think that you would use math to model how a disease spreads? You don't realize that."

Working with the combinatorics and number theory activity were Math PhD students Colleen Robichaux and Alexi Gorman. Combinatorics focuses on the patterns between various sets of numbers and evaluates similarities and differences between different sets of numbers. Students were taught about how numbers can be diagrammed to better see patterns between different numbers. Although the theory and way of thinking was new, as the students came to understand it, they found it interesting and enjoyable.

One instructor who worked with the combinatorics activity was second year Math PhD student Alexi Gorman, whose research is finding ways to make mathematical structures understandable in a way a computer might understand it.

Excited to work with high school students and high school athletes, she participated in Math Day because, "It's another good opportunity to make very sophisticated mathematics understandable to people who would benefit from knowing that this type of math is out there."

"If not for this program, many of these students would never have any idea of what math research is or that there is a place for them in math research. This program is excellent in that it not only humanizes the researchers, but also is designed to appeal to students to show them potential career paths they might never have considered. Further, it is simply a fun way to get students thinking!"

And according to Robichaux, the students learned that math is fun...and cool...and that they could do it!

"The students seemed very engaged," Robichaux reports, "and surprised that what we were doing is considered math. They seemed intrigued and had fun thinking through the activity and discussing with their peers. In the long term, I think this has shown students a more realistic view of what mathematicians do and how we work, as well as showing them that they are more than capable of doing some cool math."

DURING I-STEM SUMMER CAMP, URBANA HIGH STUDENTS' UNDERSTANDING OF AEROSPACE ENGINEERING SOARS

August 14, 2017

Amidst cheering, laughter, and lots of trash talking, the 27 Urbana High School (UHS) student athletes at I-STEM's first-ever, multidisciplinary summer camp were attempting to launch (some successfully, some not so successfully) balsa wood gliders and model rockets they'd built during Aerospace Day on Monday, August 14. Students had learned some engineering and physics behind how airplanes and rockets fly: via several brief lectures, demonstrations, tours, and lots of hands-on activities, they'd had learned about flight mechanics and jet engines, the basics of rocketry, and experienced how the aerodynamics of various shapes are tested in the wind tunnel. Then, after designing and building their masterpieces, they reached the high point of the day—a chance to attempt to launch their aircraft.

The day began with a brief introduction about Aerospace Engineering from Bliss Professor and Department Head Philippe Geubelle, then a couple of Aerospace grad students shared about current research on the shape of airplanes and how to improve rockets.

The UHS students then visited Talbot lab, home of Aerospace Engineering. During a tour, students saw several Rolls-Royce jet engines used for teaching purposes, learning about some of the different designs and how they'd been used in aircraft in the past. Students also visited the wind tunnel lab for a demonstration of testing the aerodynamics of different shapes, and saw how light and mirrors are employed to show the air movement created by those shapes.



A UHS student hopes his rocket will fly the highest on Bardeen Quad

The day wasn't just about instruction and tours. Students actually created their own aircraft. They made Balsa Wood Gliders which they "flew" in one of Talbot's long halls to test how they could change the way their plane flew by using different weights and positioning pieces in different ways.

After learning the basics of rocketry, the students then built their own rockets. To make the activity a bit more interesting, the instructors made it a competition: using the principles of aerodynamics and rocket design they'd learned, students were to create a rocket that would fly the highest. And of course, each aircraft was unique, reflecting each student's personality. Then, toting the aircraft they'd built, they retired to Bardeen Quad to see if their aircraft would fly, and if so, how long and how high.

While some tested their rockets, other students explored Alka-Seltzer Rockets. Combining Alka-Seltzer tablets and water in a film canister, the students then closed the lid and tipped them upside down until enough pressure built up to cause the main body of the film canister to shoot up into the air.



An aerospace student instructs an I-STEM camper on proper rocket-building technique.

Elle Wroblewski, an Aerospace Ph.D. student who helped with the camp, shares why events like the camp are important for high school students.

"When I was in high school," she says, "my impression of engineering was only based off of what older people would tell me; I didn't have any first-hand experiences as to what that meant. An event like this shows students more in depth and gives them a better grasp as to what engineering is and shows them a practical application in math and science, whereas beforehand, I feel like it's a little more theoretical, or it's a bit more science-fiction based."

In fact, much of what kids believe about space flight is based on what they've seen in movies and on TV and "not so much on technical details," Wroblewski admits. "An event like this makes it more realistic, so that when they're thinking about careers, they have a better grasp as to what it actually is."



A UHS student builds a glider during one of the Aerospace Day hands-on activities.

More importantly, Wroblewski says these types of events show them that they have what it takes to be engineers, refuting

“Pre-conceived notions like ‘I can’t do that because I’m not smart enough,’ because they’ve experienced that they are smart enough to do it. It’s exciting and fun that they can achieve something as opposed to not knowing whether or not they could.”

Aerospace Day definitely impacted the UHS students in a positive way. For instance, Damuzha Moore says Aerospace Engineering might be one of his choices for college.

Kuanu Duke reports that one of his favorite days was Aerospace Engineering, with its intriguing hands-on activities: “because we did interactive stuff—we were touching and building stuff.”

Jeremiah Hamilton indicates that his favorite day was “Rocketry: I do this for Boy Scouts and other things like that.”

One student, Damuzha Moore, was particularly intrigued by the jet engines.

“Aerospace Engineering has been my favorite,” he explains, “because it’s focused all on the jet engineering, and the engines and all that.”

One of the I-STEM mentors, Kushal Geonka, was hopeful that Aerospace Day and I-STEM camp might influence some of the students to consider careers in STEM fields:

“I just hope at the end of these two weeks, some of them will decide on STEM careers, some of them will think of what they want to do in the future and that it may be related to science, technology, engineering, and mathematics.”



Students fly the gliders they built in the halls of Talbot Lab.

UHS STUDENTS EXPLORE COMPUTER SCIENCE, CODING, DURING I-STEM CAMP'S CS DAY

August 16, 2017

For students from a generation that cut their teeth on computer and electronic games, what could be more fun than creating their own? So on Wednesday, August 16, 27 Urbana High School (UHS) students learned a bit about Computer Science and coding during CS Day at I-STEM's multidisciplinary summer camp. And to put what they'd learned into practice, they each created their own game or story on Scratch.

Computer Science is a field that can seem intimidating to many people, but I-STEM camp's CS Day helped to demystify the discipline. I-STEM camp mentor and ECE major Kushal Goenka, played a key role in teaching the students about the many facets of CS, as well as helping them trouble shoot while doing



An I-STEM camper working on her Scratch project

some coding themselves. He began by teaching students how to code and exposing them to a variety of coding languages. Among the programs he introduced was one known as Scratch, a free online community where students can code and create their own games and stories or add on to those that other Scratch members have created.

After Goenka's presentation about what it means to code, students visited a CS computer lab and made SCRATCH projects of their own. After an introductory session about Scratch, students logged onto computers in a CS computer lab to create their own projects. The students were quite engaged as they created their own programs and then got to present them to the other campers.

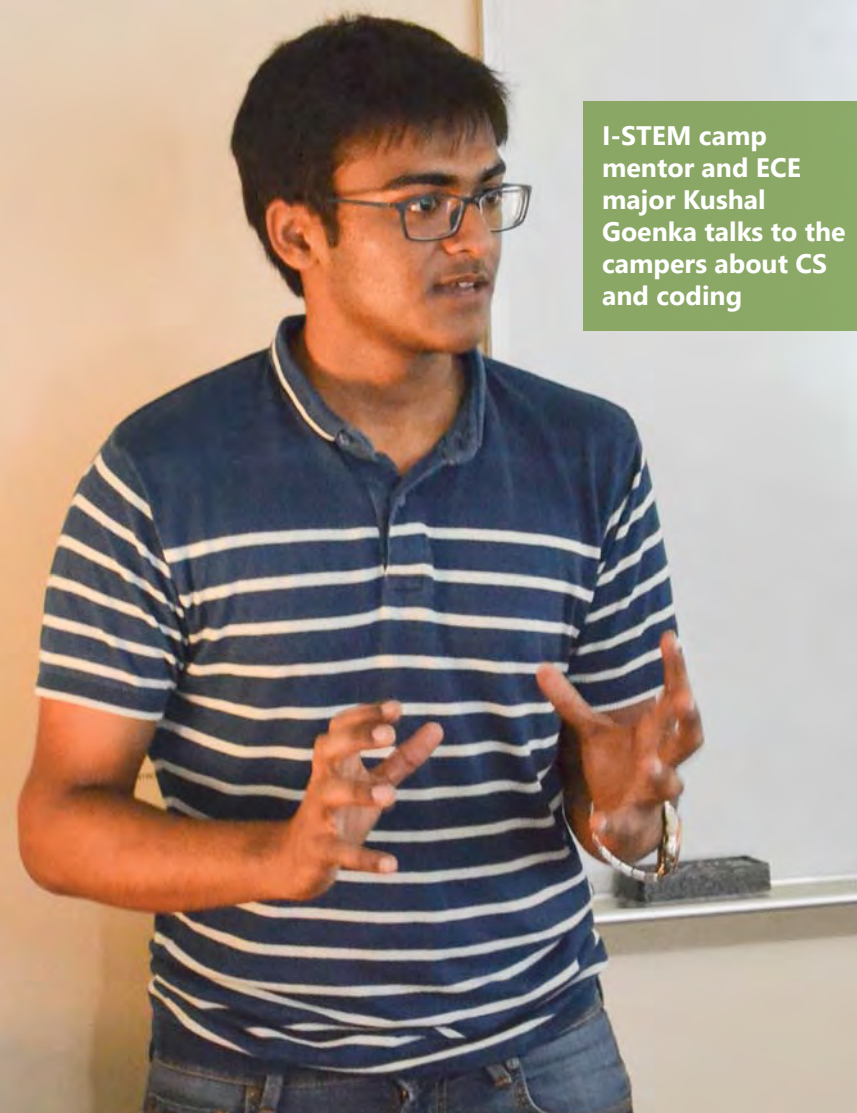
Following the Scratch project, students learned about real-world applications from CS PhD student Everett Hildenbrandt, who taught them that computer science is everywhere, explained about CS formal methods, then led them in a Magnet/ Copper hands-on activity.

Everett shared with the students that it was this activity, which is somewhat related to physics that brought him into STEM, and from there he explored further during a physics internship, then a programming project.

At the end of the day, students were encouraged to reflect on all that they'd learned so far during the camp and to begin to tie every day of the camp



A UHS student works on his Scratch project



I-STEM camp mentor and ECE major Kushal Goenka talks to the campers about CS and coding

lunch with a PhD professor who has been teaching here for 10 years, so he tells them how classes are going to be and how you have lectures, and work on your own. It prepares them for what lies in the future and not what they've been doing for 10-12 years in school."

Goenka indicates that he participated in the camp because he was going to be here on campus for the two weeks following the end of his summer courses and was looking for something interesting to do.

"I love STEM," he admits. "It's what my interest lies in, so that's why I wanted to do this. I love talking with high school students. I think education is important, and encouraging them to get interested, and telling them about what STEM fields look like and the opportunities that lie further on."

Goenka also had an ulterior motive: he wanted to be involved with the camp in order to experience some of the activities himself. "I wanted to experience all of this as well...After I found out more about it and knew that we'd be going to different departments around campus, I was intrigued, and I wanted to do that myself. I'm really interested in NCSA; I've never been there; we get to go to the Blue Waters [Supercomputer]."


What kind of impact did the camp appear to be having on the students? According to Goenka, it was very positive.

"I think they are doing fantastic. Some of them are pleasantly engaged. They are asking questions and taking notes. I hope they go back and do research on this with all their binders and the notes that they've gotten from the professors and graduate students. I think it's good; I think they're learning a lot and I hope they will learn in the next week as well. They seem interested. Their faces light up when they interact with the students and they see feedback, so that's very good."

together. Students were asked to think about the camp collectively and choose one word to describe their interaction with the STEM field. This word then became the basis of the group project they began working on in the afternoon. Their assignment? Put together a presentation and poster to be presented at Urbana High School to teach others what they had learned over the two-week camp. As students reflected on their experiences, they could hardly wait to come together to work on their project.

ECE sophomore and I-STEM mentor Kushal Goenka, who played a large role in the CS Day activities, shares why an outreach like I-STEM's camp is beneficial for high school students.

"I feel like they don't have opportunities to actually see what college life could be, since they aren't exposed to them," he says. "This gives them a hands-on opportunity to see how classes can be, colleges can be, and speak to professors. Yesterday, we had students interacting and eating

A group of students in a chemistry lab setting. They are wearing white lab coats and safety goggles. One student in the foreground is pouring a yellow liquid from a beaker into a small white container placed on a digital scale. Another student is wearing purple gloves and holding a stack of similar white containers. The background shows other students observing the process.

During the I-STEM Summer Camp's Chemistry Day, campers pour the soap they've made into a container.

AT I-STEM'S MULTIDISCIPLINARY SUMMER CAMP, UHS STUDENTS HAVE FUN WITH CHEMISTRY—EVERYTHING FROM SOAP MAKING TO GLOW STICKS TO ICE CREAM

October 12, 2017

How cold do you like your ice cream? Just on the cusp of melting? Cold enough to start a major brain freeze?

However you like to eat ice cream, using liquid nitrogen to freeze the ingredients will provide an instant, delicious dessert.

This was one of a number of chemistry-related topics that 27 Urbana High School (UHS) students got to explore and test on Tuesday, August 15, as a part of the brand new I-STEM Summer Camp, a multidisciplinary summer program that ran from August 7–18. The camp was aimed at exposing under-represented minorities to many STEM fields and job opportunities, as well as building teamwork and lab skills.

The day started with a presentation on lab safety from Dr. Tina Huang and her lab assistant Stephanie Legare. Though some might question whether this is necessary for high school students, Huang explains:

“You can experiment, but you also have certain parameters. That's for safety reasons. You can't just randomly mix stuff that we told



UHS students work together to make their own soap.

you that you can't. Especially with chemistry, explosions can happen, you know, things like that. That's why you have to understand what is a healthy dose of the boundaries in which we have to work in a chemical lab.”

Although the day was all about encouraging curiosity and creativity, Huang also emphasizes the need for proper lab safety for the well-being of everyone present.

So, after tie dye lab coats and neon orange safety goggles were handed out, the students began experimenting. Huang had planned out four experiments to engage students.

The first was saponification, the process by which soap is made. Students mixed, melted, and stirred the ingredients over a hot plate until they were left with liquid soap. As it cooled, the soap could then be molded into any shape the students desired. Many creative designs emerged, but the question remained: what was the point of the experiment? Huang wanted to show students that soap is actually just made up of fats and oils at its most basic



UHS students explore chemiluminescence, using chemicals to produce light.



I-STEM campers pour the soap they've made into a container

level. With the addition of an alkali metal, the oils in soap are fundamentally changed so that they are able to latch onto and dissolve other oils. This is how soap cleans!

Ever wondered how glow sticks can produce light without any heat? For the second experiment of the day, students explored the topic of chemiluminescence, which uses chemicals to produce light as opposed to combustion, which burns a fuel to produce both heat and light. The budding chemists' faces glowed just as much as their test tubes when the lights were turned off.

Document forgery is something one would normally hear in the plot of an action movie. For their third experiment, however, students experienced how scientists use chromatography, the process of determining the elements of a substance through a chemical process, to determine if documents have been altered or even if money has been forged. They started with melting the outer shells of M&Ms to figure out what colors are combined to create the rainbow of candies in every pack. For example, when melting brown, students discovered that instead of leaving a streak of the same color on the filler paper, the candy actually left streaks of red and blue. This process was carried over to pen inks, which were heated to a similar temperature to the M&Ms. The different types of ink flowed at different speeds, which is how it is possible to detect a forgery. If the ink from a suspect document flows at a different speed than a proven document, then the suspect document is proven to be a forgery.

To end the day, Huang had a special experiment planned to explore the topic of heat transfer, or

objects with different temperatures interact with one another. Students mixed whole milk, sugar, egg yolks, and a few other ingredients in a bag. Excitement swept around the room like a wave as the students realized that they were mixing the ingredients for ice cream! But how would they chill it? The day was almost over and there was no freezer in the lab. At that moment, Huang and Legare dragged in a big insulated tank filled with some mysterious liquid. After telling the students near her to stay well clear, Huang donned a pair of heavy duty protective glasses and goggles and opened the top of the tank, unleashing a blast of frozen air around the entire room. Students then handed their ice cream mixes to Professor Huang and watched as they were dipped into the mysterious cold liquid and flash frozen to

the perfect ice cream consistency. Huang explained that the liquid was actually a super-chilled liquid form of the gas nitrogen. Because it has such a low vaporization temperature, liquid nitrogen is cold enough to cause severe frostbite in a fraction of a second. Handled properly, however, it can be used to create a delicious cooled dessert in no time at all!



I-STEM campers reap the fruits of their labor and get to observe chemiluminescence in action.

According to Huang, activities like I-STEM camp's Chemistry Day are important to help students overcome their fear of certain STEM subjects:

"We hear from the students that in order for them to get interested, they need to start as early as possible," Huang explains. "Many students have a fear of STEM. Even though they want to major in it, they're sometimes afraid when they get to the college level. They view certain topics as really hard and difficult to master. I think if we get the attitude out and give them something fun that they can do, they'll know that it's not impossible and that learning also takes time. So then, we can have that attitude when they get college that it's going to be hard, but it's not impossible."

Regarding why she agreed to participate in the I-STEM Camp, Huang replied:

"I enjoy interacting with students in general. I have kids at the high school age, and I kind of understand how they think. I think I'm much more patient than other people when it comes to

dealing with high school students. I kind of know how to push them a little bit, they can't just push me, because I will push back. I have my own rules, especially for their own safety. I see that a lot of the good kids ask really good questions, and some of them say that they enjoy certain parts of the things and this is something that they don't get to do very often."

Regarding why she participated in the camp, Legare responded that she enjoys helping students learn about entirely new topics, "They enjoy it, it's fun to see them excited to learn something." She continues that camps like I-STEM's allow kids to experience what it could be like to work in a STEM field. They also allow students to dip their toes in how education at a higher level looks and gives them a sneak peek into the future if they do end up attending college.

With students munching their frozen desserts as they headed out the door, and conversations flying left and right as they chattered about their experiments with, soap, glow sticks, and M&Ms, the chemistry between the students was palpable. It appears that Chemistry Day was a resounding success.

Written by: Nick O'Connell



Tina Huang (right), helps a UHS student doing a hands-on activity.

UHS STUDENTS GEAR UP FOR MECHANICAL SCIENCE AND ENGINEERING DURING I-STEM SUMMER CAMP

August 17, 2017

A 24-year-old woman, Magdalena, who had bone cancer as a child and thus had an arm amputated, needs a prosthetic in order to maintain her livelihood. This was the scenario presented to 27 Urbana High School (UHS) student athletes as a part of MechSE Day on Thursday, August 17, during I-STEM's first-ever multidisciplinary summer camp. So the day's main hands-on activity involved making a prosthetic device. And while the students learned a bit about prosthetics and Mechanical Engineering during the day's events, they also learned some things about teamwork and what being a MechSE undergrad might be like.

Sharing their expertise on MechSE Day was a team of professors and students from MechSE, including Associate Professor Elif Ertekin, Assistant Professor Mariana Kersh, and MechSE grad students John Shanley and Kazem Alidoost, who shared about current research in their field and the elements that go into making prosthetics. Then the high school students got a chance to make one of their own. And, knowing that a good competition will



Elif Ertekin watches a UHS student work on his team's prosthetic.

always spur students on to greater achievement, the MechSE instructors divided the students into teams and made the activity a competition to see who could make the best prosthetic arm. The challenge? Design and build an arm for an amputee that operated using pressurized air from an air tank and included a hand with fingers that could pick up a pair of sunglasses...all in the shortest amount of time possible.

Embracing the challenge, students tackled the project. Of course, they thoroughly enjoyed the fun of competing. And while doing so, they also learned

a bit about the thought processes behind designing prosthetics. While working the kinks out of their design, the UHS students tried many different approaches (some worked, and others didn't), to design and build a working prosthetic. But if and when the teams reached an impasse, luckily, the instructors, who were knowledgeable about mechanics of prosthetics, were right in the classroom with them, so students were able to pick their brains regarding what might make their devices work better. As a result, most of the teams came up with some innovative, working prosthetic arms.

MechSE grad student, John Shanley, presents the challenge and its materials to I-STEM campers.





MeshSE grad student, John Shanley, watches on as a UHS student works through the Prosthetic Device competition.

What's the point of exposing younger students to a one-day clinic on prosthetics? According to MechSE's Mariana Kersh, it's beneficial to bring high school students to events like this on campus in order to expose them to engineering.

"Depending upon where they're coming from, they may or may not have been exposed to the applications that are available within engineering. It has to start early."

She adds that it's also important that students at the high school level learn that engineering is "a really broad and interdisciplinary world these days." Plus, she believes that exposing young people to the myriad applications and career opportunities within the different engineering disciplines (such

as prosthetics?) might increase the number of students, especially young women, who want to be involved. She recommends starting early to show younger students, especially girls, "that there are other options other than just the typical guy working on an airplane."

Kersh says events like the camp also serve as a "light at the end of the tunnel" and help students "learn that there is this bigger picture."

She says high school students must "come in with a bit of passion and a bit of curiosity and inspiration about the things they want to study. A lot of them may know that they're good in math or that they like science, but they don't really know where that's going to take them," she continues. Kersh envisions the event as helping to show them the possible routes early, and helping to keep them on track.

Plus, she insists that in order for students to avoid pitfalls and successfully navigate college with its ups and downs, they need to have a clear vision of what they want to achieve, and why. She believes that having the goal of helping others as part of their motivation can help to keep students anchored.

"It's not about the degree per se," she says, "it's about what you're going to do with it in order to help" that can help them to get through distractions and getting discouraged when they don't do well on a test, because they've learned that 'There's this bigger picture that I really learned about, and that's what is driving me.' It's hard to have that vision as an 18-year old," she admits.

MechSE grad student John Shanley agrees with Kersh that it's beneficial to bring high school students onto campus to events like the camp to familiarize them with the possibilities open to them: "It's great to open their eyes up to the opportunities that are out there."

According to Shanley, he volunteered for I-STEM's camp because he'd done activities similar to this one during eight different camps this past summer, admitting, "So it's kind of a natural fit to continue on with it."



Ertekin poses with the team that won the Prosthetic Device competition.

Plus, he enjoys giving high school students opportunities he wishes he had had when he was their age.

"I had no idea what biomechanics was," he recalls. "I was someone who knew that I wanted to be an engineer, and I still didn't know about it. It's great to see what opportunities are out there, especially for people like myself a few years ago who don't know what the options are. I was good at math, and I didn't know what to do with that. Well, this is one of the applications that you can have, so it's a good start."

Shanley intends to go into industry in bioengineering once he completes his Masters' degree. His goal is to work for a company that makes devices that help people and improves the quality of their lives. "First, I just like the idea of being able to help someone and secondly, and I think it's the industry with the most interesting problems. You can go ahead and continue to optimize things that people have been working on for centuries now, like mechanical engines and systems like that,

and there are people making real break-throughs there too, and that's cool. But there's so many different problems, and there's such a diversity of places that you can apply your skills to really make a difference, and I just think that there's a greater amount of opportunity there and that's just exciting to me."

Kazem Alidoost, a fifth year MechSE PhD student, who would like to go into academia once he gets his degree, has been involved with the Mech-E summer camp for two years. Plus, this past spring, he took ENG 599 with Professor Ertekin, Sharlene Denos, Joe Muskin, and others, and was really impacted. "That was just a really

great class," he acknowledges. "I think I'll take it again this next spring just to go back to the high school, because I think we spent a lot of time talking about how important outreach is and the beneficial effects that it can have."

He was involved in outreach in his own community where he grew up, but now would like to make a difference here too.

"I think it's important to try to make an impact where you are and identify with your current community."

Kazem Alidoost, a fifth year MechSE PhD student, coaches a camper through prosthetic design.



Alidoost also praises the *Illinois* faculty and students who volunteer for the various outreach programs, saying, “I think having students and faculty here at *Illinois* who do this because they care means a lot to the people.”

Alidoost shares why he thinks it's important to bring high school kids onto campus for outreach events like I-STEM's camp.

“Growing up,” he acknowledges, “my parents were always talking about going to college and studying engineering or medicine, and so I think for me, it was always a natural thing.”

He lived next to a college growing up, so he was familiar with the facilities. But since coming to *Illinois* to school, he's discovered that most of the people he's met were not that fortunate. “So I think it's just important to bring people so they can see what's out there,” he says.

He also believes activities like I-STEM's camp are good because they make youngsters comfortable and show them that they too can do STEM.

“They feel like they can come here, and they see that they are capable, and that they can do it. Just to show that everything is accessible to them, that we want them here, and that they can accomplish whatever they want.”

Similarly, Assistant Professor Elif Ertekin hopes to help the students see themselves here, doing what she and the others are doing. “I think that being involved in camp activities and getting other people excited about why it is that we do what we do and showing younger students who will be the next generation of engineers what we do so that they can start to imagine themselves also there and doing the same thing, is really important and valuable.”

And according to Ertekin, that was one of her main goals in doing the camp—to help the high school students see themselves doing engineering.

“A lot of the modern research shows that in order to be able to choose a certain career path, you have to be able to envision yourself being that person and doing that job in the future. So right now, by trying

to give the young people hands-on experience, working directly with graduate student researchers and faculty, I think that really helps them imagine themselves doing this as a part of their careers in the future.”

Ertekin adds that she also likes to do activities like the I-STEM camp because they help her remember why she fell in love with engineering in the first place.

“I do things like this because I think it's really important to remember the big picture of the work that we're doing in our day-to-day research. When you are doing research all the time, it's easy to sometimes forget why we got involved in the work that we're doing.”

An I-STEM camper grins in anticipation of the challenge ahead.



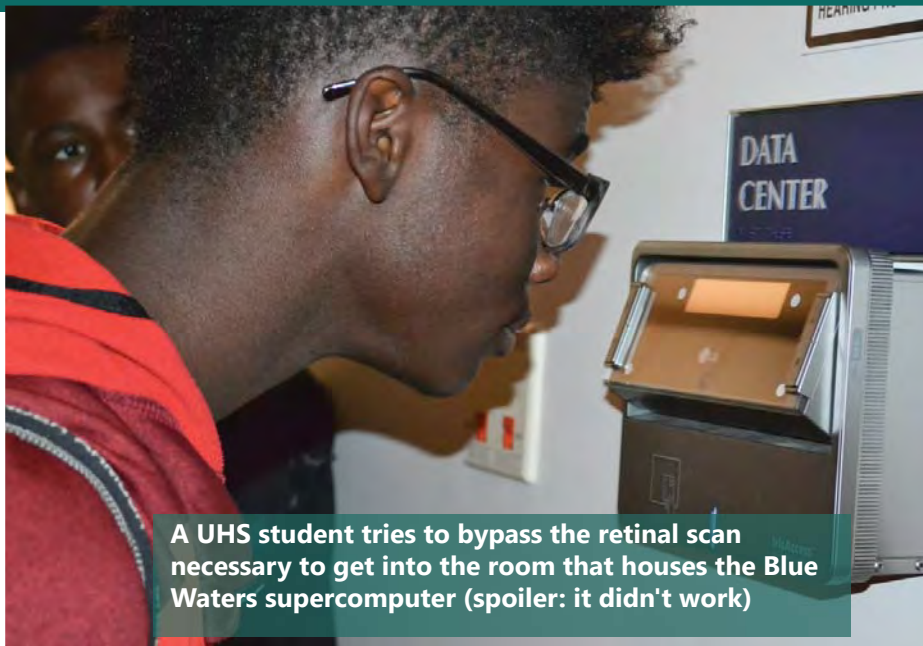
DURING I-STEM CAMP'S NCSA DAY, UHS STUDENTS EXPERIENCE DATA VISUALIZATION, SUPER COMPUTERS, AND NCSA'S RESEARCH

OCT 17, 2017

Where's the Popcorn? That was all that was missing when 27 Urbana High School (UHS) student athletes sporting 3D glasses lounged in the cushy, theater-quality seats of NCSA's viewing room to preview some of the Advanced Visualization Laboratory's (AVL) high-resolution, cinematic-quality, 3D data visualizations. They were at the National Center for Supercomputing Applications for NCSA Day, the final day of the first-ever, I-STEM Summer Camp: A Multidisciplinary Program. During the Friday, August 18th visit, students also toured the National Petascale Computing Facility and met the Blue Waters Super Computer up close, and also discovered more about what NCSA does while attending a panel discussion hosted by several NCSA researchers and programmers.

NCSA Managing editor, Barbara Jewett, and Education and Outreach Coordinator, Olena Kindratenko, welcomed the student-athletes to the NCSA. With regards to why she and her NCSA colleagues participated in the camp, Jewett gushed: "We love having students here. And we love sharing what we do."

The panel of NCSA scientists (left to right): Eliu Huerta Escudero, a Physics and Astronomy Research Scientist in the Relativity Group; Dan Lapine from the Scientific Computing Services Group; Adam Slagell of NCSA's Cybersecurity Group; and AVL research programmer Kalina Borkiewicz



A UHS student tries to bypass the retinal scan necessary to get into the room that houses the Blue Waters supercomputer (spoiler: it didn't work)

During the AVL presentation, students experienced several documentaries that, with the help of Blue Waters, used huge data sets, such as those obtained through the Hubble Telescope, to produce visualizations of the data. Some of the documentaries were even narrated by Hollywood celebrities Leonardo DiCaprio and Benedict Cumberbatch. Plus, students saw a documentary called Seeing the Beginning of Time that explored "hundreds of millions of years of galactic evolution."

According to Barbara Jewett, a managing editor at NCSA, "Our advanced visualization lab does awesome work. To come here and show things in 3D that are real science, that's pretty awesome. And that just turns people on and interests them. So it's a fun way to show people what science could do."

Jeff Carpenter, a Multimedia Technology Specialist at the AVL, explains how their visualizations differ from those created in Hollywood. "It's not just 'We think this' or 'We think that' or that we made this up. What we do differently than they do in Hollywood, our stuff, while we use the same tools, are not necessarily as flashy as the things you're going to see in Guardians of the Galaxy or anything else, like Star





NCSA Managing editor Barbara Jewett presents to the campers during their tour.

“Because you never know what is going to change someone’s life. And it is very important that we encourage young people to explore careers and the other opportunities that are available to them in the areas of math and science. And by exposing them to what is available on campus, we can stimulate their interest.”

Wars or whatever. That's an artistic thing. It may be made to look like real science. But we're using the actual data. That's our basis.”

Next students attended a panel featuring several NCSA scientists who shared more about some of the research going on there: AVL research programmer Kalina Borkiewicz; Eliu Huerta, a Physics and Astronomy Research Scientist in the Relativity Group; Dan Lapine from the Scientific Computing Services Group; and Adam Slagell of NCSA's Cybersecurity Group. After lunch, students toured the National Petascale Computing Facility to experience Blue Waters, one of the most powerful supercomputers in the world.

Jewitt indicates that one of the benefits of taking young people to see the facility's super computers is to expose them to possible careers: to “show them what you can do in the field of computer engineering, computer programming, software engineering, there's even a thing called storage engineering and network engineering to help people do the internet. To save their data.

So there's so many ways you can be involved in science, engineering, computer science, without actually being a hands-on scientist studying a deep scientific subject.”

Jewett adds that events like I-STEM's camp are important:

As an example, Jewitt shares an anecdote about her daughter, a chemistry Ph.D. student. “She got her interest in chemistry from freshman chemistry the very first day,” Jewett explains, “when the instructor poured two solutions together, and they turned pink! Pink is her favorite color and she was very interested in exploring what you could do with things that made pink. And now she's very involved in chemistry education.”

“You just never know,” she continues. “It could be they go on to be a scientist or be an engineer, or perhaps join an organization like NCSA and help promote science through visualization, through data management, through communicating science either as a science journalist or as a visualization programmer. There are so many opportunities and things you can do with science.”



AVL Multimedia Technology Specialist, Jeff Carpenter, talks to a camper about NCSA's scientific research.

“Plus, let’s face it,” she continues, “science affects our daily lives. All the food we eat; all the products we use; the air we breathe; the science that grows things. So science is in everything. So just the exposure to it and getting people involved in science is really important.”

The AVL’s Jeff Carpenter echoes Jewitt’s sentiment about communicating the importance of NCSA’s scientific research: “We’re showing the things that are in the science. And by being able to communicate the science to people, hopefully they’ll have an understanding of what goes into that research. That it is real, that there is value to it, and we should try to understand not only the universe, but our place in the universe and how we can maybe have an impact on how it has an impact on us.”

Carpenter adds that it’s important not only for kids, but to show a larger audience why the science done at NCSA is important, and how what they do makes a difference. He stresses the importance of having an educated populous:

“If people understand science, they’re not going to be taken in by pseudo-science, fake science, or bad information. I think that’s where it’s important, if you can show people that it’s real, if you can get them to understand, this is data; it’s done in a scientific way.”

Carpenter adds that he really believes in the STEAM aspect of STEM. (In STEAM, Art is emphasized, along with Science, Technology, Engineering, and Mathematics.) He says that at the AVL they call themselves a Renaissance team, in the same way that Leonardo Da Vinci was considered to be a Renaissance man, stressing the importance during the Renaissance of both technology and art. He claims that without the vehicle of art,

“You couldn’t communicate the technology,” but also stresses the importance of the technology: “If it’s just art, there’s not function behind that. Both are increased and are better when combined together.”



A UHS student-athlete inspects the sheer width of a sample Blue Waters cable

Carpenter also believes that effectively portraying the scientific data requires using both creativity and intuition:

“Pure science without looking at it from an artistic or creative side is less than when together, because you can use your intuition. Creativity is not just drawing and painting visuals. Creativity is also the spark of imagination where we can look at the data and we can understand it in a different way through our imagination, through our creativity. ‘Well, what is happening? Why is that happening?’ It’s that intuition, that spark of bringing it to the data itself. So then that’s where the art comes from and the benefits.”



STEM EDUCATION REFORM FOR UNDERGRADUATE AND GRADUATE STUDENTS



POETS SEMINAR, ENVISION, SEEK TO GET GRAD STUDENTS HOOKED ON OUTREACH

April 26, 2017

The objective of the contest? To use a pizza box to build a solar oven capable of heating up a marshmallow to the hottest temperature possible during a 10-minute time span. But in a room full of 50 or so competitive and talented engineering grad students on campus for POETS' 2nd annual NSF Site Visit, the challenge wasn't so much the design itself. It was about finishing first and getting one of the coveted, optimal spots in front of a limited number of lights! However, for those in charge of the April 19th Student Outreach Seminar, the more salient objectives were 1) to help create T-shaped graduate students (with depth of expertise in their field plus technical and professional breadth), and 2) to replicate their own love of outreach in the participating grad students—with the goal of increasing the number of youngsters exposed to STEM in the future.

Part of the POETS (Power Optimization for Electro-Thermal Systems) Engineering Research Center's 2-day NSF Site Visit, the seminar, "STEM Outreach: A Supplement to Your Research Skill Set," which served grad students from the four POETS universities, "was originally held because graduate students voiced a desire to be more involved with STEM outreach," explains POETS Associate Director of Education & Inclusivity, Jessica Perez. Helping her lead the seminar were Matt Milner, Malia Kawamura, and James Carpenter, board members of ENVISION, Illinois' Engineering graduate student group, whose main thrust is outreach.

The main purpose of the event was not just to underscore that outreach is important, but to give participants a taste of how fun and rewarding outreach can be.

Opening the session, Perez stressed the importance of outreach, then reviewed what STEM outreach looks like and why grad students should get involved. She also shared about POETS' goal of creating T-shaped graduate students. Perez explains it as:

"Depth of expertise in their chosen discipline, as well as technical breadth and professional breadth. Professional breadth includes leadership skills, entrepreneurship, systems thinking, scientific communication skills, teaching experience, management skills, etc."

While Perez says grad students can gain professional breadth by TAing for a course, or gain management skills by running multiple research projects with multiple players, she says that's not enough. She admits:

"Graduate students often find gaps in the skills sets that are required for their future job."

So POETS is trying to provide activities and resources to help students "fill in the gaps."

STEM outreach can help students build their professional skills set, Perez explains: "STEM outreach enhances scientific communication skills and provides teaching opportunities. It reinforces leadership skills and requires a new perspective on their research."



POETS grad students learn about how they might initiate outreach events at their institutions.

Milner shares his STEM outreach educational philosophy:

"Give kids exposure. Let them see these things and let their natural curiosity kind of just take over. Because when you make them curious, and you make them want to learn, they will learn. And if you give them that desire, then, I mean, if you make it their own idea, then you don't have to force them to do it!"

Also helping with the event was Malia Kawamura, the Vice President of ENVISION. A second year grad student in POETS PI Andrew Alleyne's lab (possibly another incentive to participate in the event?), Kawamura was hopeful that "the grad students can see how much fun and rewarding and impactful STEM outreach can be, in the same way that I've been able to experience that and see that."

Another ENVISION officer who helped with the seminar, Treasurer James Carpenter, is a MechSE first-year grad student in Professor Nenad Miljkovic's lab, which has at least one POETS-funded project. He took part in order to engage his fellow engineering students with the important task of recruiting kids to STEM.

Carpenter's goal was

"To hopefully convince the grad students of the importance of outreach and engaging the K-12 youth in STEM activities, to convince them to go in the STEM field, because there's a projected disparity in our workforce. So the purpose is to convince them that they can help encourage young people to go into these fields, so that we can be as competitive as possible as a nation."

While he hoped that they had fun doing the solar oven marshmallow experiments, his plan was to "convince them of the importance, and make them as excited as I am about STEM outreach."

What kind of impact did the seminar have on grad students? Perez reports that, at beginning of the activity, the students were very casual about their designs, "but once they saw the

timer go up on the projector, they all stepped into high gear. They got creative. They came up with designs outside the bounds of the activity handout. The room became energetic and was full of collaborative, competitive conversations."

In fact, she indicates that the students were so engaged that at one point, the POETS industry advisory board, who was holding a meeting next door, had to send someone over to tell them to keep the volume down because the noise was carrying over into the next room. So it appears that the Seminar leaders had successfully



A team of POETS graduate students build a pizza box solar oven during the recent POETS grad student outreach seminar.



The winning team shows the design that got them the W.

started, then encouraged the students to get involved in outreach in their own areas. He suggested that if their home institutions had no grad student outreach group, they should start one. He even gave them permission to borrow their name, an acronym formed from the words outlining their purpose (Engineers Volunteering In STEM EducatIOn), and logo.

Milner reports that ENVISION, which he and Ashley Armstrong began in Spring 2016, has grown and is becoming interdisciplinary. Initially comprised of MechSE grads, the organization now has around 30 active members from all engineering fields. They're even branching out into other sciences, like chemistry, and entomology. "So getting a lot of crossover," says Milner.

According to Milner, he and his cohorts agreed to do the POETS seminar in order to enlist allies in their quest to recruit more kids into STEM.

"I think it's important to not only give outreach, but also teach others. Because you can kind of multiply that power if you teach others to do outreach. And if you can instill in them a desire to want to do it, then you can reach that many more kids, which is what it's all about—to get more kids interested in the STEM fields and get them ready for future careers."

communicated their passion for outreach. According to Perez, being able to communicate about your research is key: "If you can explain why your research is important to a 5th grader, you can do the same for someone interested investing in your company or research group."

Perez then gave students resources to help them get involved with outreach at their institutions. Plus, the hands-on activity which followed exemplified the kinds of STEM outreach activities they could do and was designed "to give them a jump start in getting involved with outreach."

The idea was to give the students a hands-on activity they could replicate at some future K–12 outreach in their home institution. So ENVISION President and co-founder Matt Milner, along with his cohorts, exposed seminar participants first-hand to an activity ENVISION originally did at a summer camp for middle school students: building marshmallow-heating solar ovens from pizza boxes.

Teams of grad students were to build solar ovens from pizza boxes, aluminum foil, etc., then place their completed oven in front of one of the lights. The fly in the ointment? There were only a few lights, and, according to Milner, some might work better than others, so speed, efficiency (and some luck) were of the essence. The ovens were exposed to the lights for approximately ten minutes (or longer, depending on how long it took teams to finish), then tested using Infrared thermometers to see whose marshmallow had gotten the hottest. (For the record, the winner reached 127° Fahrenheit.) While the ovens were basking in the light, Milner shared about how ENVISION was

A team member finds an optimal spot for his solar oven.



ALLEYNE AND WISSA FOSTER INTERDISCIPLINARITY IN NEW BIOMIMETICS/BIOINSPIRATION COURSE

May 3, 2017

Folks in different disciplines, say engineering and biology, often don't know how to talk to each other and, thus, have trouble collaborating. So Marianne Alleyne, a Research Scientist in Integrated Biology's Entomology Department, and Aimy Wissa, an Assistant Professor in Mechanical Science and Engineering (MechSE), have teamed up to try to change that. They've designed a new biomimetics/bioinspiration course, ME 498/IB496, which seeks to use an advanced design experience to foster an interdisciplinary mindset among students in the course.

Wissa shares their goals for the class: "We really wanted to teach a class like that where we can both be teaching about bioinspiration, but also have engineers and biologists in the same room," admits Wissa. "And we won't just teach them how to do it; they would actually do it. So they would go through the process, rather than just hear about the process."

According to Wissa, interdisciplinary, not multidisciplinary collaboration, is the goal. She explains the difference. "Multidisciplinary means I do my thing, and then after that you can do yours. The product at the end is a multidisciplinary product. Interdisciplinary, to me, is that we are together during every part of the process—scientists that appreciate the value of these teams and the potential of using nature in design."

What inspired Alleyne and Wissa to do this course? Alleyne says bioinspired design or biomimicry is "a different way of thinking, and I think there is a real possibility."

Wissa adds that she also hopes to foster interdisciplinary communication: "I'm very passionate about this idea of nature inspiring design," she says, "but also the biggest thing is how little engineering students communicate outside their discipline...We don't really know how to talk to each other—biologists to engineers," admits Wissa.

So the thirty seniors and grad students (six biologists, and 24 engineers) who signed up for



Members of an ME498/IB496 team deliberate

the course's maiden voyage have spent the Spring 2017 semester learning to communicate outside of their discipline. The class format was lectures on Monday and Wednesday; Fridays, they did labs, each with a different objective. For example, on Bio Day, students were exposed to insects from Entomology.

"“I think we've reached a plateau where engineering alone can't solve any new challenges. So as engineers, we need to step outside what we know in engineering. We need to go to biology, chemistry, art, music. This was an opportunity for me to tell students, 'You need more than what you are to make the world better.'” – Aimy Wissa"

Since a key emphasis of the class is interdisciplinary design, interdisciplinary teams were formed to work together on a couple of bioinspiration design challenges.

For example, the first week of class, teams were assigned a mini design challenge. Using fishing wire, they were to build muscles, linking something up in the same way an arm functions. Teams



A student examines ants at the "Complex Systems: Emergent Behaviors of Ants table during the Nature Auction.

had just five days to do the project, so "They had to depend on each other, says Wissa. "A single member couldn't do it in a week."

Surprisingly, students went beyond the human arm—something more familiar to them—choosing to replicate other examples from biology, such as a frog's leg and an alligator's jaw.

All lectures and activities led up to the final class project in one of the four areas the class was focusing on: movements, sensing, materials, and complex systems. Students had a budget of \$150 to complete the project, and were assigned milestones—the proposal phase, design review, and final design review—to keep them on track until they had completed their project.

The biggest difference between other MechSE project/team-based design courses and theirs? Their problems were ill-defined on purpose. "For the other class, they may be asked to design a robot that moves from point A to point B," Wissa

explains. "So the problems are very defined. Here, they have to define the problem and the solution, and then define the process."

Regarding problems students were to address, their instructors gave them options to start from, like, "The world needs a better water extraction process." Wissa adds, "So we give them different approaches and let them design the solution."

Of course, having students come up with their own problem is a lot harder than a well-defined problem; that's why the two recruited seniors and grad students. "We wanted to get students in this class that had enough technical foundation so that they could go into the literature and find their own answers," Wissa admits.

To help teams come up with a project, a nature auction was held on Friday, March 3rd. Students were able to bid on several natural functions that they needed for their final project. Available functions, listed under the four areas the class was focusing on, included: movement (copepod: sneak attack, owl wings' adaptive devices, corrugates on dragonfly wings), sensing (skunk cabbage, bats-echolocation, eye of dragonfly, pine cones, shark lateral line system, owl asymmetric ears), materials (hydrophobic lotus leaves, bat wing membrane, cicada wings, nacre, bone, mammalian skin), and complex systems (bees, starling flocks, horse herds, and slime mold intelligence).

"We are going to auction nature off," says Wissa. "So we will exhibit some natural functions, and the students are going to bid on them."

The hidden goals of the auction were to expose students to as many different functions as possible, get them to start thinking about their final projects, and to emphasize the value of the teams' diversity. "On a very fast pace, it will encourage them to make decisions as a team, which one to buy, or bid on," says Wissa.

Alleyne reports that a team focusing on sensing, for instance, might have considered bidding on pine cones, which can sense humidity; cabbage, which can sense temperature; and sharks, which can sense vibration. "So you are thinking of a certain design that you want to create, and one of those sensors will be more valuable to you."

Also different from other projects classes is that students were to make a prototype. Some design

courses end with a conceptual design. “So a design on a report,” Wissa explains. “Here, we’re trying to push them through prototyping, and we’ll see what happens. They’re going to build... something.”

“They’re going to build something,” Alleyne reiterates, but indicates that what they want to see is students’ grasp of their design’s constraints.

“If the report says, ‘I was inspired by this, and I looked at five different biological systems, and I know my limits are based on this because of evolutionary constraints or time constraints or something,’ I’m happy,” she continues. “Just the fact that they looked into five biological systems.”

“As long as they understood what they are ignoring, and what they’re adopting, we’re cool with that,” confirms Wissa.

How difficult has it been to foster interdisciplinary collaboration between biology and engineering students? They’ve been doing it from the very beginning: “So they were forced almost on week one to work together, and to come up with something that had both biology and engineering in it,” says Alleyne.

To circumvent the tendency for biology students to sort of sit back when their team was addressing mechanical engineering, and, vice versa, for engineering students to do so when dealing with biology, the instructors instituted class rules:

“They’re absolutely NOT allowed to do that,” Alleyne insists. “And we actually forced them to deal with that by saying the person presenting the engineering portion had to be a biologist, and vice versa.” Another incentive? Teams that had engineers report on the biology, and vice versa, got extra credit. “So we had engineers come up to tell us about different muscles, and the biologists talked about torque,” Wissa divulges.

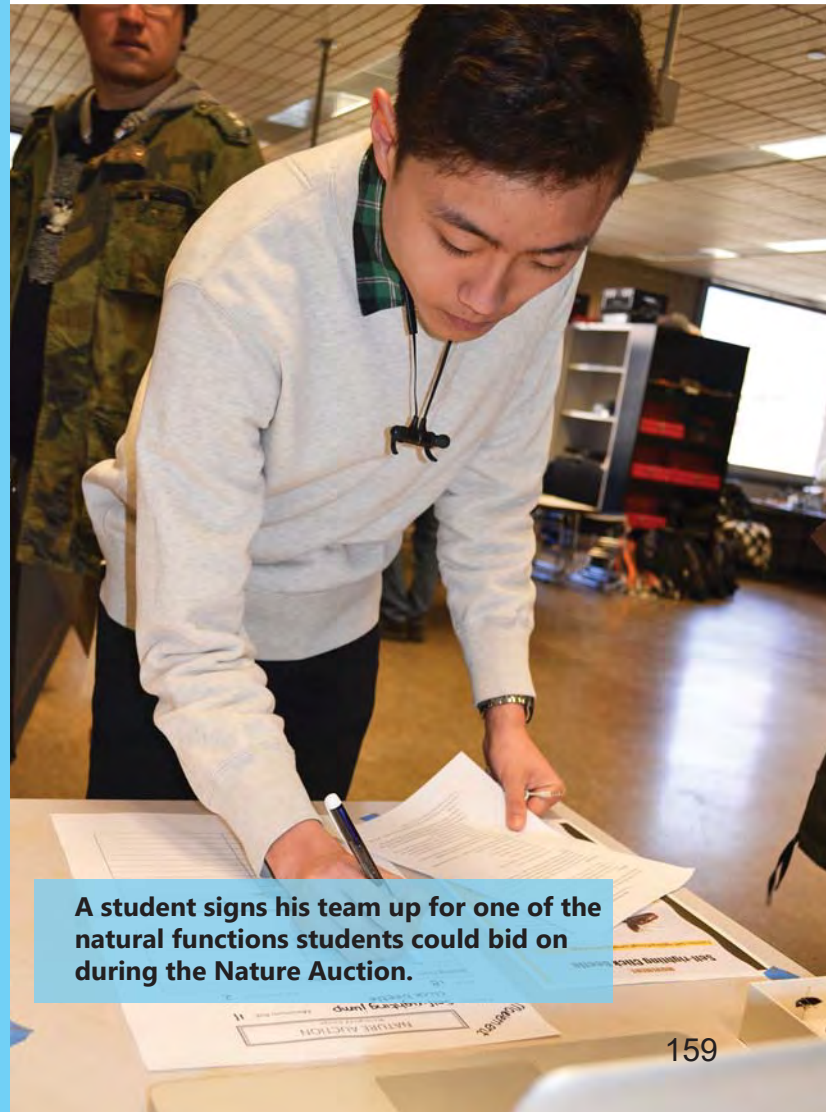
But it appears the students got more out of interdisciplinary collaboration than just a good grade. “I think they enjoy working together,” Wissa says. “If I didn’t know who the biologists were or the engineers were, I wouldn’t know from the way they interact, because the collaboration is there.”

The part that’s not there yet is an in-depth understanding on the part of, say, engineering students of how their example from nature does what it does. “They’ll say, ‘Great, I can do that. I don’t know how they do it, but I know how to create something that looks like that,’” admits Wissa.

But both agree that the students do need to know how and why what they’re trying to emulate from nature does what it does. “Right,” agrees Alleyne. “So that’s what we’re trying to get them to do. So we’ll get them there.”

Alleyne shares additional benefits for students from both disciplines: “Engineers get appreciation for the fundamentals of research, because we never know where it’s going to end up. And engineers now have a new tool in their tool box, so if they get stuck or need a new way to do something, they now have this new tool. For biologists, it gives them a reason. So they study how a fish’s jaw works, and now this gives them an application for it.”

Since one of the goals of the class was to foster communication across disciplines, Wissa and Alleyne ostensibly had it all figured out beforehand



A student signs his team up for one of the natural functions students could bid on during the Nature Auction.

SENSORS: Bats - echolocation

Function: Ultrasound for Echolocation

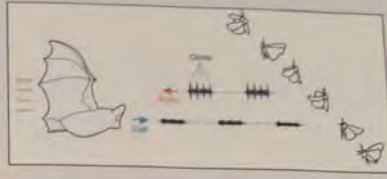


Figure 1. (left) Large ears are able to collect and amplify the echo. Bats use sonar vision to successfully hunt and navigate during the night. (right) Echolocation of bats used to hunt prey. High frequency pitch calls bounce from the prey and returned as an echo
Photo © pixdaus

Mechanism:

Most bat species are nocturnal - most active during the night. They have developed extreme hearing to supplement the lack of light during the night. Bats can emit and perceive sound frequencies of up to 100k Hz (humans up to 22k Hz). Special membranes in their ears are tuned to resonate in a narrow band of frequencies. In order to filter noise and objects from prey they first use low frequency waves followed by higher frequencies. Processing the differences in their brains they are able to pinpoint the exact location of small insects, even during high speed flight. They also use echolocation to navigate and avoid obstacles. Contrary to popular belief most bat species have a good eyesight during daylight hours.

One of the functions related to sensors, bats' echolocation, students could bid on during the Nature Auction.

Figure 2. (left) Frequency power spectrum of produced sound frequencies (right) Echolocation sound frequency signature in time.

Reference:

in order to collaborate on the course, correct? Not quite. Both admitted encountering some engineering-vs.-biology disconnects along the way, which further emphasized the need for the course.

"So even though we're both STEM, we don't know how to talk to each other. So she would say something like 'stress,' and I would think of a material straining, while she could mean physiological stress. So I think the problem is more exacerbated when you have students. For the last three to four years, they have been sitting in classes that only speak their language. Now we want them to get out of their comfort zone. And both on the technical communication level and on just forcing them to go read biology. Forcing the biologists to learn more about design."

And since learning the jargon from different disciplines is key in communicating, gave the two learned each other's jargon? "Getting better!" acknowledges Alleyne.

However, they evidently don't always know what the other thinks, but have learned to clarify. "You know to ask, 'What do you mean?'" Wissa explains.

According to Alleyne, they also keep each other honest. "I am kind of a stickler for the idea that it's really based on science," she says, "while a lot of the bioinspiration examples are more superficial or not really based on science, and I think we're both getting to the point where we're both holding each other accountable for that."

Wissa says some of Alleyne's fastidiousness regarding authentic bioinspiration has actually rubbed off on her. "She has also converted me into a skeptical. Because what engineers are supposed to do is say, 'Oh, this thing flies this way,' or 'This thing walks this way. I can make an engineering system do the same thing.' But they don't really dig deep into 'How does this thing do it?' What are the biological, chemical or physical things that lead to this behavior?"

In addition to communication, Wissa says interdisciplinary collaboration requires empathy: "And the best way to have empathy is to work with them. And I think from a biologist's standpoint, they almost know a different approach to problem solving that could be completely different to an engineer's."

Regarding the bioinspiration component, Alleyne indicates that "Nature is best at the really small stuff. Even your big birds are ultimately feathers and how the feathers are made. It does the small stuff really well." She shares that for a long time, scientists weren't able to see that, but with the creation of microscopes, are now able to model it, start fabricating it. "This is a really exciting time."

including ultraviolet. Each eye pointing at a slightly different direction enabling them to see

Dragonflies students could bid on during the Nature Auction.



She also clarifies that bioinspiration not a new way of thinking. “DaVinci looked at birds to see how to make man fly, so it’s not a new way of thinking, but the power of nature is in the small stuff. Like an ant can build an amazing nest, but we see them as just dumb ants. But somehow they have creating intelligence by cooperating with each other in a certain way. That’s why I think now is an exciting time, and why it’s so popular.”

Both admit that bioinspiration also has its limits: “And vice versa is that nature doesn’t always have the best solution,” says Alleyne. “Because nature is very constrained by ‘What is the environment like that made an animal or plant the way it is?’ On the other hand, it’s been 3.7 billion years; structures can’t just switch in certain trajectories, while engineers can.”

Wissa adds another caveat in regards to bioinspiration: “We always say that biology or nature is a great initial condition; you should never assume it’s an optimal solution. That’s another thing we’re trying to hammer through their heads.”

Both instructors consider the course to be a design project in itself and are excited about how it’s going to ameliorate down the road:

“I’m really excited for the potential of what it will be with time and iterations,” says Wissa. “This course within itself is a design project, and design projects don’t have an end until you understand better.”

Alleyne agrees. “We’re learning from the process of how students deal with these activities and these



Two students exhibit their teams' prototype.

assignments. We want to know the process that they are going through, so that in the future, we know how to teach it better.”

Their goal is to develop better-equipped, more well-rounded students:

“Just also to give students the confidence,” says Alleyne. “The students here at the University of Illinois in engineering have already accomplished a lot in a certain manner. This is different though, and I think it’s a very valuable skill to have—to communicate and collaborate and create something.”



ME498/IB496 instructors Aimy Wissa and Marianne Alleyne give students instructions during the nature auction.

ME370 STUDENTS FIND END-OF-THE-SEMESTER ROBOT RACES A FUN LEARNING EXPERIENCE

May 9, 2017

There was a lot riding on the 36 little robots navigating the ropes stretched across Boneyard Creek for ME 370's final competition. Held just north of the Engineering Building at noon on Wednesday, May 3rd, the contest drew a crowd of interested spectators who vicariously experienced the little robots' ups and downs, "oohing" and "aahing" during the spectacle. For the students, the contest not only motivated them to show off their engineering prowess; it got their competitive juices flowing as they sought to beat the socks off their opponents. And as an added incentive, teams whose robots beat the time set by Professor Socie's robot got to skip the upcoming final exam.

To test students' skills acquired over the semester, plus to add some zest to an oftentimes tedious round of final exams, MechSE Assistant Professors Sameh Tawfick, Arend van der Zande, and Professor Emeritus Darrell Socie came up with a final competition for the Spring 2017 edition of ME370, Mechanical Design I, that was a bit more unique than last year's, which involved building a robot that navigated in a fashion similar to Star

Wars' Imperial Walkers. For this year's competition, robots were to traverse a rope strung across Boneyard Creek as quickly as possible, without stalling, requiring assistance or a restart (which would get points deducted), or worst-case scenario, getting a dunking in the creek.

To make the project even more fun, instructors used a new-and-improved Star Wars scenario:

"The Empire has set up a secret base for death star research on the mega-jungle world of Costa. Because of the enormous and dense foliage reaching miles high, an attack from the sky or ground is impossible. The rebel alliance is planning a surprise attack by sneaking in on camouflaged walkers that must hang from the vines. In order to prototype new vehicles, the Rebel Alliance turns to their top-secret machine design lab on the prairie world of Chambana..."

To make the project even more challenging, robot designs were to be biomimetic or xenobiomimetic—students were to borrow designs from nature. In other words, their robots were to emulate a specific creature's method of locomotion—i.e., walk like a sloth, swing like a monkey, hang like a bat, crawl like a lizard, slither like a snake, or trellaumph like a Costanian Kryshyk. (It appears that the instructors were having a bit too much fun here—Google has no record of a Costanian Kryshyk. They obviously invented this one as an example of xenobiomimetic!) The scenario also specified that robots were to look like the creatures they were mimicking: "Since this is a surprise attack, the walkers should be camouflaged so that they will pass for the creatures they are imitating under cursory inspection."



ME370 students attach their team's robot to the cable prior to competing.

Students had around six weeks to build their projects, which included all the design process stages from concept, to detailed design, to prototype, to the competition. Plus, multiple reviews kept students on track.

To prepare students for the final project, the first half of the semester students were assigned two mini projects.

"In the first, a user-focused design project, students designed pull toys. We had the students thinking about and performing exercises on understanding who they were making the pull toys for and engaging in the creative and empathic side of the product design process," van der Zande explains.

In the second mini project, students were to design simple mechanisms that performed a specific motion. This "pushed the students to understand the technical aspects of actually building a mechanism and the differences between how an 'ideal' mechanism looks on paper or on a computer versus all the complexity that comes up in manufacturing objects in the real world." For the final project, students were to combine these two different ways of thinking.

Part of a MechSE course sequence that teaches students design thinking, ME370 helps students learn the fundamental principles of operation for machines and mechanisms (which can include everything from clocks, to bicycles, to sewing machines).



Professor Darrell Socie attaches his walker to the cable.

"Each year from freshmen to seniors," van der Zande explains, "we have students engage in more and more complicated design tasks, where they go through the process of applying the fundamental principles that they learn to actually building a working machine that can accomplish a set task."



MechSE junior Edgar Mejia watches as his robot competes in the contest.

different parts. An actual robot is somehow different than the theoretical model."

Mejia reports that in addition to learning things about mechanical engineering, he also grew personally: "First of all, it showed me the importance of collaborating in a big project like this. I believe this skill is very important for the professional world. In terms of engineering, I learned that we need to design with certain allowance for failure."

He goes on to explain that the idea behind this semester's project is for students to "apply the rigorous technical considerations of designing machinery in order to succeed while being open ended enough to allow them to engage their creative side and come up with many different and unique designs."

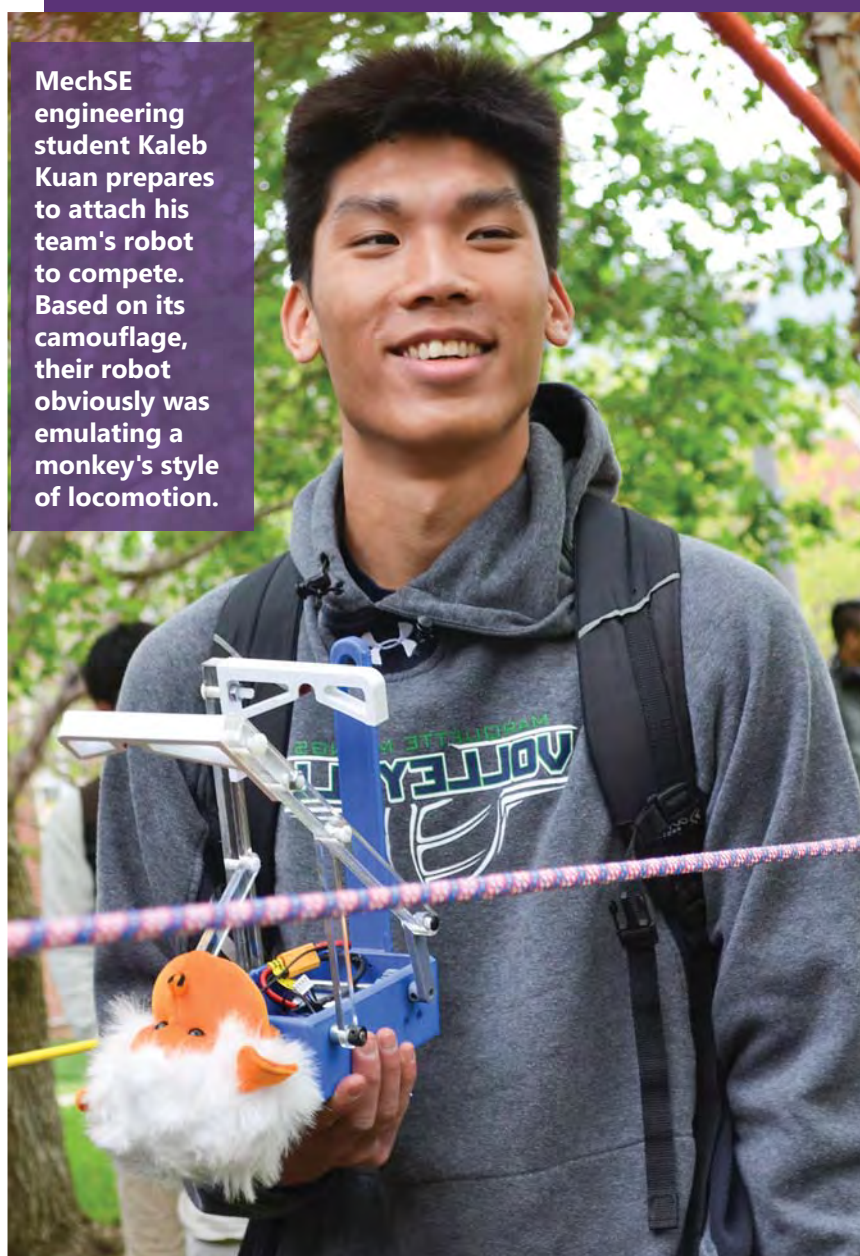
Why a competition? "It really engages the students much more," reports van der Zande, and "gets them thinking about what they can do to improve their design and win, and not just aim for the minimum they can accomplish to get an A in the class." He claims students really get into the design process. They "start working late nights in the innovation studio for weeks before the competition to perfect their robots."

For many students, the course is one of the highlights of their career at Illinois:

"Many of our students from last year have come back to me and said that this was their favorite project during their undergraduate education," says van der Zande. "For most of those students, they say that this project embodies what they really love about mechanical engineering, and why they got into the major in the first place."

What did the students learn from the project? MechSE junior Edgar Mejia, who hopes to someday have his own company developing technology and manufacturing processes with a sustainability focus, indicates that the main challenge he and his teammates encountered was "assembly due to the tolerance in the

Kaleb Kuan, a junior in MechSE, reports that in one of its earlier stages, their robot "was having trouble maintaining stability. As it traversed the rope, its movement would cause rotation about the yaw axis and ultimately one of its 'hands' would



MechSE engineering student Kaleb Kuan prepares to attach his team's robot to compete. Based on its camouflage, their robot obviously was emulating a monkey's style of locomotion.



A team of ME 370 students trouble shoot on their robot.

end up missing the rope. This meant that we had to design better 'hands' that would keep the robot from rotating."

One concept Kuan learned during the project was that of simplicity. "There were numerous groups that had significantly more complex mechanisms and designs that performed at probably less than half the speed of our robot. To be honest, when my group was designing our robot, we weren't really concerned with the complexity or novelty of the mechanism, we just wanted something that would work and would work effectively. When this project shifted from the design stage to the prototyping stage, I started to see that in reality, less was actually more."

Kuan adds that, "Studying at Illinois has been a tremendous experience full of incredible surprises... Having the opportunity to be a student here means that I am gaining expertise and learning problem solving skills that will not only equip me for my future career, but for life in general!"

What's his future career? Kuan says he doesn't quite have his career plans figured out yet. "What I do know," he admits, "is that whatever I end up doing, I want it to be something that benefits or helps those in need." Whatever he ends up doing he hopes for "the opportunity to bless others."

So were any of the robots faster than Darrell Socie's, thus the students on those teams got out of taking the final? It turns out that eight teams beat Socie's time. According to van der Vande, the fastest robot, which emulated the walking motion of a sloth, crossed the Boneyard in 19 seconds!

Kuan's team was one of the eight. Was he excited to not have to take the final? Yup. But he says he found the process rewarding on a number of levels. "In addition to being exempt from the final exam for beating the professor's robot, I think that one thing I gained was a boost in my overall appreciation for engineering. It's always extremely uplifting when you are able to overcome a task or challenge using both engineering and problem-solving skills!"

ESJ SCHOLARS' END-OF-SEMESTER PECHA KUCHA ADDRESS SOCIAL JUSTICE ISSUES IN ENGINEERING

May 23, 2017

To showcase their final projects related to social justice issues they're passionate about, eleven engineering undergrads who were part of the pilot for the new, two-semester-long Engineering for Social Justice (ESJ) Scholars program presented Pecha Kucha in an end-of-the-semester event. (In this Japanese presentation style, 20 slides are shown for 20 seconds each, keeping presentations by multiple speakers concise and fast paced). On hand to witness the May 8 final event, were a number of interested Engineering administrators, faculty, and members of the Illinois community.

Created by Engineering's Outreach Coordinator, Sahid Rosado, and Valeri Werpetinski, Director of Learning in Community (LINC), Engineering's service learning program, the ESJ Scholars program was designed to help Illinois Engineering students understand that social justice is an engineering issue and to rethink the role engineers play in society.

In the second course of the two-semester program, "Leadership in Engineering for Social Justice," students were to draw from everything they'd learned in the fall course and as mentors in ICANEXSEL (Illinois-ChiS&E Alliance for Nurturing Excellence in STEM Education Leadership),

an outreach to diverse, Chicago Public School (CPS) middle school students. In the first part of the semester, they participated in local STEM education outreach. After creating their own lesson plans, they "engaged underrepresented youth in Champaign-Urbana in STEM education outreach activities in collaboration with local community partners, DREAM House, St. Elmo Brady STEM Academy, and Don Moyer Boys & Girls Club," Werpetinski explains. For their final project, they were to choose something they feel passionate about, such as an issue that's happening on campus or locally, and come up with a program to address it.

Rosado hopes the students' projects "will help the campus community think differently about our campus and reflect on their own role within it. I hope that by seeing their presentations and their projects at work, people can start to think and realize that they too can work towards a socially just community, even if it's with something that seems like a small action or initiative."

Rosado also hopes the projects can specifically impact current engineering students:

"I hope that these projects can help them understand that engineering must not (and cannot) be seen as a field that is completely disconnected from social justice principles."

Projects were proactive in trying to foster change about a number of campus and community issues. For example, Cheyenne Syring's presentation, "What is an Engineer?" addressed the role of women, the need for human-

Illinois ESJ Scholars from left to right: Kendall Furbee, Cheyenne Syring, Mrinaal Mittal.



A poster from Cheyenne Syring's "What is an Engineer?" poster collection.

A WOMAN'S PLACE

Four women who have defied stereotypes to achieve greatness



NASA's first Black female engineer who influenced the career paths of women in STEM at NASA.

MARY JACKSON
Hampton University
Mathematician, Aerospace Engineer



Developed on-board flight software for the Apollo space program and brought her four year old daughter into the lab with her.

MARGARET HAMILTON
Earlham College
Computer Scientist, Systems Engineer

Developed software for the International Space Station and educates her community about the inclusion of minority women in STEM.



CANDY TORRES
Rutgers University
NASA Engineer, Latina Pioneer

First Black woman to become a board-certified neurosurgeon and works to change the perceptions of Black medical personnel.



ALEXA CANADY
University of Michigan
Neurosurgeon, Educator

"They have made the mink coat, not the lab coat, our symbol of success. They've emphasized leisure time, not hard work and originality. As a result, today's schoolgirl thinks it far more exciting to serve tea on an airplane than to foam a new lightweight plastic in the laboratory."

-Betty Lou Rashin
chemist
Goucher College

an issue just because it doesn't pertain to you specifically. The world is not a strict dichotomy of us vs. them, and progress can be made at a faster rate once we all realize we're on the same team."

Another ESJ Scholar, Amire Woolfolk, created the ESJ Project YouTube channel, which deals mostly with areas of social justice in engineering, and includes videos of the social justice projects done by his classmates, as well as opportunity for others to contribute.

"I focus this simply toward engineers," says Woolfolk, "seeing as though we typically, in the field, ignore the problems of engineers in society in what we contribute, as well as what we could do to fix those problems."

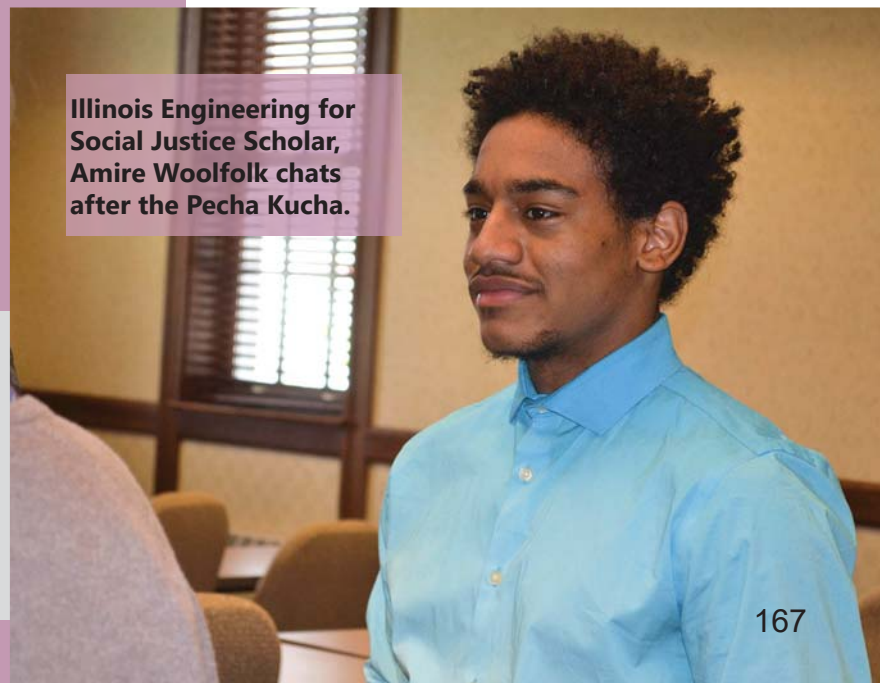
Also providing web-based resources, Hani Awni developed the Eng4SJ Project Proposal Repository. His goal was to enable future engineering students in senior design project courses to "start from a solid social-justice-oriented project proposal." According to Awni, "Due to a lack of social justice content in engineering education, even engineering students interested in social justice reach their senior year without sufficiently complex understanding of societal dynamics to enable effectively addressing problems of interest."

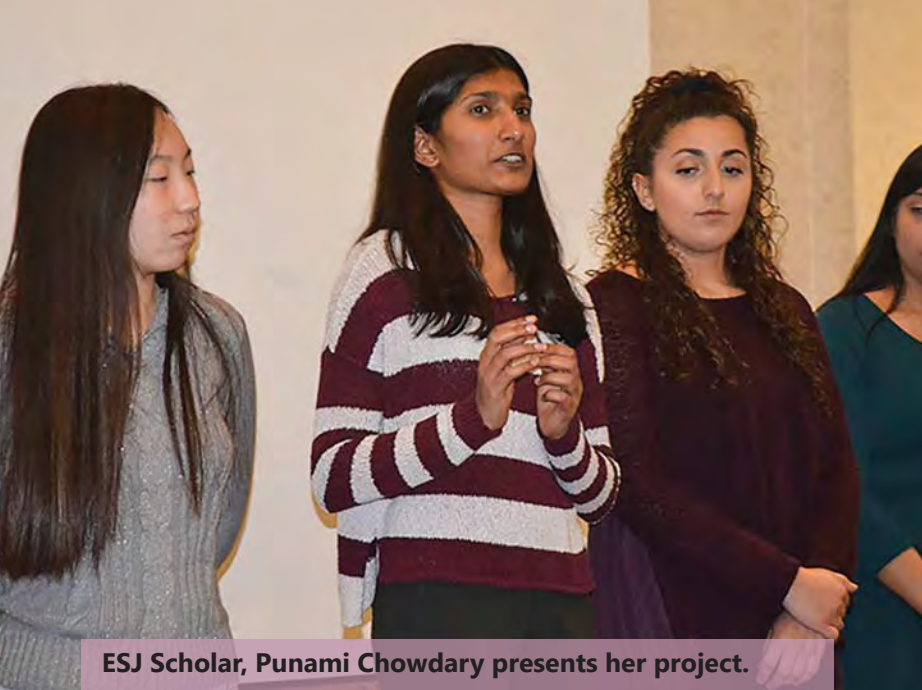
centered design, the harmful engineering mindset, and the role of Non-Western cultures. Her goal was: "to create an open dialogue to challenge society's convention of the role of an engineer." So she displayed posters on the 2nd floor of Engineering Hall.

Syring's message to students was:

"Recognize your privilege, and use it to fight for those who lack a voice society chooses to hear. As engineers, we cannot only look at the technical side of things and ignore our moral obligations to the fellow man. It's inhumane to ignore

Illinois Engineering for Social Justice Scholar, Amire Woolfolk chats after the Pecha Kucha.





According to Punami Chowdary, another ESJ scholar,

“Engineers are not introduced to career opportunities in which they can apply their engineering skills to make a social impact.”

So Chowdary sought to develop a framework for programs/ initiatives the Engineering Career Center can implement next semester to help Illinois Engineering students do so. Proposed projects included: an educational workshop to help students understand how Engineering and Social justice intersect, and a small-scale networking event the day before the Engineering Career Fair.

ESJ Scholar, Punami Chowdary presents her project.

Addressing the issue of gender discrimination in STEM, Mrinaal Mittal presented his project, “Sexism in STEM: It’s a Men’s Issue,” which was a World-Café-style event at the Beckman Institute where faculty, administrative staff, and students got together to talk about issues related to sexism. Mittal indicates that his purpose was to:

“Create a more equitable environment on UIUC campus specially related to gender discrimination.”

His project was to hold an event “targeted towards men so that they get a chance to learn about the difference they can make at an individual level and in the system.”

Also addressing the dearth of women in STEM Angel Loizzo's project, “Why so Chilly for Women in STEM?” cited some chilling statistics (26% of the current computing workforce is women, and 50% leave their STEM careers within the first 10 years), plus addressed types of subtle discrimination that can impact the number of women who end up in STEM fields, like Stereotype Threat, Unconscious Bias, and the Double Bind theory.

“The chilly climate metaphor represents the accumulation of subtle discrimination and sexism that saturates the STEM work environment and education settings.”

Seeking to increase the number of female entrepreneurs at Illinois, Kendall Furbee proposed the following programs/activities: the first four lead up to the Cozad New Venture Competition, in an effort to get more women participating in the contest.

1. A Girl Power pitch night
2. Women Entrepreneur of the Year Award
3. “Dolphin Tank”
4. 4-week business development workshops catered to women.
5. Improve marketing of startup culture at Illinois, (i.e., more pictures with women)
6. Website to expose successful Illinois, women-led startups.

Illinois Engineering for Social Justice Scholar Kendall Furbee (center) presents her project.





Illinois Engineering for Social Justice Scholar, Ann Artiaga

Somie Park's project was an Alternative Tour of Engineering Campus. She says that it "shows the struggles normally not seen due to other more positive narratives of the College, and link these struggles to larger social justice issues by questioning the spaces that are inhabited and thinking more critically about the implications of things like corporate influence on the University." So she created a self-guided tour booklet, which will soon be available publicly, dealing with the following topics: corporate influence, accessibility, community, and ethics. Throughout the tour,

questions are posed to stimulate thinking about the institutional social injustice that has taken place on campus.

Ann Artiaga's project, *Inspiración for Latinx Students: Community Art as Social Action in STEM*, was

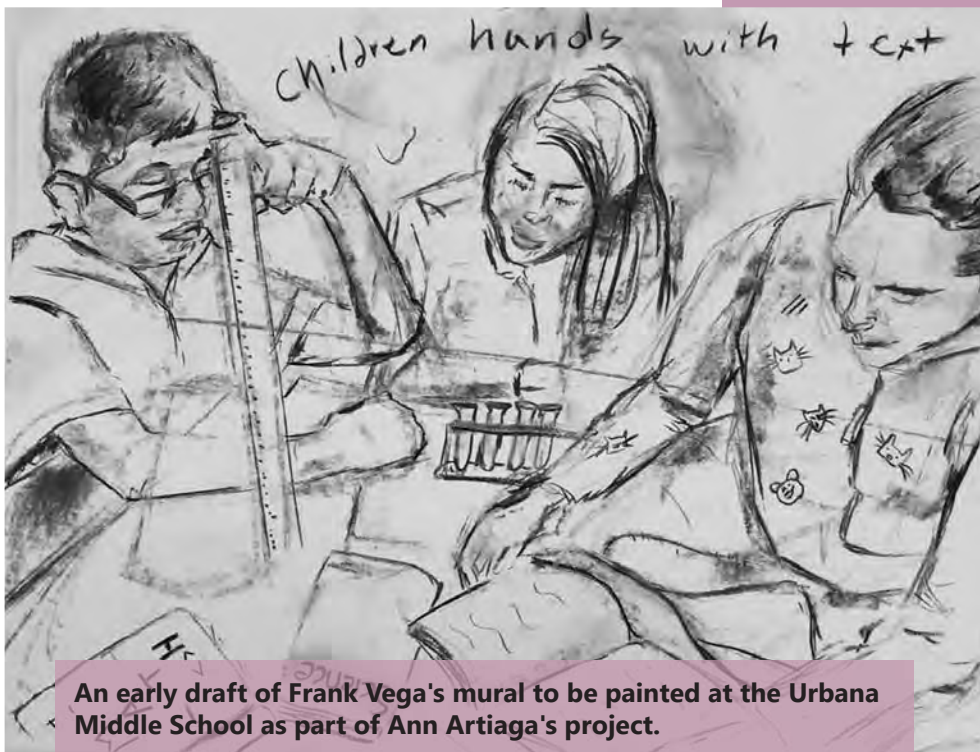
"The creation of an art piece to educate people about the value of minorities in higher education, especially in STEM. An art piece adds visibility and encouragement for viewers, opposite of a hidden curriculum. Using community art to create a narrative around a space and visibility of people is a powerful proposal."

So Artiaga is doing just that. She worked with Urbana Middle School Teachers, Ms. Maria Moreno (ELL/Bilingual Social Studies Teacher) and Ms. Darienne Ciuro Sanchez (ELL/Bilingual Science Teacher), on afterschool workshops with Latinx youth to discuss issues of identity and labeling and to generate ideas for a community mural which would depict a positive narrative about the students' goals and how they see themselves. Plus, she is working with a Latino artist, Frank Vega (Fine & Applied Arts student at Illinois) to plan the mural for Urbana Middle School, and pending approval, Frank will engage the youth in the production of the mural in May.

Ryan Gilmore's project, "Advancing Justice with the Siebel Center for Design," sought to incorporate social

justice into the principles of Human-Centered Design for Users by adapting it to communities. Gilmore used inspiration from the principles of design for social justice to propose ideas and create resources that could be used in programming for the Siebel Center for Design. He shared some of his ideas with faculty and staff at the Entrepreneurship Forum.

Jake Navarez's project, "Ethics in Engineering," was related to engineering ethics. According to Navarez,



An early draft of Frank Vega's mural to be painted at the Urbana Middle School as part of Ann Artiaga's project.

She also reports that involvement in the ESJ Scholars Program has already significantly influenced several students' future plans in significant ways.

For example, one student changed his grad school plans to continue to explore social justice-oriented research pursuits. Another accepted a summer internship in Washington, DC under the Congressional Hispanic Caucus Institute, an internship which Werpetinski says, "she would not have considered previously with her bounded understanding of the role of engineers and their potential contributions to policy or government work."

"After taking this class, I feel like I have a better understanding of the relationship between social justice and engineering. Not only that, but the relationship between social justice and education as well. As a future educator, this class has taught me how to view and help communities that I might work for in the future."

She adds that:

"Still others have declared their intentions to build on their "Engineering for Social Justice Projects" in the upcoming school year, to continue STEM education outreach work with underrepresented students, and to apply their learning in the ESJ Scholars Program to other roles that they hold in registered student organizations."

What kind of overall impact did the course have on the students? Werpetinski reports being

"Encouraged by changes we've already witnessed in the students' overall knowledge about social justice issues, enhanced critical thinking about engineering's role in promoting or inhibiting social and environmental justice, and shifts in previously unquestioned values, attitudes, and dispositions. Some of the students have really embraced the opportunity to impact their spheres of influence this year—whether that be within their peer networks, various university settings, or the broader community."



The Illinois ESJ Scholars participate in a question-and-answer period following their presentations.

**Illinois ESJ Scholar,
Angel Loizzo, presents
her project.**

SHARE YOUR THOUGHTS
How has sexism
in STEM affected you?
What changes do you want
to see?



AT BLUE WATERS INSTITUTE, STUDENTS USE PARALLEL COMPUTING, SUPER COMPUTER, TO SPEED UP RESEARCH

June 28, 2017

With the goal of learning High-Performance Computing (HPC), 26 students were on campus from May 29th through June 9th as part of the 2017 Blue Waters Institute. While some were graduate students from the XSEDE project, 18 were undergraduate Blue Waters Interns. Not only did these interns spend two weeks learning about parallel computing, but over the next year, they will continue to use their newly acquired HPC skills—and the Blue Waters Super Computer—to analyze data for their Blue Waters research projects back at their home institutions.

The institute is designed to introduce non-computer-science students to parallel computing. According to Institute instructor Aaron Weeden, it's useful in fields other than computer science as well.



During the tour of the Petascale Institute, two Blue Waters Interns, Monet Alberts and Caroline MacDonald, get an upclose look at the Blue Waters supercomputer.

BLUE WATERS

- Blue Waters is straight ahead; cooling to left, processor cabinets on right (28 cabinets, nearly 27,000 compute nodes, 79,000 processors)
- In front of Blue Waters are the Cray So disk storage units (total: 26 petabytes of usable storage)
- Spectra Logic tape libraries archive storage (nearline storage, total: 250 petabytes of storage)

"Understanding how code is running when it's on the system is really important," he explains.

Weeden reports that when recruiting for the institute, they identified students who had a desire to learn High-Performance Computing (HPC) in order to more efficiently complete a project they were working on, and whom they thought could become proficient with a two-week institute.

"This batch of students is motivated," he says, "they want to become very proficient at high-performance computing, particularly with many-core systems. Students are able to collaborate with each other, and everybody is learning from everybody."

Monet Alberts

One participant, Monet Alberts, a rising junior studying material science engineering at Boise



Blue Waters Institute Interns

State University, shares how she ended up in the program. Last year, a professor had suggested that she try his computational engineering lab, so she did, and ended up really liking it. Then, a day before the Blue Waters application was due, her professor emailed her about it saying, "If you really want to do this, let me know, and I will write a proposal for a project tonight, and you can apply for it tomorrow, before the deadline." Her response was, "Okay!" so here she was.

Her research—epoxy simulations—uses different temperature profiles to determine how an epoxy is going to cure and the mechanical properties that are going to come out of the shapes that they make. Since making parts is really expensive, industries can save on costs by figuring out reaction kinetics and simulating them before the parts are actually made.

Before coming to the Institute, Alberts had only used Python, never C or parallel computing. However, she believes she's going to be able to use what she's learned—and the supercomputer—to significantly speed up calculations.

"What we've really been trying to do is speed up our bonding routines...that's what really takes us the longest. Our simulations, at least the ones that I run, usually take about 21 hours for one simulation. That waiting time is pretty expensive computationally, and that's the reaction of bonding that's taking so long. If you have 50,000 particles and they're all bonding with one another or what have you, that's what's going to take the longest in all of the code."

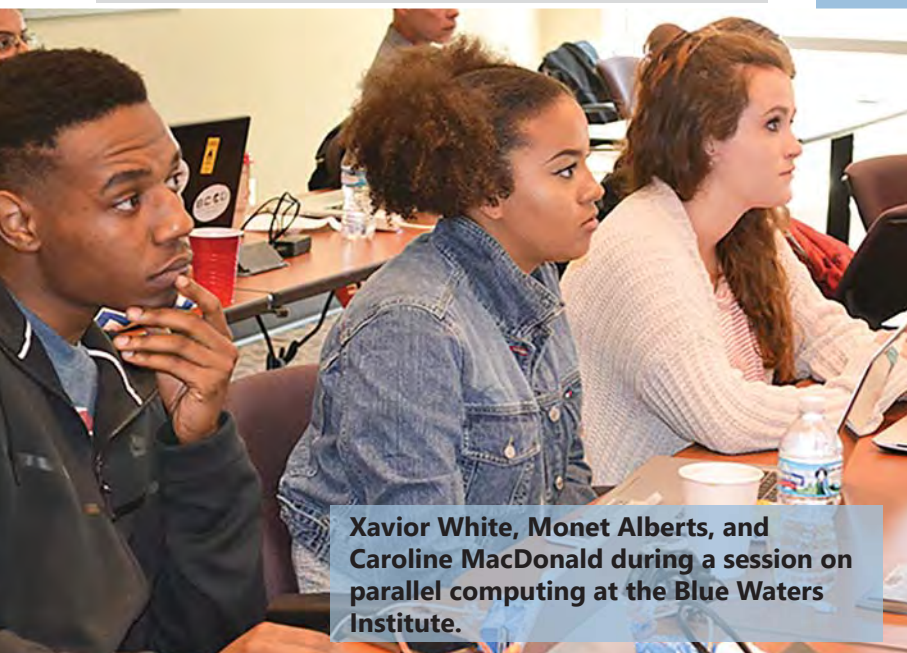


**Monet Alberts from
Boise State University**

Monet says it's been a lot to learn. "I have to go through everything that I'm learning—not while I'm in class. Later in the day [I think about how] I'm going to apply it to my own stuff. There's some things that I've learned that I know, maybe I can't apply it, but there's definitely a lot that I've learned that I think will really help. Not just that, but I've never coded in C before. I started off in Python, I've never used anything else. Python is my baby. So learning all of this stuff is really cool and being able to see my Python code into C code is something that is going to be a challenge but something I think I'll be able to do."

Monet is already strategizing on how she'll be able to use parallel computing in her research. She plans on breaking the simulation box into sections so each tiny box can be done at the same time and using MPI to communicate between the boxes.

"MPI is what you can use to communicate between processes," she explains. "Before, I wasn't able to break up my box because I wasn't able to get atoms in one section to communicate to the atoms in the next section, which is important, because they're not acting



**Xavier White, Monet Alberts, and
Caroline MacDonald during a session on
parallel computing at the Blue Waters
Institute.**

independently of one another. So I can use MPI to get them to communicate with one another so that they know if something has bonded too many times, atoms in the next box can't bond to that."

However, should she have any questions once she's back home, the researcher she's working for should be able to help.

"He knows everything," Monet brags. "Whenever I ask him a question, he has the answer. He knows, I'm pretty sure, every programming language you can think of. He's very smart with these things. Before we came, we did a little crash course on C. We did a few things, but not necessarily as extensively as we are doing here. But it definitely helps. When I came in, I knew what specific lines met, so when I get back I know for sure that I'm going to have a good resource to go to if I ever have any questions."

Monet also believes her participation in the Institute may impact her career choice. Her dream job is to work for Boeing. In fact, the reason she started working on epoxy simulations is because her mentor has some ties with the company. But she's also looking into getting a PhD in biomedical engineering. But for now, she's wrestling with how to use her new computational skills in her undergraduate work. "Lately, I've been exploring ways to do that, that haven't been done yet. So that's really exciting to me because that's something that I could do and maybe put my name on."

Alberts definitely believes she's going to be using HPC down the road. "Python is really good for a lot of things but there's some things that it can't do. So learning these different languages is really going to help...I think it's going to give me kind of a leg up over people that don't know these languages."

Xavier White

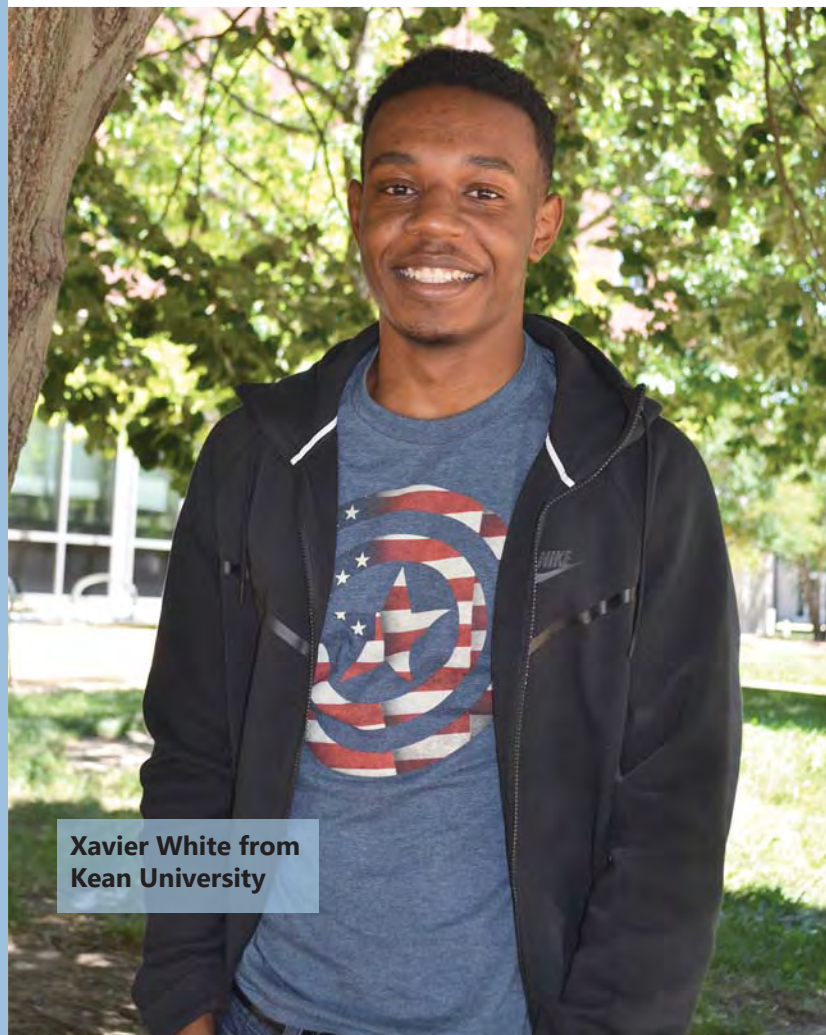
Another Blue Waters Intern, Xavier White, is a rising junior at Kean University (in Union, NJ) who is studying computational applied mathematics with a focus on the computational side.

He indicates that he decided to participate in the program, "primarily for the experience and to learn how to take my computing to the next level." Though he already has a pretty good focus on computing at his own institution, his mentor told him the Blue Waters Institute would be a really great opportunity to learn how to do high-performance computing, "so I came here to expand my horizons," he admits.

White believes he's definitely going to be able to use HPC in his computational math. "Even as they teach it [HPC] to me, I immediately equate it to something I can do within my own code... Pretty much every time I learn something new, I automatically think of how I can use that for our already-standing project and just make it better, faster, more efficient."

White says some of the programming languages he's encountering are brand new: "That's where I feel like I'm a little bit behind the curve because...I had never even heard of some of these high-performance computing languages. I primarily coded in Java and C#, which are pretty good for serialized computing but when you get to parallel computing, I'm seeing now, that they aren't necessarily the best options and then you have programs like C and Python and all these different like GPGU coding systems and things like that, where I had never even conceptualized that I might use those languages."

White is looking forward to implementing what he's learned: "By far, the thing I'm most excited to use that I've learned is Open MP and MPI, which are basically parallelization tools that use either one processor in a number of ways or multiple processors in multiple ways. I've learned how to



**Xavier White from
Kean University**

incorporate that into C, which I took a crash course in when I got here, so I guess you could say I learned C as well. I also learned how to use those open MP and MPI protocols to make C program writing exponentially faster.”

Once White gets back to his home university, he hopes to use Blue Waters for testing, more than towards the actual project that he’s working on. “It’s an unbelievable resource as far being able to run multiple tests. Whereas, it would take me a couple of days to run hundreds of tests on my laptop, maybe even weeks. I probably could do it in a couple of hours on Blue Waters.”

White believes HPC is definitely in his future. Before he came to the university, he says he was planning to start his own software engineering firm, but reports “I had never really found motivation to get it off the ground, look at what I need to actually start a company and take it from an idea to a reality.”

However, while here, he reports being inspired by the guest speakers and fellow institute members (“So many smart kids here,” he acknowledges, “It’s just so inspiring,”), so he’s actually started taking the first steps towards creating that firm.

“I think that one of the highest things I can do with that would definitely be to take high-performance computing and just make it more accessible. It’s a beautiful tool, but I feel like a lot of [folks] don’t get the opportunity to learn how to use it, or if they don’t want to learn but just use it for their business or their personal research, or PhD students who aren’t necessarily computer science students but they want to use high-performing computing to fuel their research; I would love for my service to help people with all of that.”

White recommends the institute for any student who wants a career in computer science. “Whether or not you’re going to directly use high-performance computing, the ideas of parallelization are usable in any aspect of the real world from project managing, which we saw a presentation on, to cooking, if you really wanted to. I think the ideas here are far more important than the syntax we use to code. The ideas of breaking up a task is far more invaluable than the syntax we use.”

White also recommends that the institute expand to include more underrepresented students: “I wish we could handle more kids,” he says. “I would definitely bring a lot more kids like me from the inner city. We don’t really have resources like this. I didn’t even truly know what a super computer was until I got to college. I didn’t know you got paid from certain institutions to conduct a PhD research. That’s something that a lot of inner city kids don’t even fathom, let alone, going to college. So that’s what I wish and hope this program could expand on: outreach, because I feel like a lot more kids need it and would be very much appreciative of it, value it, and get a lot more out of their careers as a result.”

Another impact of the institute? As a result of his participation, White is probably going on for a PhD himself. “I was thinking about it before I came



During the Blue Waters tour, students get a look at a model of the supercomputer.

here,” he admits, “and I’m fairly certain now that I’ve come here, and I’ve seen what I can do with it.”

Caroline MacDonald

Blue Waters Intern Caroline MacDonald from Mississippi State University is studying geosciences with a concentration in professional meteorology and a minor in psychology. She plans on pursuing a Master’s, and, after that, “It’s still a work in progress...But right now, I would definitely say working for the National Weather Service, because it’s probably the best way to interact with people and help people which is what I want to do.

While MacDonald doesn’t have a computer science background, she’s had some coding experience. “I got lucky in that one of our professors at our university, he actually just started a computer methods in meteorology class, so basically applying coding to meteorology and learning what’s useful in meteorology, and I took that this past fall.”

So while she had a background in Python but no prior knowledge of parallel computing.

“I’ve definitely broadened my languages being here. It was interesting coming in just because I knew I didn’t know a whole lot, but I’ve definitely learned a lot here, so it’s been really good.”

She also learned more about how to use Python: “I already knew a lot of Python, but yesterday we worked on it some more and learned how to apply it to Blue Waters, which will be very helpful.”

MacDonald believes she’s going to be able to use HPC in her career. “I think coding in different languages and having that background brings a lot to the table...I think it’s just a very useful skill to have. I might not use it on a daily basis, but at the same time it’s something great to have and definitely very useful.”

MacDonald’s Blue Waters research will be related to predicting a tornado outbreak.

“Basically, we’ll be running a high-end meso-scale model which, in order to run anything like that, you have to compute. It’s seeing how well the model is running and when we can basically see if there’s going to be a tornado outbreak. So we’re going to be running five specific tornado outbreaks and just seeing at different lee times, just like 12hr/24hr like that sort of thing, seeing how far out in advance we can notice certain characteristics and see if that’s possible.”



Caroline MacDonald, a Blue Waters Intern from Mississippi State University

JONT ALLEN'S ECE 298 JA COURSE REINFORCES ENGINEERING MATH FUNDAMENTALS WHILE SURVEYING THE HISTORY OF MATHEMATICS

December 11, 2017

How well do AP students do on Illinois' engineering math courses? To answer that question, about 12–15 years ago, a joint group of Illinois math and engineering professors studied the issue. While there is a strong correlation between AP scores of incoming students and how well they do in subsequent engineering math courses — students who get 5's typically get A's, 4's get B's, etc. — the study also discovered a great deal of variance and overlap between scores: though most students follow the norms, some end up getting A's while others get D's. Jont Allen, a professor in the Electrical and Computer Engineering (ECE) Department at Illinois, sees this enormous variability as a problem, so he set out to correct it. He created his own class, ECE 298 JA (his initials), to refresh incoming students in engineering math fundamentals while teaching them the history of mathematics.

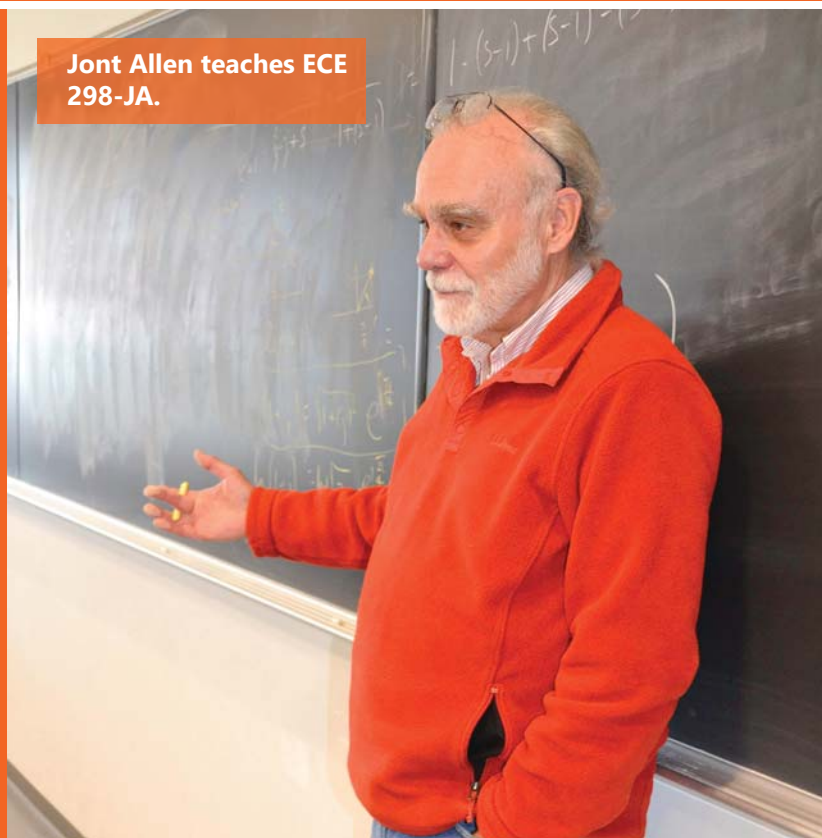
While Allen was aware of the above study, it was his colleague, Steve Levinson, who first underscored the need, triggering the around 50 or so ensuing discussions they've had about the problem: These freshmen," Allen relates, "they come in; they've AP-ed out, and they don't do very well in their engineering courses, which is kind of shocking and concerning." He continues:

"They're obviously smart. They've AP-ed out of their calculus; they think they're smart; they are smart, but then they come in and they don't do very well."

Why don't they don't do well? Allen has a theory: "The problem is, clearly—do I have data as to why? No, but I can tell you why—the high school education just isn't up to college-level math. It's very simple."

He elaborates on why there is so much variability: "Because different schools have different levels. And the quality of the teachers is highly variable." Some teachers simply prepare students for the AP

Jont Allen teaches ECE 298-JA.

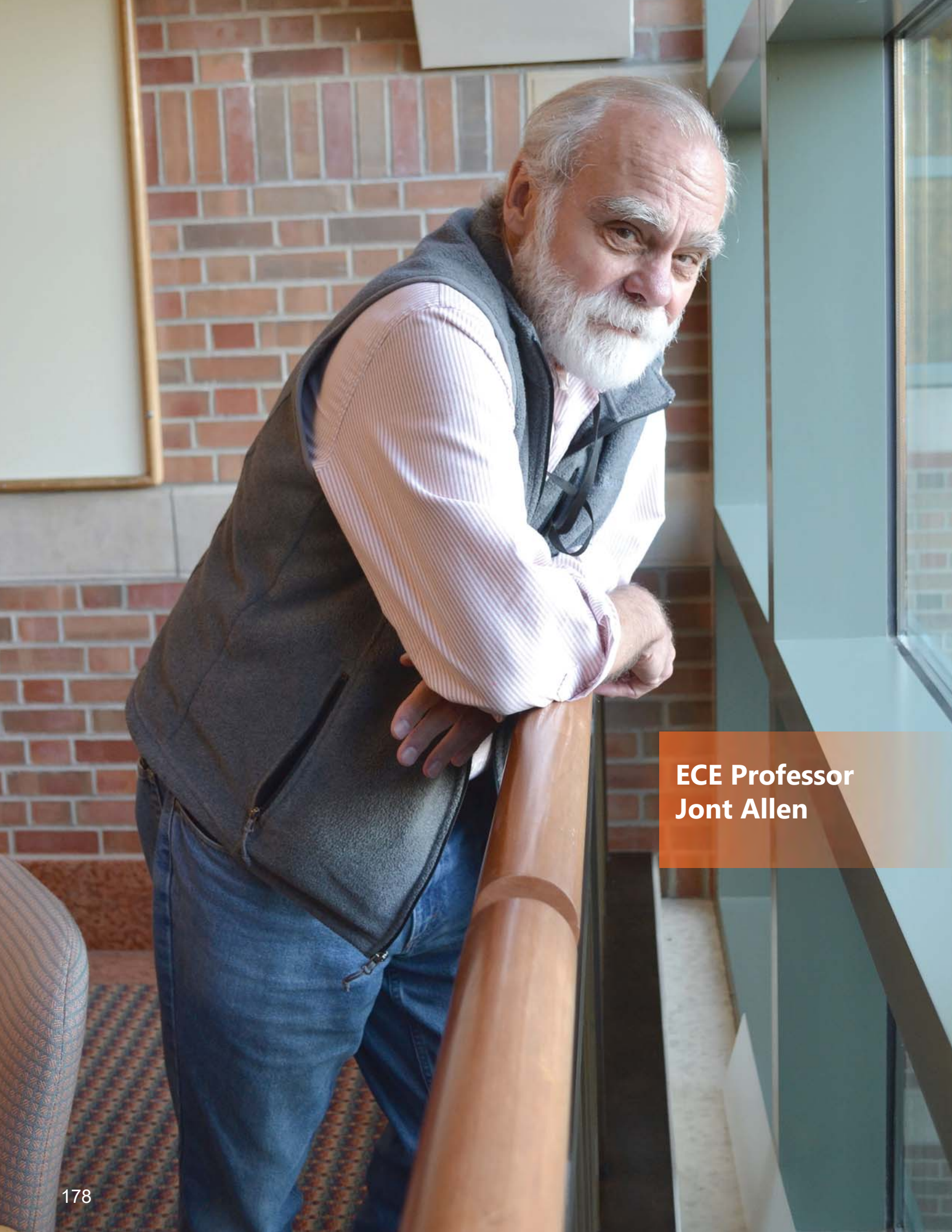


exam, whereas others focus on topics not included on the exam.

The different levels of preparedness in the incoming students prompted Allen to do something about it: to create a foundations course in math and physics that would challenge the more-prepared students while also allowing less-prepared students the time to catch up and feel more confident.

Allen teaches the class by presenting his students with a history of mathematics. His course is patterned after a book he had stumbled upon, *Mathematics and Its History*, by John Stillwell. "It inspired me. I just loved it. It really did a lot for me," he admits, so he used it as a kind of template for his course, where he and his students explore a historical timeline for the progression of the seven fundamental theorems of mathematics.

So how far back in history does Allen go? China 5000 BC. Then he travels forward to the present by addressing the discoveries of a number of math greats that even non-engineers/mathematicians have most likely heard of: Euclid. Bernoulli. Pythagoras (to name a few). In the materials he's



**ECE Professor
Jont Allen**

created for his course, Allen includes several timelines explaining who did what, and when, and how people are connected.

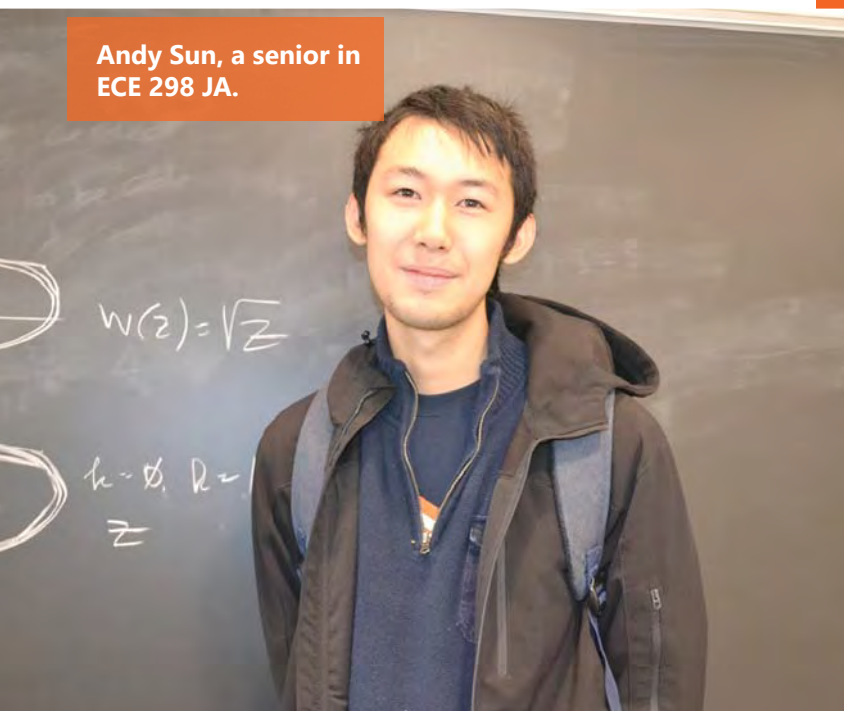
“I include the history to talk about who did what, and try to put a personality into it,” he remarks. “What I like is that no one’s going to change the history.”

Students still get the refresher course Allen set out to give them by “re-discovering” the theorems and how they came about. The historical component allows students to see how each theorem was developed and worked on by many people, as well as how the theorems spin off of each other. The cornerstone of modern mathematics is the Pythagorean Theorem, from which the other fundamental theorems originate.

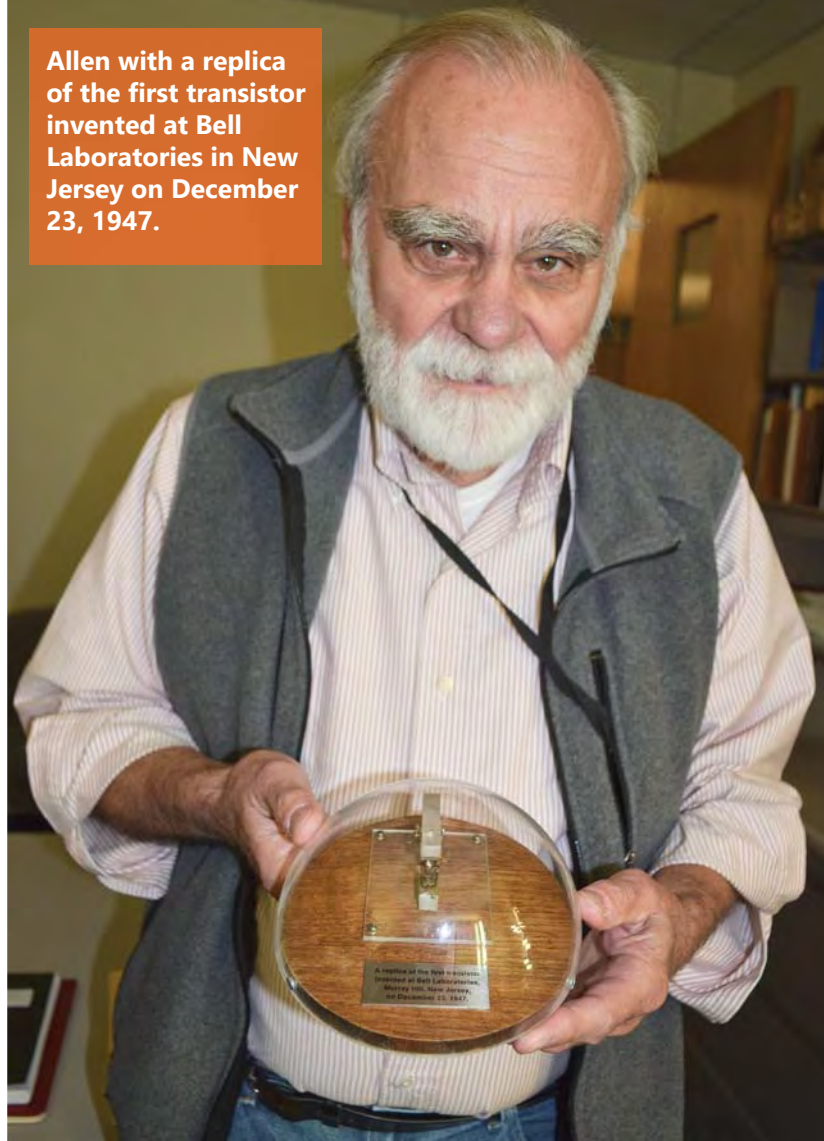
Allen comments on the necessity and effectiveness of his class:

“It’s good because students are learning things they’ve never heard about before, and it’s all very basic mathematics. This is five semesters of mathematics in a one-hour course. It’s calc 1–3, linear algebra, differential equations, vector differential equations, and complex variables. I cram it all into this one semester, and it works. It stays at a pretty high level, and I emphasize seven fundamental theorem of mathematics.”

Andy Sun, a senior in ECE 298 JA.



Allen with a replica of the first transistor invented at Bell Laboratories in New Jersey on December 23, 1947.



While the course was originally intended for freshmen, upperclassmen who have taken it as a review course have found that it gives them a context and helps them better understand previous math courses taken. Also, Allen encourages older students to take his class in order to ensure a steady supply of TA's for coming semesters.

Take Andy Sun, a senior who took another class Allen taught, decided to take ECE 298 JA, and enjoyed it immensely. He comments:

“For engineers we need a lot of math, and this class is a good review of math classes I’ve previously taken... Before, in class, I just learned how to use a formula and then plug in numbers. This gives more of a conceptual understanding of where everything comes and shows more of connection between everything.”



Jont Allen (left) helps an ECE 298 JA student work through a problem.

Sun recognizes the need Allen's been emphasizing: engineers need a fundamental mathematics course at the college level to help them understand how their other classes function in relation to it.

Like Sun, Yucheng Liang, another upperclassman, had a very similar experience.

"It [the class] helps me to better understand some of the courses I already took. It is just so helpful to me," she acknowledges.

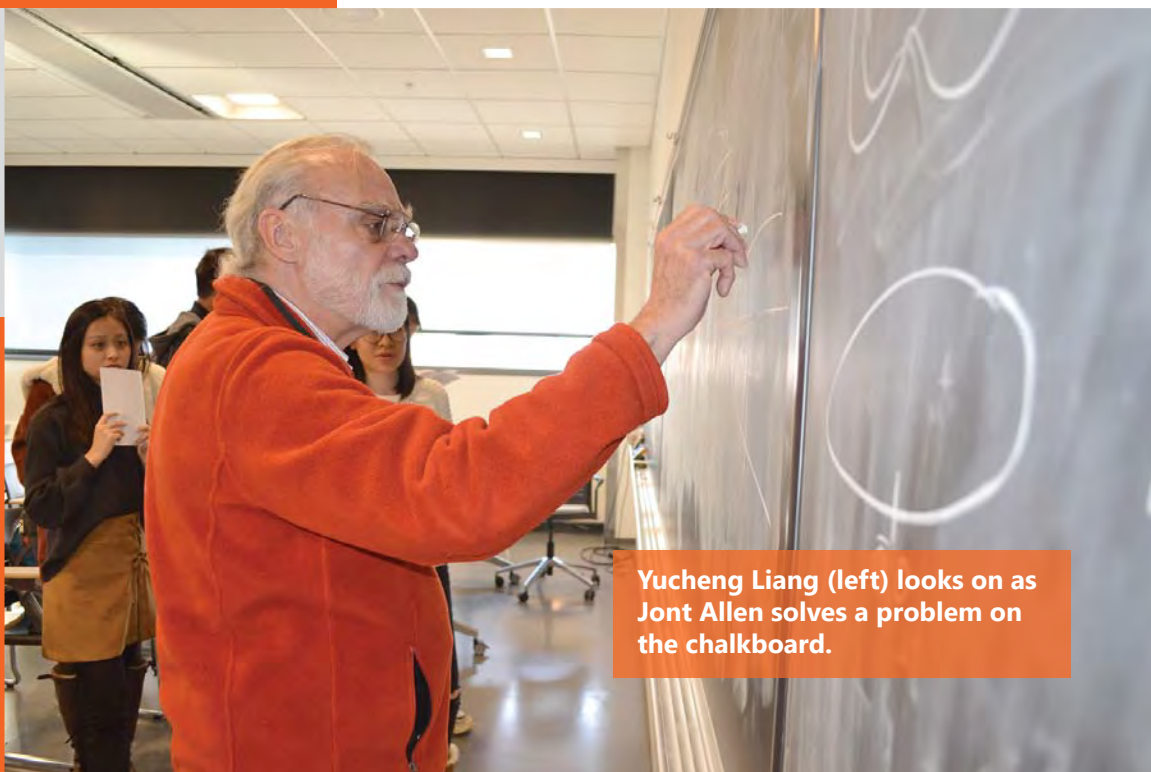
Since the class combines the basic concepts of physics and engineering as well as math, it gives students both new and old perspectives on what they have already learned, either in high school or other college courses. Instead of

merely memorizing formulas, students can actually understand the derivation of formulas and which math fundamentals actually help them to do well in other classes.

When it comes to understanding the mathematics practicing engineers need in their craft, Allen knows from personal experience. In addition to being a professor at Illinois, he has also had an amazing career in the private sector.

He received his Ph.D. in Electrical Engineering from the University of Pennsylvania in 1970, and his primary research area is biomedical imaging, bioengineering, and acoustics. His 32 years at AT&T Bell Labs saw Allen specialize in cochlear modeling, auditory and cochlear speech processing, and speech perception. He and his team developed the first commercial multiband wideband dynamic range compression (WDRC) hearing aid, as well as many other significant advancements. In 2003, he joined the Illinois faculty in the ECE Department, teaching and working with his students on noninvasive diagnostic testing of cochlear and middle ear function.

Also, in keeping with his long tradition of trying to better people's lives through his research, Allen has also been passionately researching another issue that has less to do with the ears itself but more to do with the ear-brain interface: the detection and identification of reading problems in young children. He works with Cynthia Johnson, in the department of Speech and Hearing Science, to study a group of children, half of whom are controls and the other half who are reading disabled. Allen remarks, "For the last 10 years, Cynthia and I



Yucheng Liang (left) looks on as Jont Allen solves a problem on the chalkboard.

did a study on these children. We demonstrated without any question that the reading disabled kids can't recognize some 20–30% of different speech sounds. They can't decode....” Essentially, though these children have completely functional hearing anatomy, their brains cannot identify the different phonemes, or sounds, of the language.

According to Allen:

“About 15% of the normal population in second grade has a reading disability. That's a lot of people. They go on, and they're years behind the class. And they end up dropping out of school unless they have parents who can afford to put some resources on them and try to get the problem fixed.”

Allen wants to raise awareness about this disability because often these children are quite intelligent; they just get bored in class because they cannot understand what is going on. Many get behind in their classes and drop out simply because schools

and teachers do not have the resources to identify the problem.

Allen makes one final plug for his ECE 298 JA course. In the words of its creator, it's important because he's seeking to help “...these young students who are very smart because they've AP-ed out. But when they come to take the courses, they don't do very well always. So we need some way to bring them all up to speed to reduce the variance. They come from all walks of life, they need to have a uniform way. It's a foundations course, and the ones I've talked to from past years are all now top in their class.”

Based on its positive impact so far, Allen encourages any student, regardless of age, who feels they need a refresher course in the basic fundamentals or mathematics to sign up for his class next semester!



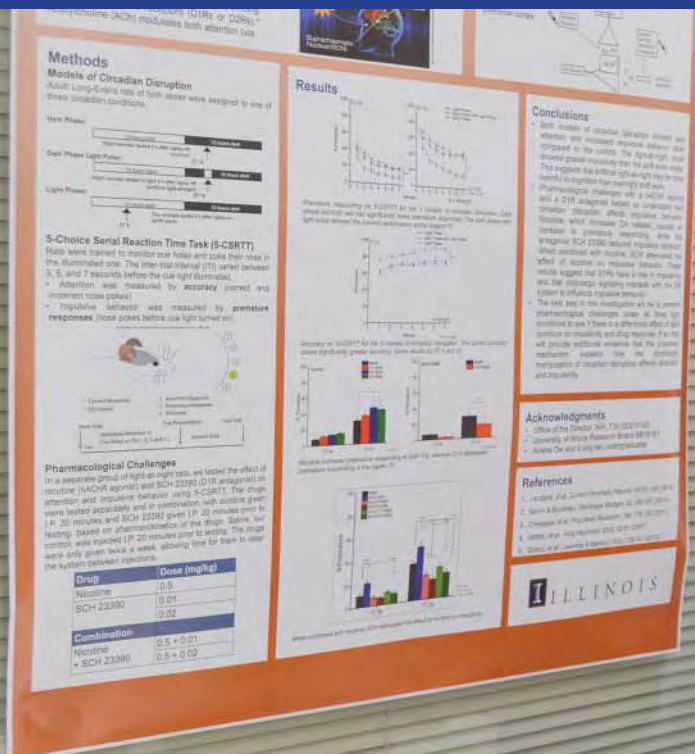
A group of ECE 298 JA students consult each other during class.



Bioimaging REU participant Than Huynh and his grad student mentor, Jamila Hedhli.



STEM RESEARCH EXPERIENCES AND OPPORTUNITIES



BIOIMAGING REU EXPOSES UNDERGRADS TO IMAGING RESEARCH, WHAT GRAD SCHOOL IS LIKE

July 25, 2017

In its third summer, the Bioimaging Research Experience for Undergraduates (REU) allowed ten undergraduate students to experience research on imaging. Not only did they learn about the specific area they were researching; but they acquired new skills related to imaging; gained professional skills, such as how to present their research; plus learned what graduate school is like. For some, it confirmed that graduate school/research was in their future.

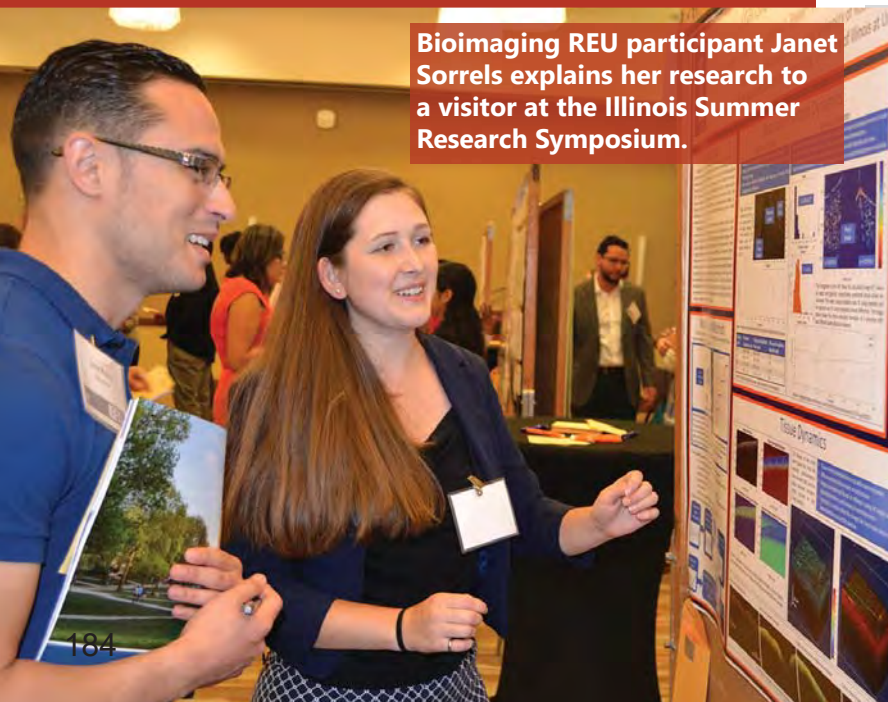
According to Co-PI Andrew Smith, since the BioEngineering Department (BioE) didn't have an REU, they felt that offering one about bioimaging, a sub-field of bioengineering, was a "great way to get people into research that wouldn't have any experiences otherwise." They also felt it would provide students a summer opportunity related to Bioengineering compared to a standard job.

Another goal was recruiting students to graduate school "who might be on the fence about going and need some sort of inspiration to get to the next step to make that decision to go." It appears that the REU is achieving this goal, because it has had a tremendous impact during the first two years of the program. Around 80% of the participants have gone on to graduate school; 25% (four out of sixteen) have actually come or accepted offers to come to Illinois.



2017 Bioimaging REU undergrad, Carolyna Quiles.

In keeping with NSF's broadening participation mandate, a major motivation for the REU is also to increase enrollment of underrepresented minorities and females in STEM:



Bioimaging REU participant Janet Sorrels explains her research to a visitor at the Illinois Summer Research Symposium.

"We do see it as like a gateway to getting underrepresented groups who might not naturally be interested in going...to the graduate level into the STEM program where it is more math heavy and more engineering focused. So that's a major motivation for us is to specifically recruit students like that," Smith indicates.

"It's to give people the experience to do research in these fields, which we think are very exciting," Smith explains, "and to be well mentored in it so that they understand actually how to do experiments, how to analyze data they derive from the experiments, how to

interpret it, the full gamut of the idea, concept all the way to data collection and interpretation—everything to do with research in respect to that.”

Obviously, one of the main goals was to expose students to what research is really like.

Students not only gained professional experience related to research, such as how to write the data up into a document, but they got to experience presenting it and giving a scientific talk. At the end of the summer, they both gave an oral presentation and presented a poster about their research at the Illinois Summer Research Symposium at the i-Hotel. They also attended workshops about preparing one’s resume and how to apply to graduate school.

What did the REU directors hope the students would learn this summer? For one, they wanted students to “see the grand challenges of biology, bio-medicine, and clinical medicine practice and to be able to identify them, and then to tie that to a technology related to imaging.”

Specifically, they hoped students would learn what bio-imaging is and how to use it, and acquire hands-on skills related to bio-imaging at multiple scales ranging from cells and tissues to whole organisms. They also wanted students to understand the relevance and need for more complex and abstract things like math, and to tie that back into something that is useful and interesting.

“So it's to really use images as a showcase for complex math and statistics and computation, which are not really interesting to most people—so it's to make that interesting, so they get into fields like STEM fields that are very math heavy.”

What are the benefits for the students? Well of course there’s the financial aspect. And while they could have earned money doing a more traditional blue collar job, during the REU they spent the summer doing something that’s more career oriented.

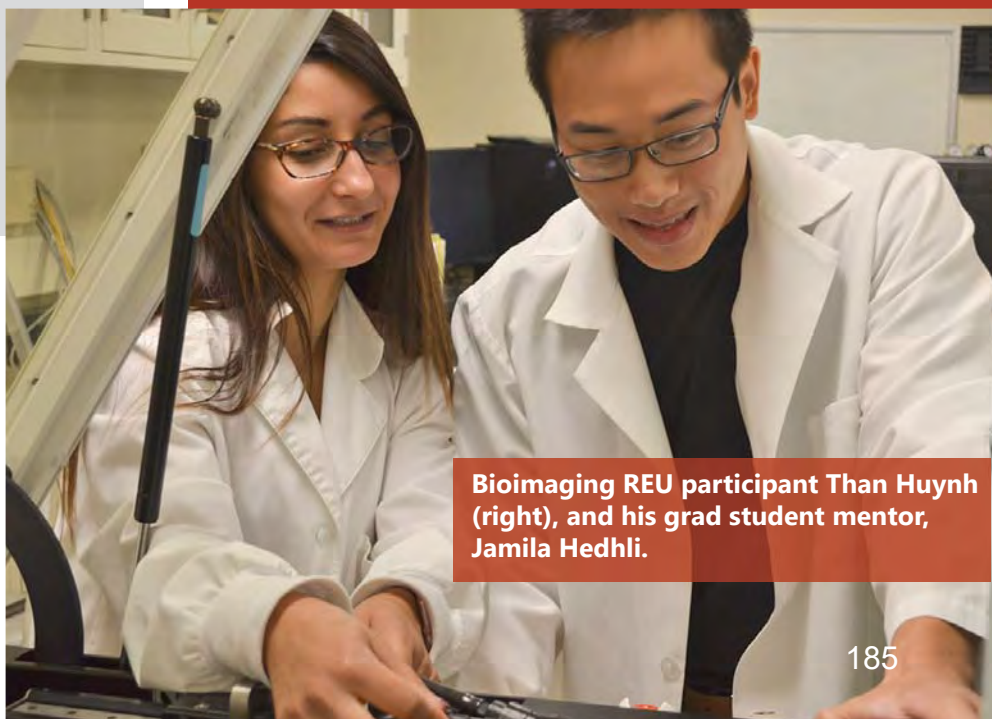
Another benefit for students was inspiration:

“Here, they get to do something that's very much focused on their career outcomes,” Smith explains, “so hopefully this will be something that they might get inspired to go into a specific career because of this. So I think the inspiration is a big thing.”

A third benefit? It looks really good on their resume. “It looks good that they got into a program like this, and they went through the whole thing, and they could write on their resume what they did, so they have all these professional skills they could write down now that they achieved.”

Finally, the students got experience presenting their work at the Illinois Summer Research Symposium (see above), and can potentially present their work at a professional society meeting. According to Smith, students will apply and may be selected to go to this year’s Biomedical Engineering Society Conference in Phoenix to present a poster or oral presentation based on their work this summer.

“Getting involved in research as an undergraduate is one of the most important things to do as an undergraduate, because you don't have that opportunity after you leave an academic setting really. So learning the full concept of what science and engineering is it really starts from basic research.”



Bioimaging REU participant Than Huynh (right), and his grad student mentor, Jamila Hedhli.

Smith adds that once one gets into industry or medical practice, everything's applied and generally based on profit. But in an academic setting, things are more holistic, and things could start just from a concept and it's not driven by finances initially.

"So it's a really unique opportunity for students to get involved in research at that level because you could completely open your mind to any concept, and just an idea can spin off a whole field potentially... You get a very open ended experience... it can be life-changing for some students.

Smith reports being in something similar to an REU as an undergraduate. "That was what really changed my focus... once I got into research, it was like everything made sense to me." He reports learning "fundamental concepts like thermodynamics, things that are not that interesting because you can't see how they're applied. But once you get into research, you can see that that's the tie-in between all these really fundamental concepts that you learn into actual practice and to use. And so... for me, that changed my career perspective."

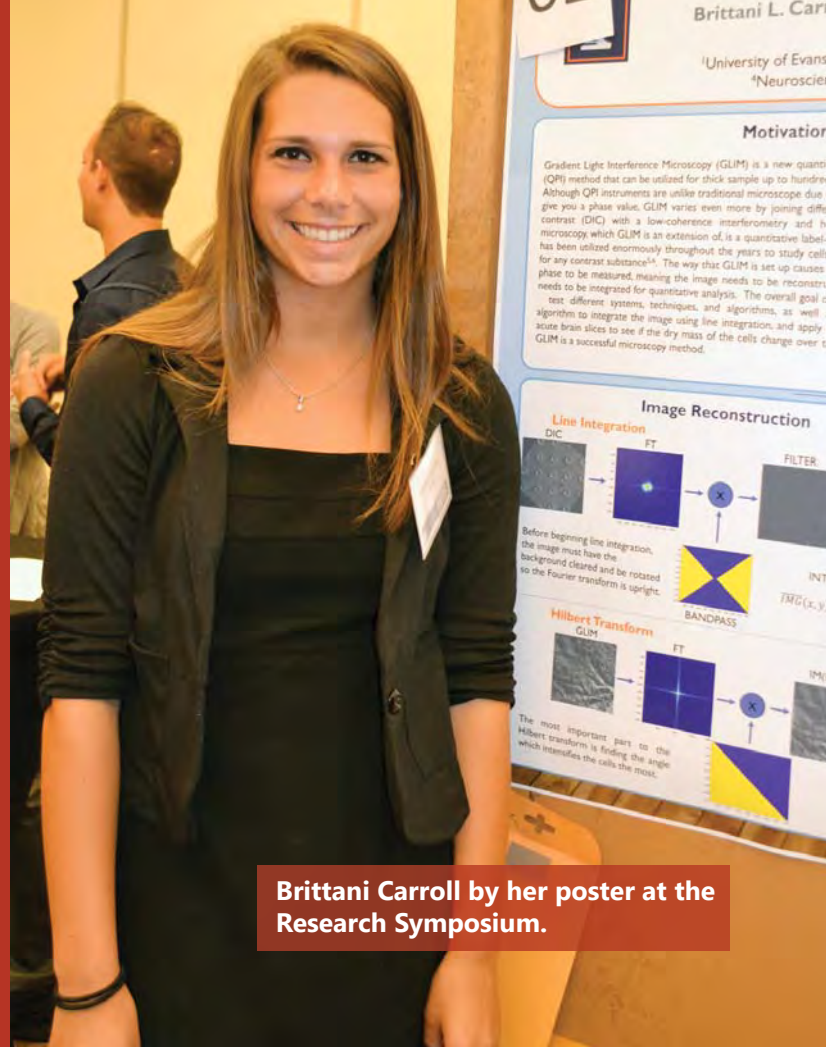
Smith finds it rewarding to see the REU students change over the course of just several weeks:

"When they actually get into a lab or when they start analyzing data, you see things start to click... And then they also get inspired to just learn as much as possible because then they realize they can actually apply even fundamental concepts. A book might not tell you why you might need to know how to do integrals, but then you can see it in practice when it's actually what people do day to day in basic research.

Carolyna Quiles

One of the 2017 crop of Bioimaging undergrads for whom the REU had a significant impact was Carolyna Quiles, a rising senior studying biomedical engineering with a minor in psychology at the University of Virginia.

Quiles participated in the REU because its theme was aligned with what she wants to do: "I am definitely interested in bioimaging. Back at my school, I haven't had the chance to go into it at all.



Brittani Carroll by her poster at the Research Symposium.

This was a new experience. It's been awesome, truly amazing."

Quiles' research in Rohit Bhargava's lab involves "printing sacrificial scaffolds that will be coded in a bio-gel in order to study or mimic tumor microenvironments. Right now we are just printing and seeing what works best."

Might what Quiles is doing now enable tumor research down the road? She says, "Yes, for sure. That's the plan!"

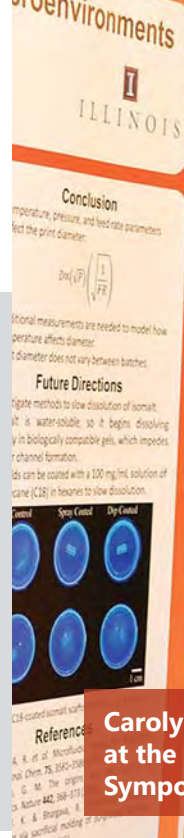
While she's learned a lot about her field, she's also learned about possible career directions. "There's so many different paths you can take as a biomedical engineer. I've also learned a lot about grad school and how that all plays out."

She doesn't really have any of the details planned out yet regarding her future career; however, she does want a job where she can use her engineering background to:

"be creative and solve problems in the field of medicine," then adds, "I'm definitely interested in devices."

While the experience hasn't necessarily impacted her career choice, it has impacted her inclination to go to graduate school:

"I think this experience has opened my eyes to what grad school is like, and has made me want to apply. If I had any doubts about going to grad school or not, this experience has definitely pushed me towards pursuing that."



Carolyna Quiles presenting her poster at the Illinois Summer Research Symposium.

Quiles has also discovered how bioimaging might be useful in the future. She says it's important "because you want to be able to visualize what you're doing. Whether you end up working with nanotechnology or nanoparticles, you always want to have some sort of knowledge and practice in bioimaging so that you can visualize, analyze, and get data from your samples." She says it also produces "nice pictures to share with the scientific company."

Quiles definitely thinks there's research in her future. "If I go to grad school (which I'm pretty sure I am), that's kind of what grad school is all about."

Might Illinois be in her future?

"Possibly!" she admits. "I really love it here."

The REU hasn't just been about work, though. "I've also made a lot of good friends," she says, "which is great. My cohort is filled with great, amazing individuals, so that's also been really good."

Regarding her overall impression of the REU, Quiles says, "This has truly been a really, really great experience. Not just in the educational realm, but also networking, social, education and academics. I think everything has come together very nicely. I'm having a really good time, and I'm really looking forward to the other half of the experience."

Troy Comi, Quiles' mentor, whose research involves developing artificial models of cancer

development using the 3D printer, acknowledges that he signed up to mentor an undergrad to pay it forward.

"I had a lot of great mentors when I was an undergrad, so I thought it would be good to give back to the community and help Carolyna this summer with her project."

Regarding the benefits of the REU for the participants, he asserts, "Undergraduate research is a great opportunity to take what you learn in classes and apply it to the real world. Also, you get to try out working in a lab before you maybe go on to grad school or med school, where you basically do it full-time."

Janee Phillips

Janee Phillips is a rising senior studying bioengineering at North Carolina A&T State University. Her experience in the Bioimaging REU taught her what she does and doesn't want to pursue, careerwise:

"So I'm definitely thinking about pursuing my Ph.D., which involves a lot of research. And this ten weeks was really intense, and that's just a little piece of what grad school is. So, even though it was really intense, I was happy that I was actually able to produce. So that's kind of what grad school is about. You go through stress your whole four years, and your fifth year you do your thesis, and you're like, 'I did it!'"

One thing Phillips learned during the REU was that she intends to go to grad school, but not in bioimaging. “Maybe not so much bioimaging. This project was a lot to understand. And bioimaging isn’t only ultrasound technology; it’s MRI, PET-CT, I’m not sure that’s the direction I want to take. So, this kind of helped me distinguish, ‘Ok, what do I want to do for grad school?’”

“I used ultrasound in order to image blood flow, because we want to be able to get an estimate for slow rate, We’ll eventually be able to determine, ‘Ok, how many nutrients is tumor getting?’ in order to say, ‘Ok, this is how fast the tumor will grow.’ And we can make the correct plan of action.”

Javier DeJesus

Javier DeJesus, a rising senior studying mechanical engineering at the University of Puerto Rico at Mayaguez, indicates that he joined the Bioimaging REU because in Puerto Rico, “In order to use high- tech instruments, you need to be in the top of the group. Coming here has allowed me to use novel instruments. I came to be exposed to the instruments.”

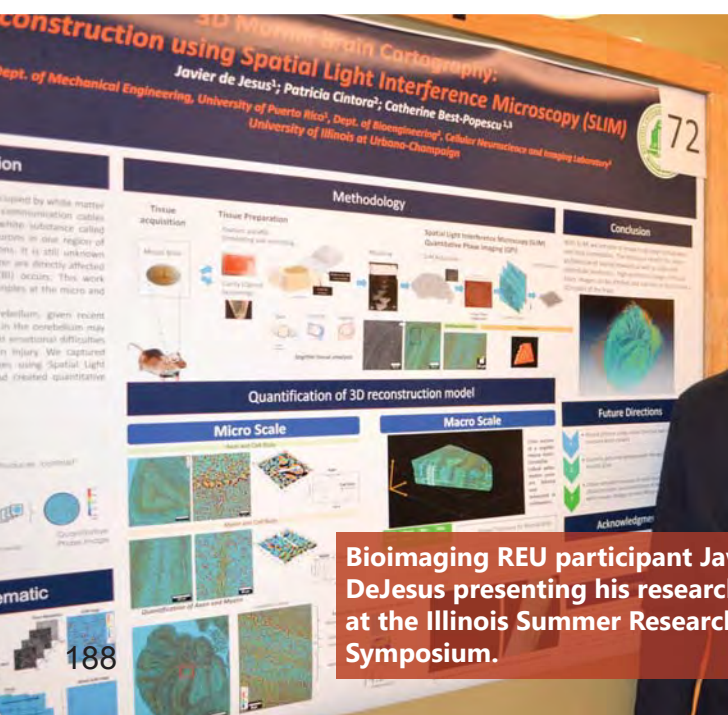
Some of the cutting-edge instruments he’s used included a new microscope called SLIM, which allows the user to create high-resolution images without using fluorescent tags. He also used a data technique called CLARITY, in which the liquids are removed from the organs and made to look clear to take images. “Neither one of those exist in Puerto Rico,” says DeJesus, “so I came here to use them.”

In addition to using CLARITY to image, DeJesus also gained some clarity about his future career plans:



2017 Bioimaging REU undergrad, Janee Phillips, by her poster at the Illinois Summer Research Symposium at the iHotel.

“After this experience, I am thinking about going to med school because I would like to keep developing new devices to help improve the quality of a person’s life...My hopes are to apply for biomechanical engineering to do medical devices and robotics but also to med school and see what happens there.”



Bioimaging REU participant Javier DeJesus presenting his research at the Illinois Summer Research Symposium.

DeJesus claims that “The biggest benefit this program allowed for us is to connect with other persons. For example, I tried to take advantage of the opportunity and talk to other professors and see what they are doing and see if I can work with them in the future... I met professors from robotics programs that allowed me to go to their research and see how they do and what they do and that was pretty nice.”

Than Huynh

A rising junior in bioengineering at Illinois, Than Huynh, shares why he participated in the REU:

“I thought this REU served a really clear purpose, and that was to demonstrate potential in imaging and the advancements that could be made in the field. I thought that was a very cool perspective for me as an undergrad, seeing that this is a new and evolving field.”

Huynh, who intends to pursue an MD/PhD, thinks the PhD portion will be in bioengineering with a focus in imaging, so the REU was relevant to his career plans. “They play hand in hand,” he admits.

Huynh, who worked in Professor Lawrence Dobrucki’s imaging lab during his sophomore year, indicates that he decided to continue his research during the summer. Huynh reports that they are trying to develop new probes for diagnosing illnesses like cancer and diabetes, which they

then image on a PET-CT (positron emission tomography) scanner. They also monitor angiogenesis, or the formation of new blood vessels, using the PET-CT and laser Doppler.

Huynh says he definitely will be doing more research down the road. “Since I’m trying to pursue an MD/PhD...a majority of my time will be in research, and it will be hopefully to engineer new imaging modalities or improving current ones.”

The specific disease that he’d like to focus on? Diabetes.

However, since the REU is a 10-week-long program, he had to choose something on a smaller scale. So his summer research involves comparing mechanically-activated melanoma cells to non-mechanically-activated ones. They learned that restricting melanoma cell shapes to certain shapes of the cells makes them exhibit stem-cell-like properties, such as the ability to renew themselves and to differentiate to more tumor-progressive cells.

“If we set these limits on them and we instill them to these certain shapes, they become

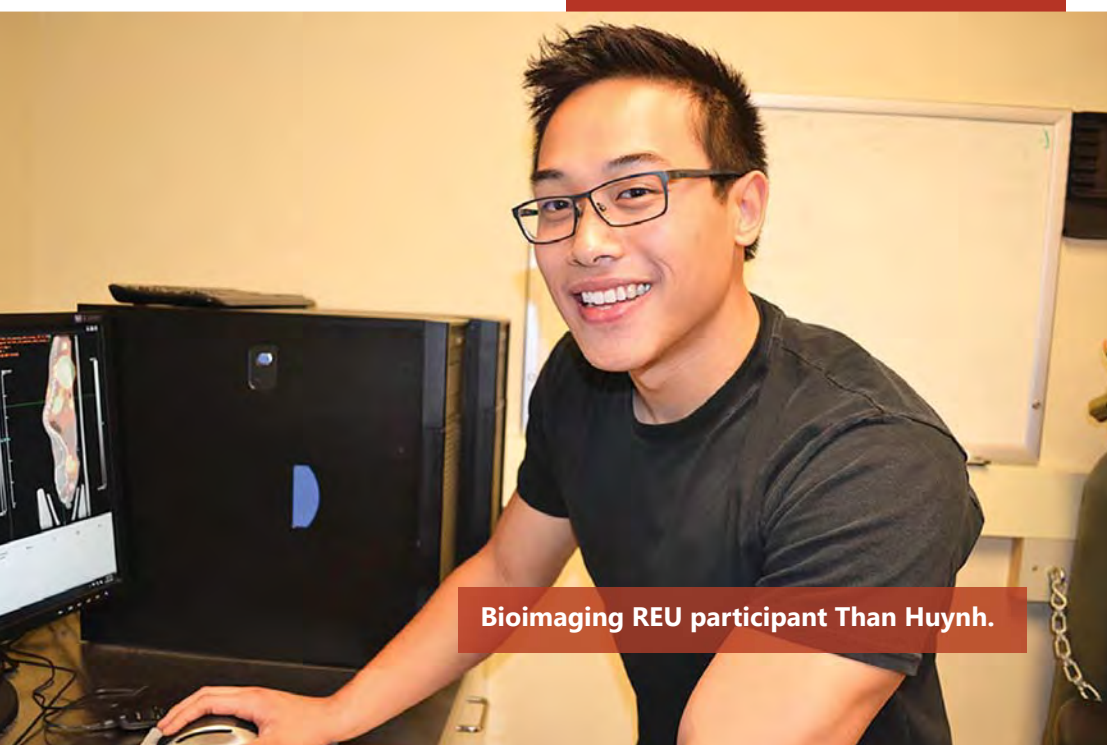
more aggressive. From that we can essentially create a more accurate model for other research labs across the world to test their new drugs to address aggressive tumors.”

Huynh reports that he also learned a lot about research professionally this summer: how to write research and how to compose, reading literature and interpreting it as well as more methods: how to culture cells and the patterning that goes on behind it. Plus, he’s learned how to use PA (photoacoustic imaging), a new imaging modality as well. He’s also learned methods to analyze the images they obtain. He says most of it goes on behind the scenes during the year, but now he’s gotten to actually see it.

Huynh’s mentor, Jamila Hedhli, a Bioengineering graduate student, says mentoring her student has helped her grow as well. “I think it’s very important for graduate students or even advisers like the PI, to mentor just for you to demonstrate and show other candidates how are things being done and that is an evaluation for yourself as well as the person you are mentoring.”

She also finds sharing all they’ve accomplished to be quite rewarding. “And I really think it’s a fulfillment when you’re relaying everything that you’ve learned all of these years to someone else and seeing them accomplishing what you do and even more than that.”

Hedhli has only positive things to say about her mentee, Huynh: “I actually think he will be a promising new scientist. I see a lot of brightness in his future, and he is hardworking, and it will show off one day.”



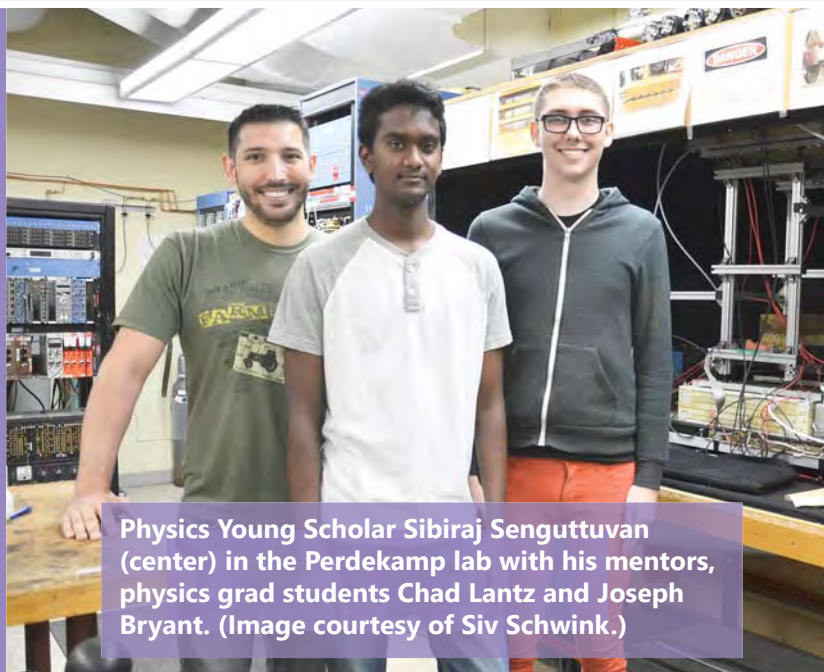
Bioimaging REU participant Than Huynh.

YOUNG SCHOLARS PROGRAM EXPOSES LOCAL HIGH SCHOOL STUDENTS TO RESEARCH, THE UNIVERSITY

August 2, 2017

Instead of spending their summers working at McDonalds, or lounging by the pool, twelve rising juniors and seniors from Centennial and Central High Schools in Champaign spent the summer learning about things like photon quantum mechanics, dark matter detectors, and the biochemistry of swimming bacteria. Part of the Young Scholars Program, a new, six-week summer research opportunity, the students got to experience authentic, cutting-edge research in some of Illinois' premier research labs. Begun by the Nuclear Physics Laboratory in the Physics Department, who joined forces with the POETS Engineering Research Center to broaden and strengthen the program, Young Scholars received funding from multiple sources: ICR funds from the NSF NPL grant, the NSF-funded POETS, the Physics Department itself, and the College of Engineering (which provided funding for one student). The fledgling program was begun to help students discover what research is actually like, determine if research might be in their futures, plus give them an idea of what college is like.

From June 19th–July 28th this summer, the twelve scholars worked from 9–5 every day in campus research labs, receiving a \$2000 stipend. Since the program was not residential, students lived at home, but received MTD passes to facilitate transportation. And to give them a taste of what



Physics Young Scholar Sibiraj Senguttuvan (center) in the Perdekamp lab with his mentors, physics grad students Chad Lantz and Joseph Bryant. (Image courtesy of Siv Schwink.)

life on campus is like, lunch was provided for both the high school students and their mentors at the Illinois Street Residence Halls.

According to Jessica Perez, POETS' Associate Director of Education and Inclusivity, the Young Scholars Program recruited minority students, with a preference for first-generation students (their parents hadn't gone to college). Of the twelve participants, half were young women (generally underrepresented in STEM fields). While the ethnicity of participants is protected by FERPA, Douglas Beck, a Physics Professor and a Young Scholars co-director along with Perez, stresses that:

“Drawing from underrepresented groups is a key element of the program.”

According to Beck, the program was begun in response to the April 22nd March for Science, during which more than one million people in more than 600 cities around the world “marched” as part of a “grassroots effort to champion science as a pillar of human freedom and prosperity.”

Left to Right: Grad student mentor Roshni Bano, Clara Duarte, and Yann Chemla watch as Clara does a procedure in Physics Professor Yann Chemla's lab. (Image courtesy of Siv Schwink)



“We were trying to think of something that we could do locally that would be more than just having a statement on one day,” Beck explains. “And we thought that bringing high school students into our labs to show them a little bit about how science was done would be a good thing. And so that was the way the program started.”

Beck says the goal of Young Scholars was to:

“Provide a program for those young people in our own community who might not have the opportunity to participate in STEM careers, or just to experience cutting-edge science in person.” Beck’s one-sentence goal was to “better appreciate how we ask and answer questions in science.”

The program also sought to “help the students to be comfortable in a campus setting,” Beck adds, “to encourage them to take advantage of higher education.” Perez agrees, adding that, initially:

“We just wanted to get students in the lab, and we wanted them to feel comfortable at a university and to make them feel like this is a place they could call their own. So we were really focused on making them feel comfortable and less so about how productive their research experience was.”

However, as the planning progressed, the directors more fully developed the support system in regards to the research. Each student had an undergrad, grad student, or post-doc research mentor, in addition to the researcher in whose lab they were working. However, concerns arose that the scholars might feel uncomfortable asking questions of their mentors (who would be older and an authority figure), or that their mentors might

not know how best help the high schoolers adapt to working in labs. So planners decided to pair students with persons with whom they already felt comfortable—teachers from their own high schools. So every week, students met with Centennial’s Jill McLean and Central’s Darren Plattner, who helped coach them regarding how to navigate a lab and ask questions.

“It also is another point of entry where if the student doesn’t feel comfortable talking to us or the graduate students or the post-docs,” Perez explains, “they have someone that they know, that they can voice some of their concerns with.”

Perez continues, “Because the emphasis is making them comfortable in the university environment, we’re hoping that that structure will help get us closer to that goal, because we’ll be able to catch if there are any issues along the way.”

Scholars also attended research talks, workshops, and training sessions. For example, they learned about the college application process and how to present their research, such as via a poster.

In addition, both the scholars and their mentors received training from IRISE (the Illinois partnership for Respecting the Identities of Students in Engineering). IRISE Associate Director Sharlene Denos and other IRISE staff led the mentor/mentee training effort by organizing three workshops for the graduate student mentors and their young mentees, which took place over the duration of the

Physics Young Scholar Neha Hebbar (right) and her grad student mentor, Gloria Lee. (Image courtesy of Siv Schwink.)



program. IRISE's goal was to train the mentors in best practices in mentoring and to help them develop mentor action plans to most effectively support their young mentees, based on the mentees' specific interests and goals. Workshops for the young scholars helped them communicate their goals to their mentors so they could get the most out of their experience.

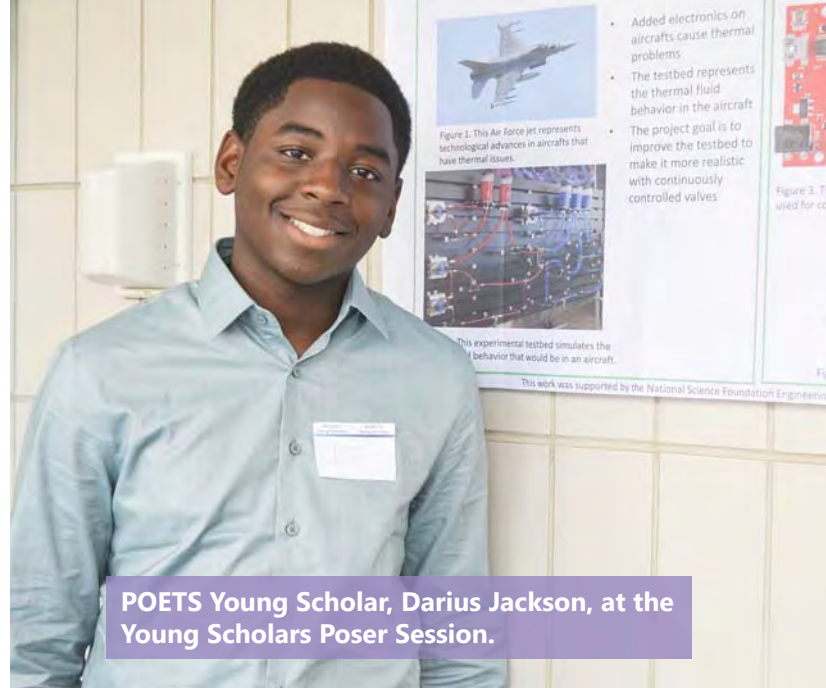
"I also tried to remain in touch with the mentors and organizers as the program progressed," says Denos, "providing advice where possible to improve the experience for mentors and mentees."

To give participants a chance to interact with some of the other program participants outside of the lab, several social activities were scheduled. For instance, an ice cream social, in addition to providing a tasty snack to tide participants over until dinner, gave the students a chance to not only get to know their fellow scholars better, but other university folk participating in the program.

Students also gained another skill—making and presenting a poster at a research symposium held on Friday, July 28th—to which students, mentors, teachers, and parents were invited.

However, the main take-away the scholars gained from the program was the research, which was why they wanted to be involved.

For instance, Clara Duarte, in a thank-you note to Douglas Beck following the experience, shares:



POETS Young Scholar, Darius Jackson, at the Young Scholars Poster Session.

"I just wanted to thank you for the fabulous experience that this Young Scholars program has been. It has definitely made me want to seriously consider physics as a field of study. Everyone in the program was very kind and helpful in teaching me all I needed to learn. After having such a great experience, it will be hard to return to high school, which isn't half as fun. I'm really going to treasure this experience."

Professor Yann Chemla shares some of the benefits he sees for the students involved, including his own grad students:

"Mentoring a high school student is a lot of work, but it is very important and hugely rewarding for all parties involved. Understanding what working in a lab is like, and how different it is from learning science in a classroom, is enormously beneficial to a student, even if they don't end up pursuing a career in science."



Physics Young Scholar Ritu Dave and her grad student mentor, Raanan Gluck, at work in their lab. (Image courtesy of Siv Schwink.)

"Also," he adds, "mentoring junior students is a great experience

for my lab members. Teaching someone how to do an experiment helps a graduate student learn ways to communicate complex tasks effectively and also forces them to think about the reasons why we do experiments in a particular way. I think mentoring experience is invaluable; it helps graduate students become better scientists.”

For instance, Physics Scholar Neha Hebbar, a rising junior at Central High School, shares:

“I wanted some research experience, because I’ve never done research before, and I’ve never really been in a professional lab, so I just wanted to see how that goes.”

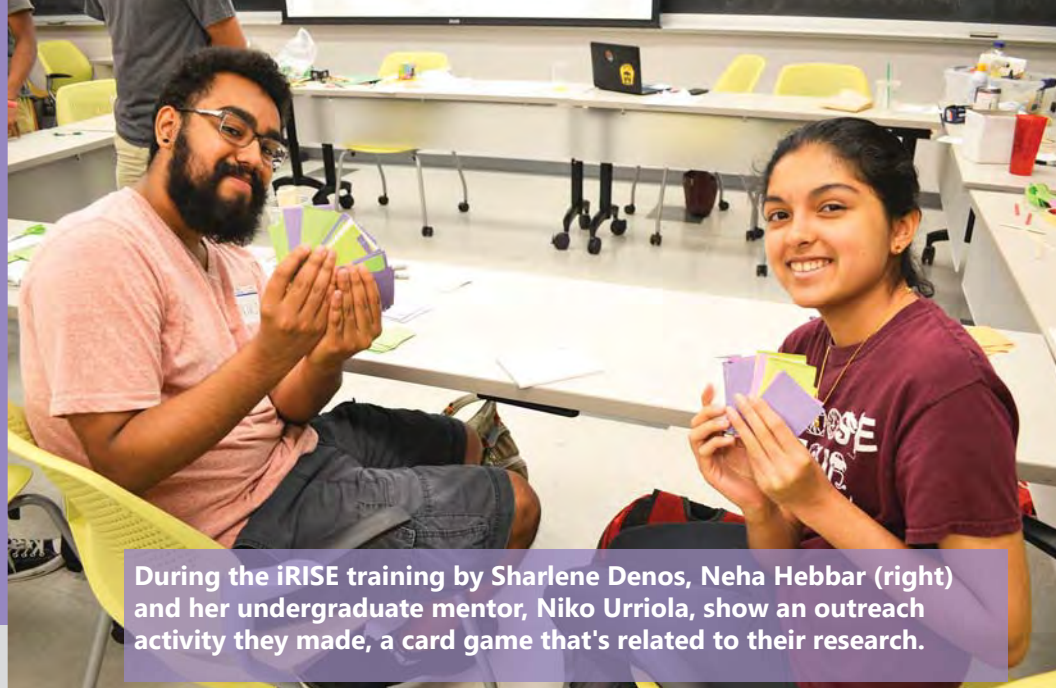
So how did it go? “I really like working in the lab and having some tasks to do,” she reports. “I never had this experience before. I’m thankful I got to do it so early. My favorite part of the experience is the hands-on lab work. We’re working on transposable elements called ‘jumping genes.’”

Working in Physics Assistant Professor Tom Kuhlman’s Lab, Hebbar admits that while they didn’t make any major discoveries during her time there, “We’re getting there. We’re doing small steps. We’re trying to image the jumping genes using fluorescence.” Working with her mentor, grad student Gloria Lee, Hebbar says they were “trying to improve her technique of finding where it is. So we’re getting there.”

Hebbar has also discovered that she likes research, and it’s something she might consider down the road. “I’m thinking neuroscience,” she says, “but physics may be an option.”

According to Gloria Lee:

“Neha seems to have a real interest in science, so I think getting research experience this early has been beneficial to her. She can see what it’s like to work on a real science problem, successes, setbacks, and all, as well as develop some practical lab skills.”



During the iRISE training by Sharlene Denos, Neha Hebbar (right) and her undergraduate mentor, Niko Urriola, show an outreach activity they made, a card game that’s related to their research.

Lee also reports that Hebbar has been an asset to the lab:

“As an experimental biophysics lab, we carry out procedures that are very hands-on and can be learned fairly easily. I show Neha how to do an experiment and then have her carry it out, so a lot of the progress on my project actually has been made by her.”

Hebbar’s other mentor, undergraduate senior Niko Urriola, explains why he decided to be a mentor this summer. “I thought it would be a good way for me to not only show someone else what I’ve learned while researching, but also get them to show me a few things about teaching young students, and that’s something that I really enjoy.” Urriola indicates that he’s learned a lot about teaching from Neha, grad student Gloria Lee, as well as from researcher Tom Kuhlman.

POETS Young Scholar, Darius Jackson, a rising junior from Centennial, explains why he joined the program. “I really like Physics and making things,” he says, “and then my teacher told me about it because I didn’t get into two other Physics programs. So this was really good for me.”

Jackson, who hasn’t taken Physics yet, thinks his participation is going to give him a jump start when he takes it this fall.

His research in Professor Andrew Alleyne’s lab involves valves and motors. Jackson, who didn’t really know anything about valves and motors

before this experience, reports that valves either have an off and on button, but can't really go half way or 25% of the way. So in his lab, they're trying to do give the researcher control over how they operate.

Jackson indicates that he likes research, says, "It's definitely different from high school," but that it's something that he might want to do down the road.

His mentor, Malia Kawamura, who just graduated with a Master's degree in May in Mechanical Engineering, says she agreed to be a mentor because she had been a mentor last semester and really enjoyed it.

"I was like 'That sounds fun. That sounds like something I would enjoy doing because I loved working with the [POETS] program and so I knew that the program was great and knew anyone coming out of that would be great to work with.'" She reports that she thought he would fit in well into their lab group, "And he really has."

Kawalura, who's working with a thermal fluid experiment that needs valves, reports that Jackson is contributing to the larger project by looking at a few different types of valves.

"We've been needing to learn more about how valves work, and how to control them, and so that's where he's



Chad Lantz and Young Scholar Sibiraj Senguttuvan (right) do a procedure in the Grosse Perdekamp lab. (Image courtesy of Siv Schwink.)

really contributing to our lab with that effort. So it's been very direct for how that's going to help in our group."

Davan Minor. Physics Scholar Davan Minor, a rising senior from Centennial High School, participated in the program because he wanted to "learn more about physics, and get some experience." He indicates that his favorite thing was: "getting hands-on experience in a lab and getting to work with lasers."

Minor, who is researching photon quantum mechanics in researcher Paul Kwiat's lab, reports that he likes the research.

"It is pretty interesting, and there are really a lot of details to the research, so you have to be careful and pay attention when you're working."

Minor, who was excited by the opportunity to learn more about physics, compares what he did in the lab to high school, "Here you actually get to see how it works, instead of just doing formulas."

Minor thinks physics is something he might be interested in doing down the road. His career goal is to "be an engineer, working with robotics."

He also feels his research experience is also helping him as a student:



Jai Rice (left) at work in his lab with his mentor, Sidney Lower. (Image courtesy of Siv Schwink)

"I think it gave me a head start on stuff that I may be learning in the future in class, or things I may be dealing with."

Sixth year Physics PhD student Courtney Krafczyk shares why she signed up to be a mentor.

"I just like mentoring people. I find it rewarding, and I think it's important to help the next generation come up and help shape the field. And also, I am considering maybe being teacher after I graduate with my PhD, so it's a good experience for me."

Physics Young Scholar Ritu Dave, a rising junior at Centennial High, worked in the Yang lab, with mentor Raanan Gluck, researching dark matter detectors.

"The radioactive sources we put in go through the crystal," Dave explains, "then light comes out and we measure it. We're using this to calibrate our detector, so that it can be used to look at dark matter particles."

What did she learn this summer about research?

"Lab work comes with a lot of setbacks and things that don't go right that you need to fix," she admits. "You need to learn to fix problems and work around the setbacks to get answers. So, one thing I learned is that research answers don't come quickly."

She also acknowledges that her experience was significantly different from learning in the classroom:

"This is way more hands-on than school. We get to look at our data and decide what to do next. There are no next steps laid out for us—we have to kind of guide the experiment."

Dave hasn't yet firmed up her career goals: "I was very interested in medicine," she admits, "but now that I have studied some chemistry and physics and been exposed to this experiment, these subjects have grown on me. I might pursue physics, maybe a little more on the side of engineering, where there is more problem solving. I'd like to go into scientific research."

Beck's assessment of the program's impact was similar to many of the students' comments:

"I think that lots of the students were surprised, maybe, by the range of things that are being done at the university," Beck explains. "I think that they're surprised, maybe, by the amount of painstaking and sometimes tedious work that's involved in doing science. So a whole range of experiences. I think that they've learned something about working in big groups—very often the labs involve lots of



Physics Young Scholar Neha Hebbar presenting her research at the poster session.

people. So, all kinds of lessons that, I think, are transferrable to whatever they decide to do in their future."

Douglas Beck expressed appreciation to the other principles, Jessica Perez, and Sharlene Denos, plus many others who helped to make the program a success, including Joe Muskin from POETS/ MechSE, Centennial teacher Lindsay Aikman, Erika Olivares and Karissa McDermott at the Unit 4 district office, and Beck indicates they received "lots of critical support" from Physics Business Manager, Mike Suchor. In addition, I-STEM provided evaluation support and publicity.

INCLUSION REU SEEKS TO FOSTER DIVERSITY WHILE EXPOSING UNDERGRADS TO CODING VIA OPEN SOURCE SOFTWARE

"We're doing this because we would like to get students that wouldn't have the opportunity otherwise to think about software, to learn about open source software, and then potentially be able to use that in either graduate school or in industry."
— Daniel S. Katz, PI

August 21, 2017

Ten undergraduate students were on campus this summer to participate in NCSA's new 3-year REU, INCLUSION (Incubating a New Community of Leaders Using Software, Inclusion, Innovation, Interdisciplinary and Open-Science), funded through the NSF's Office of Advanced Cyber Infrastructure. The goals of the REU are to enable ten undergraduate students each year to develop software and contribute to software projects, specifically Open Source Software projects; to make the population of software developers more diverse; and to foster cross-disciplinary collaboration across all fields with projects led by two mentors from different disciplines. Student participants gained skills they hope to use in the future: they learned about Open Source Software and programming; they learned how to present research; plus they made some relationships and networked.

What's Open Source Software?

Daniel S. Katz, NCSA's Assistant Director for Scientific Software & Applications, Research Professor (iSchool, Electrical and Computer Engineering, and Computer Science), and PI of the grant, defines it as free software, but adds the caveat: free can have different definitions. Free could be getting something free and clear, like free beer; a free puppy, on the other hand, has strings attached: one actually has an obligation after getting it. Katz likens open source software to the second, which he says:

"Only works if people don't just take from it, but they also contribute to it over time. That's part of what we're trying to encourage, is to build up some skills in the next generation of undergraduates that may go on to graduate school or may go to industry."

According to Katz, one of the main tools people use to collaborate and write open source software is a website called GitHub. Git is a tool that people can use to collaboratively write and work on software.



Gavin Ridley (second from the left) and some of his fellow INCLUSION REU participants at the 2017 Illinois Summer Research Symposium.

GitHub is a development platform that provides tools and features that foster collaboration among software developers.

What are INCLUSION REU's goals?

Katz explains that the REU's first goal was to help students grasp that software is an important knowledge product, and to be able to understand, encrypt, and read software code. Students were to create their own; contribute to already-existing, or test software (make it better, or provide documentation and user support). But like the software itself, any contributions they made to the projects were free; "there's no money involved," he explains.

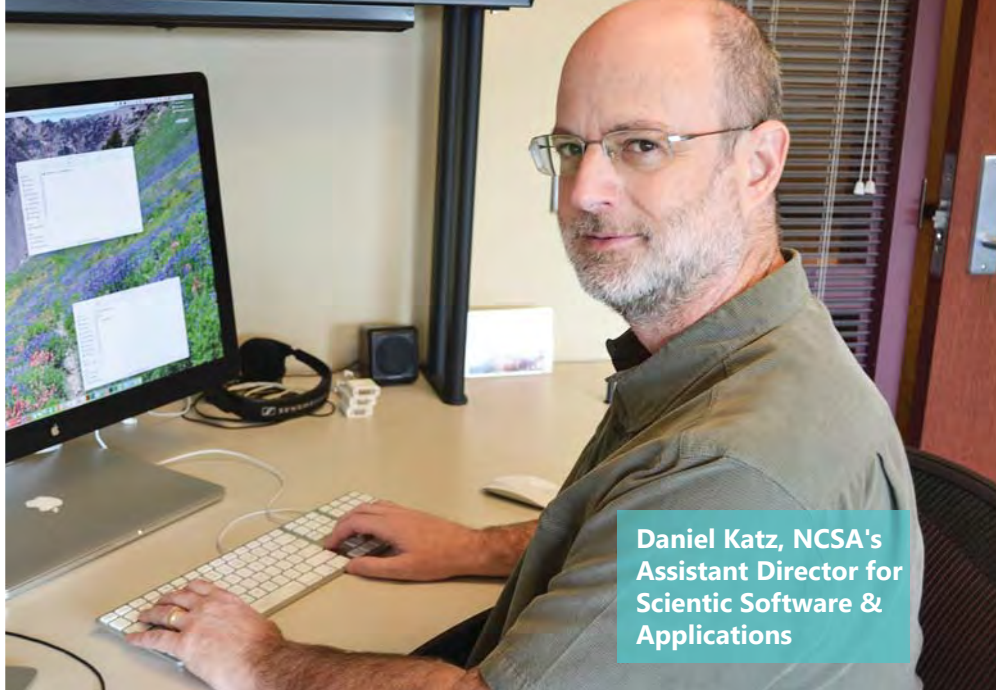
Besides being an acronym, the REU's name, INCLUSION, refers to its second goal—the inclusion of students from underrepresented groups in an effort to increase diversity in software development. For instance, recent survey data identified the demographics of people contributing to software on GitHub's website as "overwhelmingly white and male," Katz reports.

How'd they do on meeting their inclusion goal in 2017? While more than half (60%), six of the ten participants were women, the percentage of students of underrepresented ethnicity was low (two Latinas). And while in some fields, women might not be considered to be underrepresented, in STEM, "women certainly are an underrepresented group," Katz explains. He acknowledges that while they didn't meet their goals 100%:

"The goals that we had are still good goals," and says, "I would like to see us get more underrepresented groups that are including women, but not exclusively women. That's probably the biggest challenge for the next two years."

The REU's third goal is related to collaboration.

"Because open source software is a community activity, we wanted to focus on or emphasize people working together."



Daniel Katz, NCSA's Assistant Director for Scientific Software & Applications

So they strove to have pairs of students working with pairs of mentors, which they weren't always able to do. Sometimes they had two mentors, but not two students. In some cases, INCLUSION students were paired with other students already in the lab. Katz is hopeful that in the 2018 REU, some 2017 students will come back and they'll be able to better implement the model described in their proposal: a more senior student helping a junior student.

Students were matched with their mentors via a mutual ranking system. First, pairs of interested NCSA mentors in different disciplines who were willing to work with a pair of students were recruited to participate. When students applied to the REU, they ranked the three projects in which they were most interested. Then, the mentors looked at the student applications and ranked the students that interested them the most. Olena Kindratenko, INCLUSION co-PI and project coordinator, then made the best matches possible.

Katz admits that while the REU mentors support the REU's diversity goals, they also are motivated by "more specific goals....Partly, they'd like something useful to come out as a part of their project. Partly, they would like to have some new candidates for new graduate students that might work with them in the future." The program and the mentors have to balance their desires for students who have already developed software skills and can contribute to projects immediately, perhaps due to advantages they've had in their lives, with training less advantaged students, who may be equally or more capable after being trained.

Additional skills students gained, along with coding software, were related to reporting on

their research. Helping students regularly and in a focused way was SROP's graduate student liaison, Nicole Jackson, who met with the REU students once a week, but was also involved with them electronically and helped them write research proposals, their final papers, and the posters they presented at the Illinois Summer Research Symposium near the end of the summer.

Katz credits NCSA's five-year-old SPIN program (Students Pushing Innovation) for many of the REU's components: the students coming on campus for summer research, working with mentors, and ranking their research preferences when applying. One difference? SPIN is for Illinois students; the REU is primarily for students who are not from Illinois.

Geraldine Padilla Sainez

Teamed up with Dickinson on his project was clinical psychology major Geraldine Padilla Sainez. A senior at Illinois, she applied to the INCLUSION program because it specified no previous knowledge of computer programming was needed, and she needed a research opportunity on her resume for graduate school. She confesses that at the beginning, it was:

“A little bit scary, seeing that everyone else was an engineer, and I was not. But I just kept with it and, luckily, I learned new skills that I will use eventually. Although they're not perfect, I'm still working through them, learning, coding programs, and languages. It's a fun experience for me.”

Sainez' research was to answer the following questions about authors who have published articles: How do different institutions, regions, a person's job and tenure affect the availability of code and data in their articles? While she didn't have results yet at the time of this interview, she expected to use R to create charts showing which regions have the most authors with the most code and data available in their articles or showing the relationship between tenure and the amount of code in the articles.

Sainez thinks that a lot of what she learned this summer should be helpful down the road. Coding, for one. She's learned Python, R, and SQL in order to get graphs and charts to

visualize her data, and feels like that's going to be helpful with the results; she also expects it will be helpful in grad school. “It's also easier to analyze data through SQL and Python, and with large amounts of data, I'm sure I'll use that,” she says.

She also feels like she learned about the writing process while writing her research paper. “Learning how to cite properly, learning what is appropriate for a research paper,” she says. She says she's written only one other research paper which she claims was not her best, “So I feel like this time, just having one-on-one help with a mentor was very helpful. I feel like the networking is amazing. It's helped a lot.”

Besides learning about code and how to write about research, Sainez also did some networking this summer and built relationships. “I feel like I'll be able to contact them for just helping me with applying to grad school. Maybe not specifically to my field, because it's very different, but just recommendation letters, and overall just the friendships. Maybe eventually we will work together on some project.”



Geraldine Padilla Sainez presents her research at the Illinois Summer Research Symposium.

While Sainez' dream job is to be a psychiatrist and go to medical school, she reports:

"This program has made me realize that maybe a PhD in clinical psychology is where I want to go. I want to focus more on therapy than just medication, and I feel like I definitely want to help my community especially in Chicago's south side. I want to go back and give to my people."

Alex Dickinson

One such student was Alex Dickinson, a rising junior in computer science at University of California, Irvine, who chose INCLUSION because of Illinois' strong CS program. Dickinson worked with mentor Prof. Victoria Stodden (iSchool, Law, Statistics, and Computer Science) and her NCSA postdoc Matthew Krafczyk.

Dickinson's research was to assess the quality of code used in computational physics research, which he said has implications for the replicability of the studies with which the code was associated. So he examined code from computational physics papers, trying to get it to output the results in the corresponding paper. Of the nine papers he looked at, "The results aren't good," he admits. "None of them achieved full replication of the paper."

He says the authors of the papers wrote most of the code from scratch in C++ or Fortran. "But the C++ code was kind of a mess," he acknowledges. "I could get it to work, but it took quite a bit of effort."

Dickinson plans to use what he's learned about Linux and the command line in the future. "So that's very useful information." He adds that coming to Illinois, and:

"Having that name on your resume is very useful due to the high ranking. This has definitely been a worthwhile experience."

While his experience hasn't changed the trajectory of his future plans, he thinks it will be advantageous:



"The stronger my resume is, the more options I'll have. I'm pretty happy with the way this has played out. I've met some interesting people, and I'm sure that they will benefit me somehow in the future."

Gavin Ridley

Another REU undergrad was University of Tennessee student Gavin Ridley, who describes how he got involved with INCLUSION. Already familiar with GitHub, he'd even seen someone make a fork (a copy of software one can work on and thus contribute to it). So when he became interested in Moltres MOOSE application, which was relevant to his nuclear engineering experience, he asked the developer of Moltres how he could get involved. The developer, NCSA postdoctoral scholar Alexander Lindsay, said, "Oh, you should apply to this INCLUSION program, and that would be a great opportunity for you to help with this."

Quite knowledgeable about GitHub jargon, Ridley explains that in order to contribute to projects on GitHub, after making a clone of the code and making modifications to it, you then make "a pull request," saying, "Hey, you should incorporate the changes I made into your code; look at all the new stuff it can do!" The idea is that you would like them to pull your code into their repository."

He adds that those who maintain the software review pull requests. "They know what's best for the project, usually. Making my first pull request was very rewarding—and stressful—because I got some criticism, but it was very constructive."

Co-mentored by Professors Katy Huff (Nuclear, Plasma, and Radiological Engineering & NCSA) and Matt Turk (iSchool, Astronomy, and NCSA), Ridley had done undergraduate research before, but he'd "never had any time to just focus on that before, which was what this summer was, so that was really good."

What did Ridley learn this summer? How to make scientific software sustainable and reproducible.

"I've learned a huge amount through this. I learned how to make [software] reproducible, meaning others can get the same results, and sustainable, meaning the code can be continued."

Ridley claims he's absolutely going to be able to use the things he's learned this summer down the road. In fact, he hopes to leverage what he's learned to advertise himself to potential graduate schools, telling them, "I would like to use sustainable software practices to do some finite element modeling to advance nuclear power."

Ridley cites a benefit of open source software: "The source code is available to everyone online... So I think it enables people from all over to enable your code and possibly extend it or contribute to it."

Like Sainez, Ridley valued the networking he did over the summer, especially the "tight bonds" he made with people in the REU. He also got to know his mentors well, especially post doc Alex Lindsay. "He's not my main mentor," Ridley explains, "but he's definitely the one that's taught me the most while I've been here."

Lauding the REU as a "really fantastic program that can get people on their feet for a research-oriented life," Ridley cites Dickinson's project on "how a lot of modern software for physics is not sustainable and it's not reproducible," and recommends that having:

"More people in programs like INCLUSION would be able to vastly improve the state of the art with computational sciences."

Katz describes Ridley's research as: "trying to simulate different kinds of nuclear reactors that may inherently be more passively safe and sustainable, with a focus on reactor behavior in challenging events." Katz continues, explaining why Ridley needed to use an open source framework, in this case, MOOSE (Multiphysics Object-Oriented Simulation Environment).

According to Katz, open source software was integral to Ridley's project because he was trying to design a new reactor, not trying to control an existing one. "There are existing design tools that can design existing solid-fueled reactors," he explains, "But for people who want to design liquid-fueled reactor types, there is no easily customizable software that can do that right now, so they have to do it themselves. Using something that's open source that does a part of it, reduces the amount of work they have to do to do their own complete job."

How prevalent is open source software for research? Katz estimates that in science and

engineering, at least half of research that's done with software is using open source software. It's field-dependent. He believes that "engineering has probably been the slowest to accept open source software, because there is a lot of commercial software." While some commercial software is licensed, and there is some regulatory reason that it has to be used, "in other places like physics, almost everything is open source," he says.



An INCLUSION REU participant, Gavin Ridley, at work on his research.

POETS' REU EXPOSES UNDERGRAD STUDENTS TO ELECTRO-THERMAL SYSTEMS RESEARCH

August 21, 2017

Ever wish your electronic devices were faster and more powerful? As part of the 10-week Research Experience for Undergraduates (REU) sponsored by the POETS (Power Optimization for Electro-Thermal Systems) Engineering Research Center, four undergraduate students had an opportunity this past summer to learn more about this issue. Their goal was to not only participate in current research to put more power into less space in our electrical technologies, but possibly help do something about it. POETS' 2017 REU program had one undergraduate student at each of the four POETS universities: Illinois, Arkansas, Howard, and Stanford. While all students participated for ten weeks, they started and finished at different times based on each school's schedule. Because students were placed at four different institutions, they each had unique opportunities as POETS took advantage of the various offerings at each of the schools.

"So the program looks very different at the different schools," says POETS' Associate Director of Education and Inclusivity, Jessica Perez, "but we're hoping that we can unify them through POETS, through the different things that we do."

For instance, all four students participated in biweekly webinars so they could understand the research at POETS. Each student also did a research presentation during the June 28th webinar, which enabled students to talk about the research they did this summer as well as interact with graduate students at the four institutions.

"So it's good exposure for the students," Perez explains, "and then graduate students can ask the REU students questions about their research and also learn about what other research is happening at the different institutions, because the REU students are like a rep for whatever research group they are in."

Adam Castaneda presents his research at the Illinois Summer Research Symposium.



Perez indicates that each of the universities had programming to help prepare the students for graduate school: how to apply, and preparation for the GRE, which they need to take prior to applying to graduate school. Some students attended research talks to hear about research going on at the various campuses.

In addition, because Illinois and Stanford already have large summer research programs in place, the REU students at those schools had access to additional resources. For example, Adam Castaneda, Illinois' REU participant, partnered with SROP (the Graduate College's Summer Research Opportunities Program) to take advantage of their programming as well. However, although Howard and Arkansas don't have similar research programs in place, faculty gave their REU students the same types of opportunities. In addition, all student participants made final research presentations at their schools; for instance, Adam Castaneda presented his research at the Illinois Summer Research Symposium on July 20–21. Students were also encouraged to take advantage of social events on campus and in their labs.

Perez explains the selection process to POETS' REU: to disseminate information to potential participants, information was posted on POETS' website, plus staff emailed numerous schools about the opportunity. Around 60 people from all over the country applied for four positions. And to ensure that the students would be successful in the program, students who were "very good academically" were chosen.

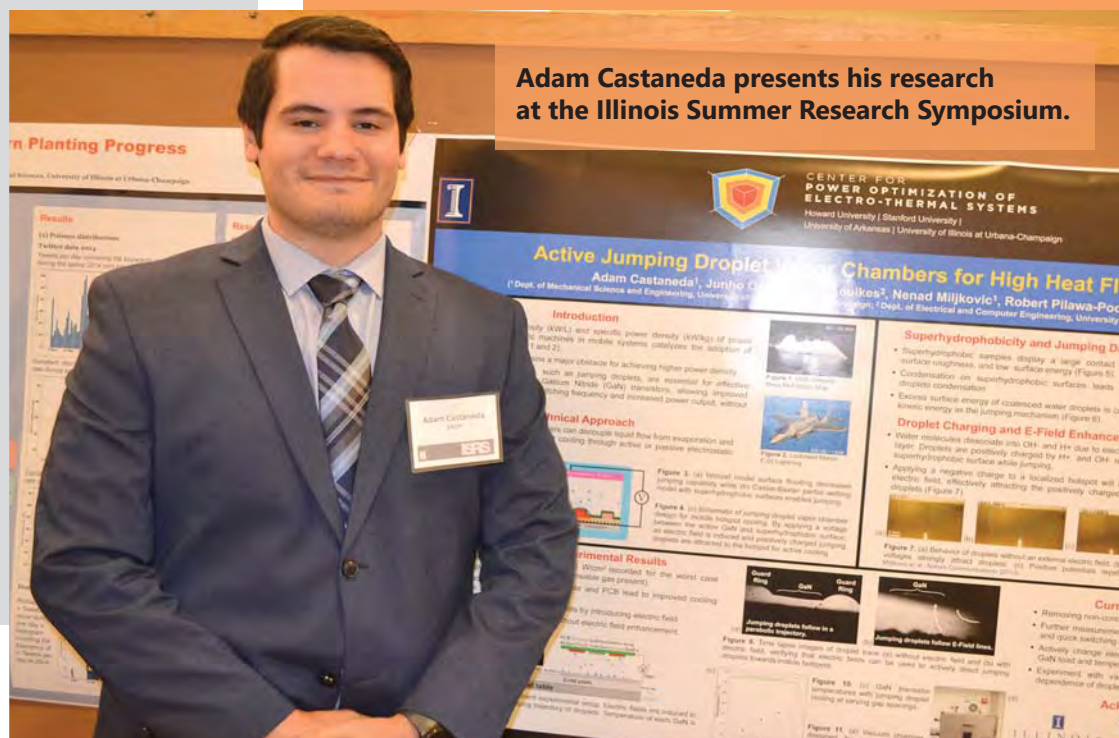
"But for us," Perez says, "we also want to focus on broadening the participation in science, and so we recruited students that were from a racial minority and that also had some type of need. Maybe their family didn't go to graduate school, for example. Having this exposure is going to be more valuable to someone who didn't get that experience."

POETS' goal for the REU? To broaden the participation of students going into graduate school.

"If we can help some of these high-achieving minority students continue on their track and get them interested in doing research, that's a win for us," Perez says. "Through the program, we're hoping to increase their confidence in doing research; getting comfortable in a lab environment; interacting with professors; understanding how to go about doing the research process, like how to ask questions and how to set up experiments to answer those questions; and getting some of that confidence."

According to Perez, the overarching goal for the program, kind of a common theme across all four institutions, is for students to have an increased interest in academic research and a research career. "So we're hoping that by bringing in these students that are high-achieving that come from more of a minority background—that they can be exposed to a research environment and then start to build confidence in their ability to possibly be a graduate student or work in a research environment."

Perez says another outcome they are striving for is to help students develop a mentor/mentee relationship with their research mentor, either the faculty member, graduate students, or other students in the lab. "Developing those personal connections is really great," Perez explains, because when the student leaves, they have that connection to whatever REU university they are at. And I think that will help them a lot moving forward in their career. They can be a person they ask advice from, etc."



For instance, additional time to work with his mentors was what motivated Adam Castaneda, a senior in Mechanical Science and Engineering (MechSE) at Illinois to participate in the POETS REU.

Castaneda reports that during the academic year, he had already been working in a POETS-affiliated lab, MechSE Professor Nenad Malchovich's Energy Transportation Research Lab (ETRL), on a similar topic related to super hydrophobic surfaces. "When I saw this opportunity come up," he admits, "I figured, 'I'm already in the lab; I know what's going on here; I feel like it'd be a pretty seamless transition into the program'" He reports that it was a seamless transition, "but since it was a different experiment, there was still plenty of work that I had to do."

Perez notes another serendipitous benefit regarding the matchup:

"Two of the graduate students he is working with are also POETs graduate students. It's a great opportunity because it's an example of inter-generational learning across POETS. We were excited to hear that."

Some of the technical things Castaneda learned about the research area? "Super hydrophobic surfaces are extremely important," and that "droplets jump off super hydrophobic surfaces." He also discovered something about himself: "I've learned that there comes a point, despite how much hard work you put in, you still need to reach out to people to help occasionally. One thing about myself is that I'm like 'I can do it; I can power through it; I don't need help,' but this research opportunity over the summer made me realize that I need some occasional help when things get overboard."

Regarding how the overall experience over the summer has impacted his future career plans, Castaneda says it resulted in "definitely making me more seriously consider grad school. Prior to the whole research opportunity, I kind of had it on my mind, but not necessarily something that I wanted to do immediately. I knew I had the option, but I was more in the mindset of, 'I only have a year left; I can graduate and find myself a nice job!' But I found myself really enjoying research, and working through the entire experience makes me realize that I think I can find myself going even for a PhD." Maybe even at Illinois.



Jessica Perez, POETS' Director of Education and Inclusivity.



A Uni High student works on a solar car design during a test run of a POETS RET curriculum module.

POETS' EDUCATION PROGRAM INTRODUCES STUDENTS OF ALL AGES TO INTERDISCIPLINARY RESEARCH IN ELECTRO-THERMAL SYSTEMS

August 31, 2017

In addition to cutting-edge research in electro-thermal systems, the NSF-funded POETS (Power Optimization for Electro-Thermal Systems) Engineering Research Center has educational programs that expose students (and teachers) to POETS' research via educational activities, research, and courses that foster interdisciplinary collaboration plus expose learners to the Center's unique research.

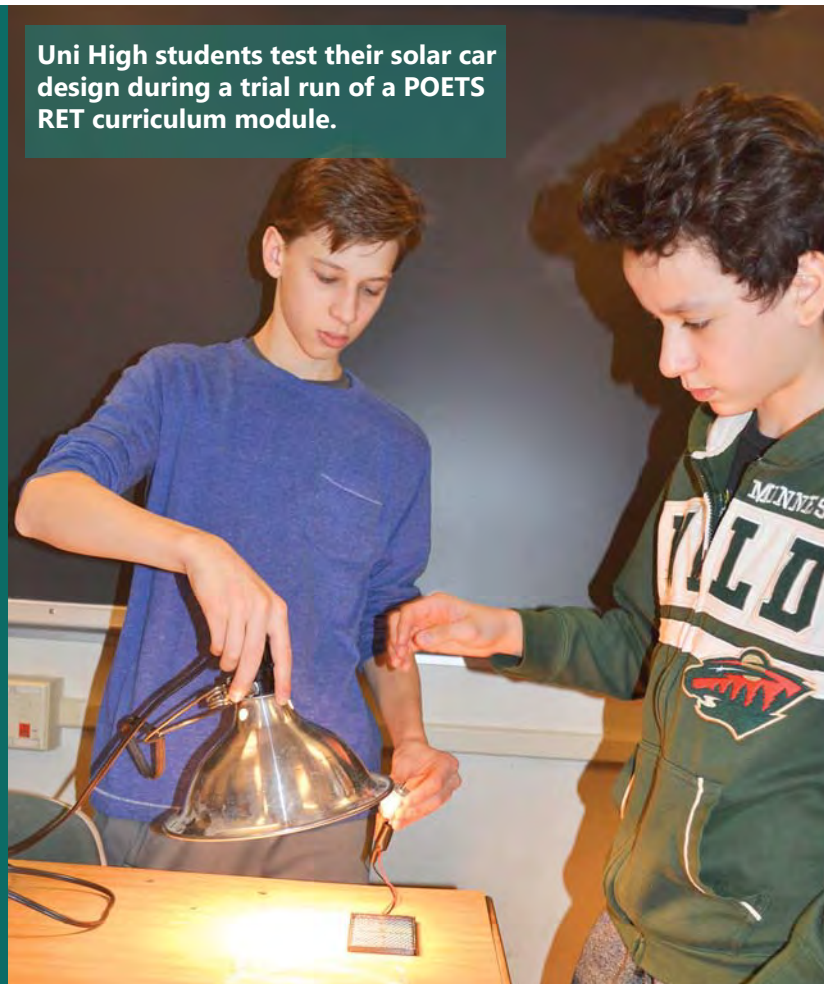
Since POETS is comprised of four partner institutions—Illinois (the lead institution), as well as Arkansas, Howard, and Stanford universities—its educational offerings are unique in that the programs vary across the different institutions based upon leaders and personnel, research being conducted, and other university programs available. According to Jessica Perez, POETS' Associate Director of Education and Inclusivity, the goal isn't to make everything identical across the different institutions, but programs are “different at every university because every university has strengths that we would like to leverage. However, we do hope that they have a similar experience throughout all of the programs.” She claims the goal is to “give each university similar experiences.”

K-12 Students

Research Experience for Teachers (RET). One way to impact students is vicariously through teachers; so POETS' RET brings middle school and high school teachers to the universities to focus on either research, curriculum development, or a combination.

For example, at Illinois and Arkansas, teachers focus solely on curricular development. After being introduced to POETS and its research, they then focus on developing a product. Stanford's program, however, is a traditional RET: embedded into a research lab, teachers are trained in laboratory safety, do experiments, analyze data, and give a poster presentation summarizing their research. But they also get together with the other teachers to design a curriculum around what they learned.

Uni High students test their solar car design during a trial run of a POETS RET curriculum module.



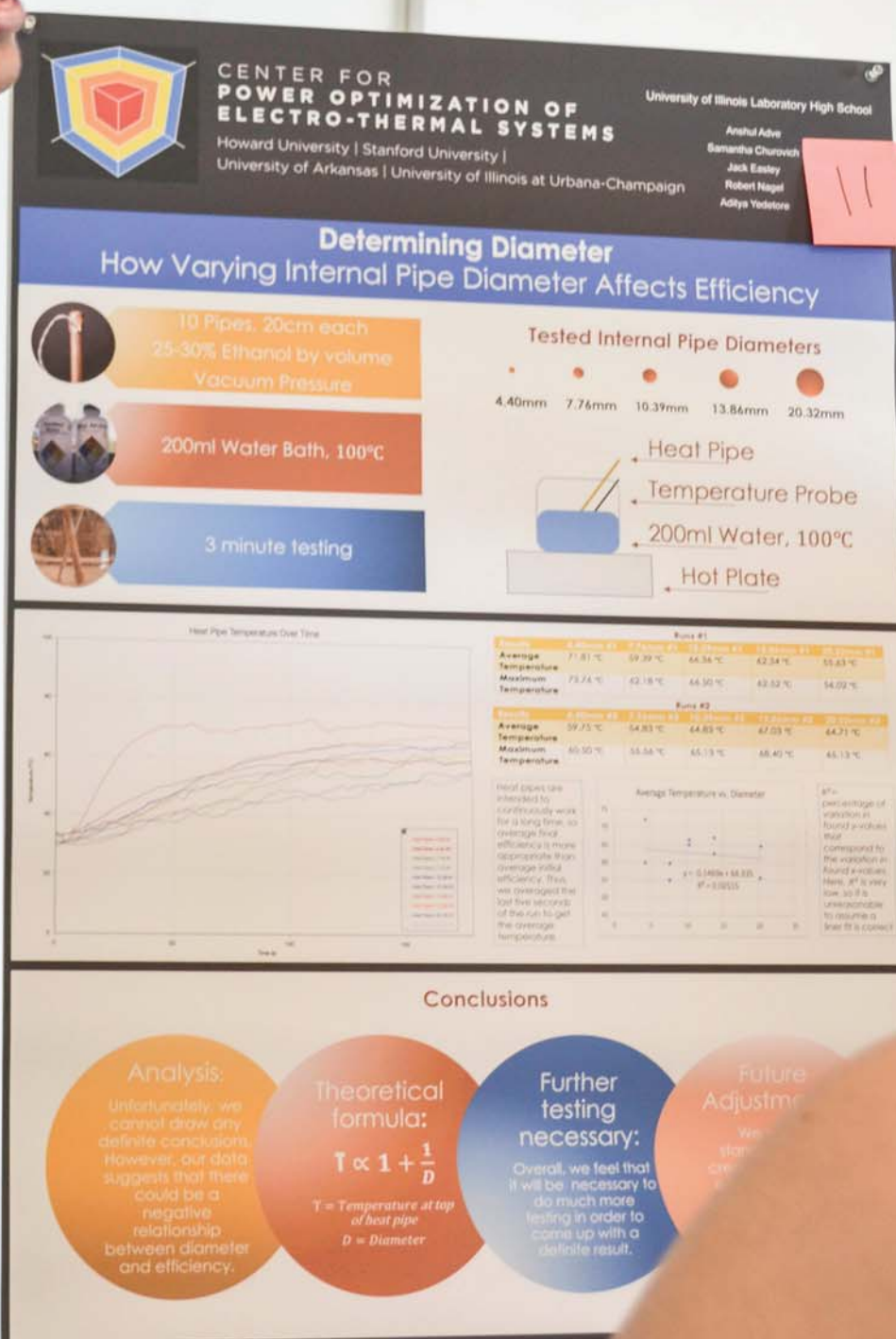
While there is enough funding for stipends for eight teachers (two at each university), in the summer of 2017, some schools (Howard and Stanford) could only host one teacher; thus, Arkansas had three RET teachers, while Illinois had six half-time teachers.

Since the RETs across the partners are structured differently, to unify the program, the goal is to develop a multi-week curriculum related to POETS research and comprised of modules the different RET teachers develop.

So in Illinois' RET, a team of local science teachers has been tasked with creating a multi-week curriculum unit related to power, heat, and power density that's aligned with Illinois' Next Generation Science Standards.

To do a test run on the curriculum developed so far, in spring 2017, teachers from Illinois' 2016 RET team tested the curricula they had written

A Uni High student presents his research on heat pipes during POETS' poster presentation for high school students.



with their students. For example, David Bergandine's chemistry students at Uni High did research projects testing twelve different variables about heat pipes. While gaining general knowledge related to heat flow and heat transfer, and some in-depth knowledge about the specific area they researched, students not only learned what research is like, but got to present their research at POETS' 2017 High School Student Research Symposium (see [istem article](#)).



A Uni High student presents her team's research on heat pipes during POETS' 2017 High School Student Research Symposium

Another module about solar cars was tested in two local schools this past spring: at Uni High in Sharlene Denos' class, and in Bryant Fritz's class at Next Generation School (see [istem article](#)). Then this past summer, both returning and new POETS' RET teachers worked to refine the 2016 modules and add new material to the multi-module unit.

Although during the first year of the program, teachers were encouraged to pick a topic related to POETS research and develop a module, the long-term goal is to foster cross-partner collaboration in developing the curriculum. "Now that we have some units already started," Perez suggests, "where can we bridge those units together? Can we fill in some of the gaps?"

So the goal over the next couple of years is to foster collaboration between partner universities.

Also, Perez shares a tentative plan for how the unit should be structured. At the beginning, students would watch a video of a thermal-related issue (i.e., hoverboards exploding or Samsung phones catching fire), then be asked: "What happened?" and "Why?" Students would then pose questions related to why it had happened, hopefully related to heat, batteries, and how power works.

"So if we get to these questions," Perez explains, "we can start understanding why this device messed up." Students would then explore those

questions with the end goal of creating something, where "hopefully they circle back to that first question. That's sort of the loose plan," she says, "but how we'll get there, we're still figuring out."

Perez is excited about the RET because traditionally, RET teachers develop their own curriculum to implement in their own classrooms. "There's a limit to how much it is shared," she admits. But RET planners believe cultivating cross-institutional collaboration among the partners, who are in very different communities, could "create a curriculum that has mass appeal across different communities." Plus, when POETS is gone, "We still will have something that will last, that people can continue to use."

Perez believes cross-partner collaboration is key:

"This is very unique because it involves multiple universities collaborating on one curriculum. But I think that could also be very powerful because, this next year, when we start trading curriculum and people start testing out stuff that we did in Illinois in the D.C. area, or in Arkansas, maybe we'll learn things that we didn't know. They're very different populations, so

maybe there are going to be certain things that they have trouble with that we didn't know, and vice versa. So we can start creating curriculum that is more universal."

Though POETS is currently funded for five years, with the possibility of funding for five additional years, Perez is already planning ahead. She says for the first five years, they're focusing on a middle school, multi-week curriculum, and then will focus on developing a high school curriculum the last five years.

Young Scholars Program. During summer 2017, twelve local high school students found out what research is like while working in Illinois labs studying things like condensation heat transfer and thermal fluid testing.

Run by POETS and Illinois' Physics Department, the new Young Scholars Program provided students a six-week summer research opportunity where they experienced authentic, cutting-edge research in some of Illinois' premier research labs. The goals of the program were to help students discover what research is actually like and whether it might be in their futures, and to give them an idea of what college is like (see istem article).

Perez indicates that the program recruited minority students with a preference for first-generation students (their parents hadn't gone to college). Of the 12 participants, half were young women, who are generally underrepresented in STEM fields.

Undergraduate Students. POETS Research Experience for Undergraduates (REU).

Four undergraduate students, one at each of the four universities, learned about electro-thermal systems research this summer as part of POETS' 10-week REU. And because students were placed at four different institutions, they each had unique opportunities as POETS took advantage of the various offerings at each of the schools.

"So the program looks very different at the different

schools," says Perez, "but we're hoping that we can unify them through POETS, through the different things that we do."

POETS' goal is to "broaden the participation of students going into graduate school," says Perez, and to "help some of these high-achieving minority students continue on their track and get them interested in doing research...Through the program, we're hoping to increase their confidence in doing research; getting comfortable in a lab environment; interacting with professors; and understanding how to go about doing the research process, like how to ask questions and how to set up experiments to answer those questions and getting some of that confidence."

The program recruited students "from a racial minority that also had some type of need," Perez explains. "Maybe their family didn't go to graduate school, for example. Having this exposure is going to be more valuable to someone who didn't get that experience."

First-Year Design Course on Personal Mobility. POETS' engineering design course, ENG 198, piloted in fall 2016, is designed to give freshmen a chance to discover what it's like to be an engineer early on. Working as part of an interdisciplinary team, they are to come up with



Sharlene Denos (left) works with two Uni High students on their solar car design as part of a POETS RET curriculum module.

an innovation of benefit to society in the area of personal mobility. The goal is for students to learn the engineering process, experience teamwork, and come up with an end product that lets them experience having contributed to society.

The joint IEFX/POETS course is similar to other projects courses: teams of 3–5 students have a budget of \$200–300 and a timeline of 8–9 weeks to complete a project that's a useful innovation. What's unique is that the innovations are to be related to a specific theme: personal mobility (see istem article).

Interdisciplinary Senior Design Capstone course. Slated to be piloted in fall 2017, this course will address the siloing inherent in many senior design courses. (A silo is a system in which personnel in one field are incapable of collaboration with others that are, or should be, related.)

“They are trained to work independently,” Perez explains, “and because of that, they have a hard time exchanging ideas, because they’re stuck in that lingo. So the idea was that if, in the real world, all the engineers come together and work together anyways, why not introduce an opportunity for the students while they’re in school to start working on design projects together.”

So in this course, electrical and mechanical engineers will work together on a similar project and have similar curriculum that will teach them how to better communicate across disciplines.

Graduate Students. One of POETS’ graduate student education goals is to train graduate students, through doing research in POETS’ labs, to go out into the workforce. According to Perez, because of POETS’ multi-institution emphasis, graduate students’ experiences are unique across the different institutions. “But we’re hoping that we can at least bridge their experiences enough that they understand what POETS is and that they feel connected to the Center as a whole.” Because grad students are “here for the long run,” she continues, “if they feel connected to the Center, then that helps drive the collaboration on the research side to make sure that we’re breaking down those silos and that the different disciplines are talking to one another and collaborating effectively.”

T-Shaped Engineers. One of PI Andrew Alleyne’s goals for POETS is to produce T-shaped engineers who are comfortable in an interdisciplinary environment. They would 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 he also envisions students with breadth—“experts, but...relatively broader than the average engineer.”

To achieve this, students work on interdisciplinary teams to address cross-discipline research projects in their labs. Another thing he envisioned, which has been implemented at POETS’ space at Illinois, was changing the physical layout of the offices where grad students work—bringing the walls down and having them in one large space rather than having them off in separate cubicles, which would encourage collaboration between people.

In-Person and On-line Connectons. But Perez indicates that they are also working to connect graduate students to POETS at large. POETS has two strategies to “break down some of those boundaries of all the miles between us...and to bring the students together,”

Perez explains. One is through meetings POETS personnel attend “in person,” such as the annual NSF site visit, “a great opportunity for the students to meet together, interact, learn about each other’s research, and we start forming some relationships with them,” Perez explains. Everyone also gets together again at the annual meeting, which, since NSF isn’t there, has more of an inward focus. Similar to a conference, POETS faculty and students give research presentations and talks about where the program is going.

A POETS graduate student places the pizza box solar oven he and his teammates created in an optimal spot for “baking” during a 2017 workshop on outreach for POETS grad students.

Another way students get to know each other is via webinars. “They share their research; they teach people about a research topic in terms of an overview,” says Perez.

Another strategy Perez and a colleague more or less stumbled upon was holding a town hall meeting for students. They had been grappling with how to best serve the grad students, and needed answers to questions regarding: “What sort of

programs should we give them? What sort of education things do they want? How do they want to get more involved in industry?"

So they held a town hall to collect ideas, "But it kind of turned into this thing where the graduate students got together and figured out, 'What are some of the things that can improve POETS in general and improve our experience?'" Some things they brought up included communication: they meet in person periodically, but there's a need for connecting throughout the year. How can

that be done? Suggestions included a student retreat where students could get together and interact informally, and improving connectedness between students at the individual university levels. Unlike at Illinois, the other partners don't have a space dedicated to POETS. So one of the issues mentioned was,

"How do the other schools connect if they don't have a common place like this?" Student Leadership Council. POETS also has a strong Student Leadership Council composed of

graduate students, which has officers, a technical conference leader who runs the technical conference, plus student representatives at each university. "Every university is represented in that committee, and they make decisions about how things should move forward with the graduate students as a whole and also they interact with the management team to voice the graduate students' concerns." While the Council runs things like the annual technical conference (another way students connect), plans are in the works for the Council to lead initiatives to improve connections between students, including social events at individual universities which are connected across universities and communication tools so students can interact informally and exchange research ideas.



POETS graduate students attend a workshop on outreach during the 2017 NSF site visit.

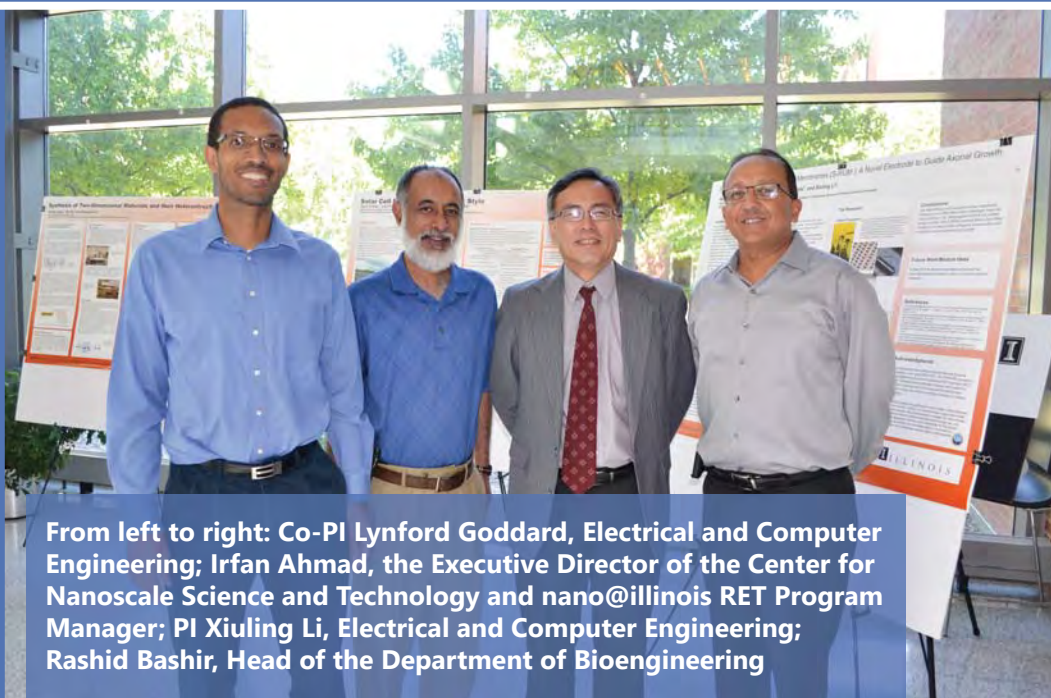
NANO@ILLINOIS RET TEACHERS EXPERIENCE CUTTING-EDGE NANOTECHNOLOGY RESEARCH—INTRODUCE IT TO THEIR STUDENTS

September 18, 2017

In its fourth and final year, the nano@illinois Research Experience for Teachers (RET), funded by the National Science Foundation, offered eleven P–20 STEM teachers the opportunity to do cutting-edge research in nanotechnology under some of Illinois' premier researchers in the field. The second emphasis of the RET was for teachers to develop modules related to their research that could be used in their own and other classrooms. The goal of the RET is that, based on teachers' resulting enthusiasm, content knowledge, and increased familiarity with possible careers in the field, along with the modules they develop, which will be available for use by other teachers as well, a larger number of students will be exposed to the field.

Near the end of the six-week research program, the teachers presented their research at a research symposium/poster session held at MNTL on August 8th. In addition to University folk, a group of Urbana High School students participating in I-STEM's summer camp attended their research presentations to discover what a research presentation is like and to get pointers for making their own poster presentations down the road.

While the short-term goal of the RET was to expose the 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 through lesson modules. The teachers began developing these this past summer and will complete them over the course of the next year in order to use with the students in their own classrooms. One challenge many encountered when choosing the idea for their module was that they'd been doing research in a cutting-edge lab using expensive equipment; however, their



From left to right: Co-PI Lynford Goddard, Electrical and Computer Engineering; Irfan Ahmad, the Executive Director of the Center for Nanoscale Science and Technology and nano@illinois RET Program Manager; PI Xiuling Li, Electrical and Computer Engineering; Rashid Bashir, Head of the Department of Bioengineering

goal was to develop lesson plans that replicated something similar to their research but that any teacher could implement using inexpensive, easily accessible materials/equipment.

Excited about the experience, teachers not only felt they had learned a wealth of new information about the subject area they had researched, but that they had grown personally and as teachers, and felt confident about sharing their new knowledge and skills with their students.

Antonio Gamboa

For example, Antonio Gamboa, who teaches Chemistry, Biology, and AP classes in Pomona, CA and was in his second year in the RET, couldn't wait to share what he'd learned with his students.

"It actually was fantastic," Gamboa reports, "because it really confirmed all that I learned last year, and I was able to even improve on everything. And what I bring to the high schools is gonna' be fantastic...I feel really confident now to actually implement what I learned," he says.

While he also worked with cells and neurons during his research this summer, one significant accomplishment that relates to his high school students was the creation of a solar panel. "So the students will be able to create a solar panel in the classroom," he says, "and it's really fast, easy, inexpensive; the lesson is all written and available for teachers; so it's really exciting."

Having participated in research for two summers now, Gamboa calls research, "It's essential. I mean high school students—anybody should participate. I think they should be exposed to the fact of being able to try to find out something new. Just to learn something you didn't know and to question, I think is fantastic. That's a great opportunity."

Gamboa shares what he gained personally from participating in the RET. Along with a lot of new knowledge, he says, "I have confidence on new information and futuristic views. I think, at least for myself, it totally transforms my classes—the way that I can teach it, the way that I approach it. Instead of being the old style of teaching, this gives you a total refreshed view, and totally different way to see it and present it and the interactions with the teachers too were phenomenal."

Regarding the positive impact participating in the I-STEM camp and attending their poster presentation had on the local high schoolers,



nano@illinois RET Master Teacher Terry Koker explains his research to a visitor to the poster session.

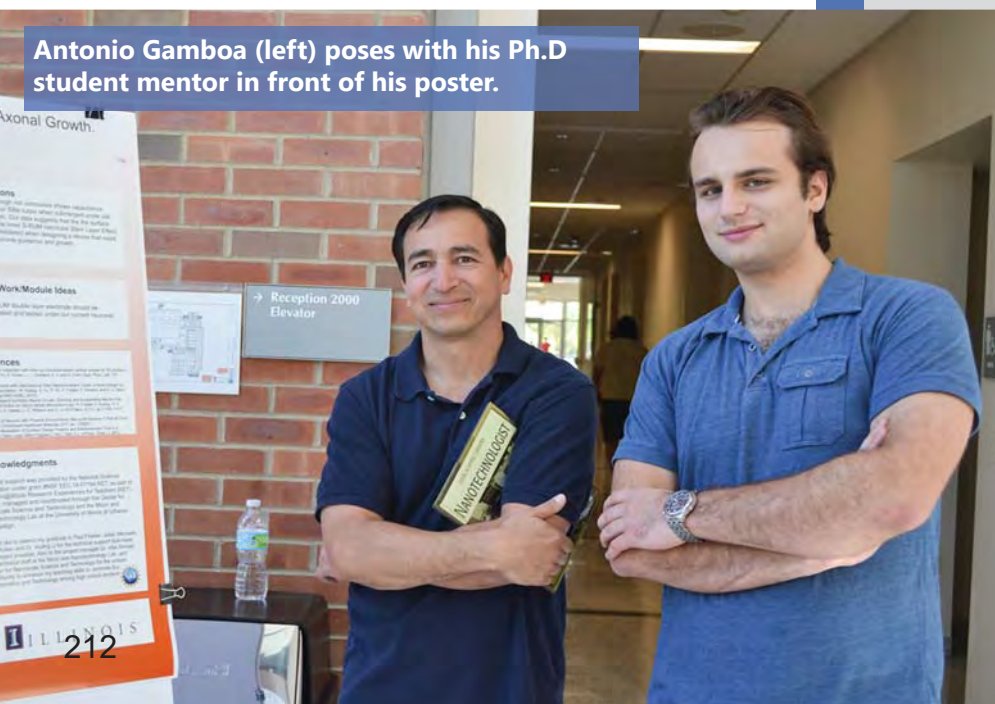
Gamboa shares why it was good for the students to come to something like this:

"It opens up their eyes," he says. "It's very difficult in high school to be able to see the opportunities. You can tell them, talk to them, show them, but there's nothing like walking on a campus, seeing the buildings, talking to people, seeing the posters, seeing everything. It all becomes real."

And according to Gamboa, after students participate in programs like this, there's a noticeable change:

"You notice it when they come back, they are different. What I notice is that they come back and they're ready to go to college. They're excited, motivated, and now they see that it's real. So many of the communities don't have this exposure. They don't have doctors or lawyers; they don't have anybody. You tell them and it seems to be open in the air, like maybe it's for someone else. But once they come, they realize that, 'Maybe, this is something for me!' And that is life changing."

Antonio Gamboa (left) poses with his Ph.D student mentor in front of his poster.



J. D. Graham

A local teacher, J. D. Graham, teaches biological sciences to grades 9–12 at Sullivan High School in Sullivan, Illinois.

Graham's research involved using a nanoSIMS machine to separate out atoms or ions according to their mass by sputtering (hitting a cell and exploding an area over and over), thus removing layer by layer, nano-meter by nano-meter, to create a 3D model of where all of those atoms were, then label them and associate them with certain organelles, enabling researchers to learn their composition and their position, which has never been done before at this resolution.

The lesson that Graham is going to have his students do is in two parts. The first involves using cigarette smoke extract to make exosomes, which are associated with both cancer communication and with bio-replication. In his lab, they would chemically induce a virus to replicate using cigarette smoke extract. "Do those exosomes look the same?" Graham says. "And if they do, can we disrupt or control their formation, thereby stopping viruses from replicating or stopping cancer cells from communicating?"

The second part involves working with a colleague at another school district who's going to have his students making silver and gold nano-particles. Students will be doing a cytotoxicity test to see how much cigarette smoke extract, nano-gold (almost completely non-toxic), and nano-silver (which has some toxicity) it takes to kill a certain amount of bacteria.

Regarding what he personally took away from the research experience, Graham indicates that as a teacher, he doesn't often get to do something like this with people "who are incredibly knowledgeable and passionate." He reports that he and his fellow teachers, in their role of spurring students on to greater achievement, are:

"Usually pulling very hard up, and here we had people pulling us up, and it's a nice thing."

He adds that the biggest impact was related to depth of learning. He would reach a point where he thought he understood what they were doing, "but then, every day, come back to find out that I don't understand it as well as I thought, and to find out that there's another layer of understanding, another layer of ideas. Every day I came in, I thought I had a handle on it; every day, they would then say, one more layer. That's an incredible feeling to have, to just keep going down deeper and deeper."

Should a student come to him and say, "Hey, I'm thinking about research as a career," Graham says he would tell them, "It's an incredible opportunity. There's always going to be a need for people who can think and can solve problems."

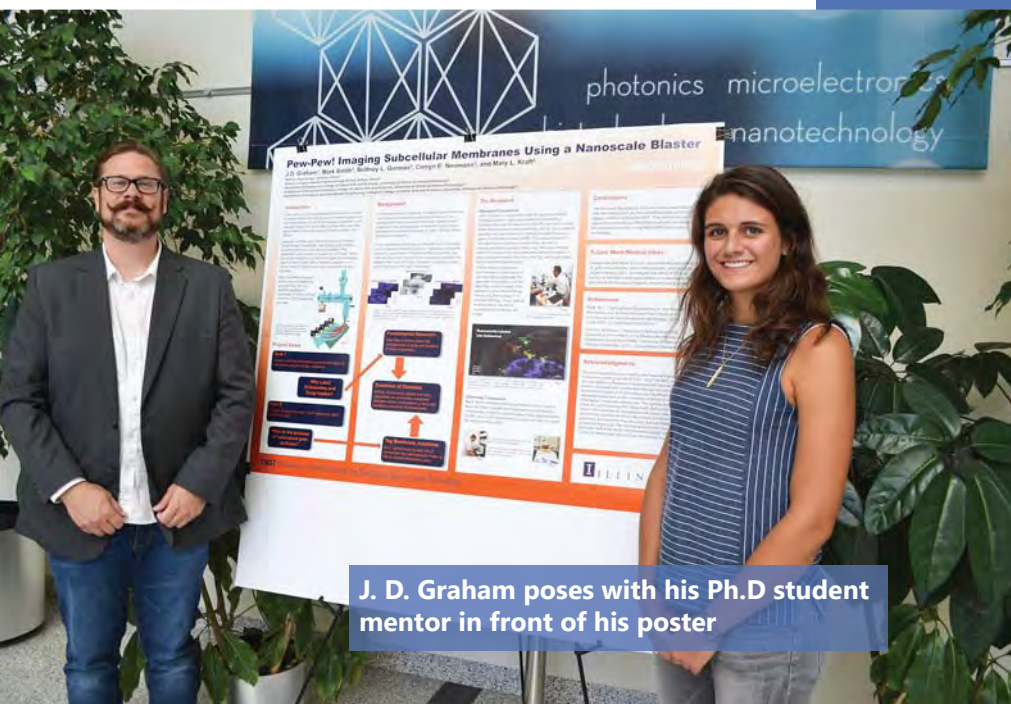
He's also hopeful that since he's been in the RET program and made some connections, he might be able to pull some strings, or at least "definitely find more programs for them to get started and get established."

He admits that he himself was reluctant to go to grad school after he got his Bachelor's. "A lot of it was just ignorance. I didn't really know what that lifestyle would be like." But now he knows exactly what grad school is like:

"And when you know what something is, when it's familiar, it's much easier to take that next step, and I hope to give a student the ability to become familiar with it."

Joanna Simeca

In her first year in the RET was Joanna Simeca, who teaches grades 10, 11, and 12 chemistry at Georgetown Preparatory School in



J. D. Graham poses with his Ph.D student mentor in front of his poster

North Bethesda, Maryland (just outside of Washington D.C.)

Simeca joined the RET to get experience doing research in the physical sciences. Because her background is in biology life sciences, she says she has lots of research experience there. “But I’ve never worked in an engineering facility or with any type of chemistry or physics research,” she says, “so it was really cool to actually get some experience there, and hands-on research that was not biology based. I was looking for a summer job too, so it was a fun way to learn more about science and also do something with my summer.”

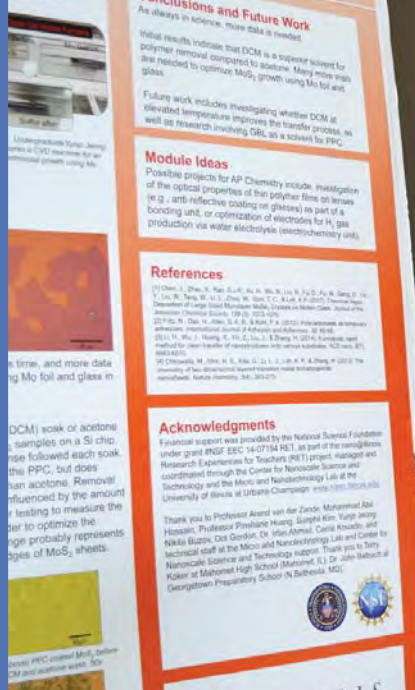
Simeca’s research involved finding the best way to make one-atom-thick layers of materials. They used a semi-conductor, molybdenum disulfide. “It’s really customizable,” she reports, “more customizable than graphene, so scientists are really interested in it.”

Is graphene, the wonder child in terms of one-atom-thick materials, on its way out? Simeca says no, but that there’s a huge body of research about graphene. TMDs (transition metal dichalcogenides), however, are still a relatively new field.

Simeca’s main takeaway from the summer was that she “learned a lot about the engineering process and how engineers have to keep trying and refining their process to find their best way to do something, rather than discovering never-before-seen scientific principles, which is what I would understand scientists do. So I got exposed to what engineers do”

She reports that it “was really cool to see how they keep tweaking their processes to learn.” Although she learned a lot about basic nanotechnology lab techniques, she won’t be able to use them in her class because her school doesn’t have any of the equipment, “But I learned a lot of what can be done,” she admits, “a lot about the field of nanotechnology, and what areas of our society are impacted by it.”

She’s not sure yet what project she’s going to take back to her students. She indicates that she might do some experiments that involve breaking water down into hydrogen and oxygen gas and finding



nano@illinois teacher, Joanna Simeca and her poster

he best way to do that most efficiently with a battery, “which is kind of an application of what I was doing,” she says. She might also investigate how polymers can be applied to glass to make anti-reflective coatings like on glasses. “So that would teach my students about polymer chemistry and some inter-molecular forces.”

If a student were to come to her considering a career in research, Simeca says she would tell him or her to first, go to a research university that has programs that they’re interested in, but has a wide variety of programs. “So that if you get there and you decide you don’t like material science, you can also still study electrical engineering or whatever,” she says.

She would also encourage the student to get undergraduate research experience early on:

“Reach out to professors; be persistent; get some undergraduate experience as soon as you can. If you don’t like the first lab you’re in, keep trying. I worked in three different labs as an undergrad, and even this was the best experience I’ve had in a lab. Keep trying, even if it doesn’t click at first, keep trying.”

She would also encourage students to do some kind of summer program at the high school level, like maybe the ones that the University of Illinois offers, or more local ones, that could be a good way to expose them to those programs too.

VET MED STUDENTS FIND NEW PASSIONS DURING SUMMER RESEARCH PROGRAM

October 31st, 2017

Every year since 2003, the Summer Research Training Program (S RTP) has hosted 14-25 veterinary school students from the University of Illinois to conduct a research project for 10 weeks over the summer. The goal of the program is to facilitate the career progression of vet students who have the ability and motivation to become research scientists. Each participant was paired with a mentor from the Illinois College of Veterinary Medicine, where they not only completed a research project but also explored future available careers, trained in research ethics, and learned about proper scientific writing. Of the 35 applicants for the summer 2017 session, 21 were accepted and 14 ultimately participated, which lasted from May 22nd to July 28th.

By the end of the program, participants had written an abstract and manuscript and designed a poster, all of which summarized their findings. The research poster was presented first at the College of Veterinary Medicine Symposium on August 2nd, and then again from August 3rd through the 6th at the Merit-NIH Veterinary Scholars Symposium at The National Institutes of Health, who funded the

program. Additionally, participants attended weekly seminars that focused on professional career development of a research scientist.

Bridget Clancy

One student in particular who discovered a new interest in the research environment was Bridget Clancy, who is now in her second year of Veterinary Medicine's 4 year program. Bridget entered the program having minimal lab experience, and she felt that it would be important for her to gain more due to her desire to one day become a lab animal veterinarian. Her research project was on circadian disruptions in rats and how it affects certain aspects of their behavior, specifically their impulsivity and attentiveness.

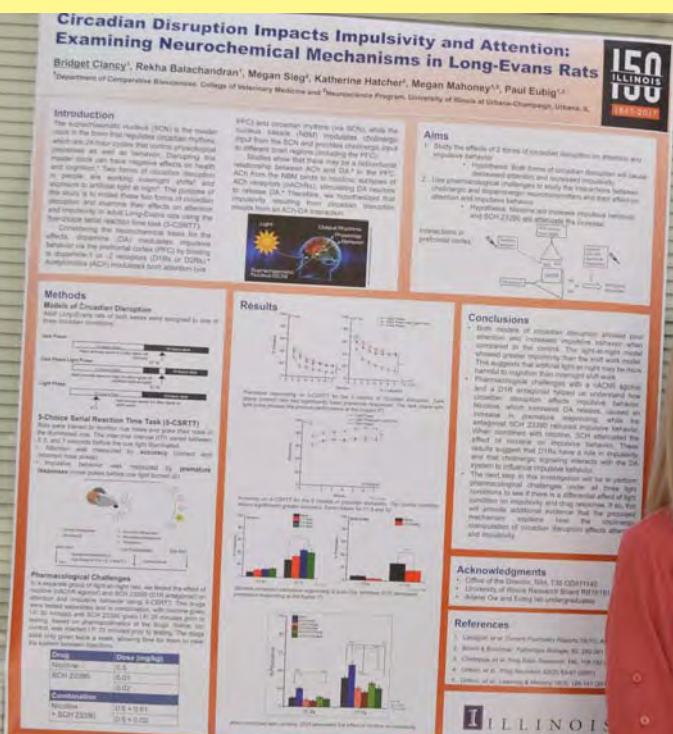
The study found that rats were indeed impacted by circadian disruptions, and they experienced decreased attention and increased impulsive behavior when compared to the control. Bridget claims that circadian disruptions can have a similar effect on humans due to "going to sleep looking at their cell phones or working overnight shifts at work... those things can affect your cognition".

Making these connections to humans is one of Bridget's favorite things about research:

"I think discovering new things is super important and very exciting. That's a really exciting part of the veterinary career, helping to find new discoveries for people and animals that could help both human and animal health. And I think that's a really exciting part of the veterinary career as a whole."

Bridget loved being able to complete a project from

Bridget Clancy, Second Year Vet Med student.





Second Year Vet Med student, Tony Bieser.

start to finish that produced concrete results. From the experience, she was also able to get to know some of her professors on a more personal basis that she would be unable to from class alone. An added bonus for her was even working with the lab rats, which she says are “quite friendly and much nicer than people think!”

Tony Bieser

Tony Bieser, another second year student, also found the summer SRTF program particularly valuable. Tony had some lab experience prior to the summer, but none where he was able to participate in the planning and designing of experiments. This summer, though, Tony was able to experience the planning aspect of research, which he discovered is a lot more work than anticipated. He had no idea how many papers he would have to read and people he would have to talk to in order to properly plan an experiment, but through this he was able to gain a “better understanding of what it takes to start a project from the ground up”.

Tony’s research was to design a protocol for treating intestinal illnesses in dogs using a fecal transplant procedure. This involves using different techniques to preserve stool samples from healthy dogs and processing it so it can be used in diseased dogs. However, the samples were being aerated a little too much, which decreases its total amount of anaerobic bacteria. Subsequently, the experiment was unable to produce conclusive

results. But this doesn’t mean that the experiment was a failure! Tony plans on continuing and completing the project this fall semester, and he hopes to participate in other similar studies in the lab, gaining more research experience. Tony especially loved this project because one of his biggest interests is gastrointestinal diseases in rabbits.

Tony says there could be a strong connection between his interests and the study:

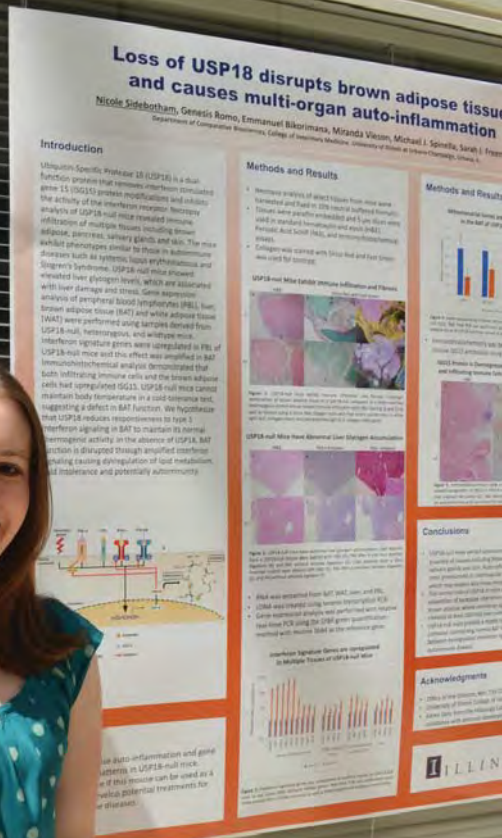
“I’m hoping that the results that we get from this project can maybe be transferred over into a future project that I can do, specifically on rabbits. I think the overall impact that this can have on a number of different species down the line, I think is pretty significant.”

Nicole Sidebotham

Nicole Sidebotham, a third year student in the Veterinary School, was able to gain a better understanding of how she can make research part of her career. This summer gave her the opportunity to “see what life as a researcher would be like”, which she says will be particularly valuable when making career decisions down the road.

Third Year Vet Med student, Nicole Sidebotham, presents her research.





Third Year Vet Med student, Nicole Sidebotham.

"I'm definitely more interested in trying to make research a part of my career. I've gotten a few ideas on maybe how to pursue that, even if I decide to go into more of a clinical practice aspect. Definitely a lot stronger leaner towards, making research a part of my career."

Nicole's project this summer focused on looking at a specific mouse model to study autoimmune diseases and developing potential treatments for them. She found that her mouse was a great model for studying autoimmune diseases, specifically the autoinflammation and autoimmunity targeting brown fat.

Kalinda Clark

On the other hand, Kalinda Clark is one student who had extensive prior lab experience, but still found the SRTP program extremely valuable. She spent almost two years researching how nanomedicine can be used to combat cancer at Georgetown University prior to enrolling in Illinois' Veterinary School, where she is also enrolled in the joint Masters of Public Health program as well.

Kalinda's research was on a toxin that lives in the human stomach known as vacuolating cytotoxin and how it "targets the acid secreting cells or parietal cells in order to create a colonizable environment for pylori to live". Even though she was already highly experienced in research, she claimed this research experience was still very valuable to her academically.

"It definitely solidified that I do want to go into this. The research aspect of infectious diseases and veterinarian medicine and it definitely fueled my love for research even more."

In fact, Kalinda hopes that after a bit more work, her study will be published! She plans on continuing working on the study this fall in order to make it happen. She's very proud of what she accomplished within the project, stating:

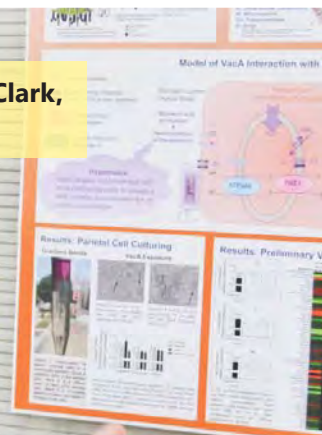
"It was my brainchild. I came up with this protocol... and it ended up working!"

One day, Kalinda hopes to go into public health veterinary medicine, with her dream job being to work in the CVC Epidemiology department.

Written by: Patrick Pavilonis



SRTP participant, Kalinda Clark, presents her research.



NCSA'S SPIN PROGRAM EXPOSES ILLINOIS STUDENTS TO INNOVATIVE, HIGH-TECH RESEARCH

November 29th, 2017

Illinois undergraduate students seeking to do challenging research on campus, especially related to cutting-edge new technology, need look no further than NCSA's SPIN (Students Pushing Innovation) program. Begun in 2012, it was created to support undergraduate research on campus and also to provide access to new technology—high-performance computing, data analysis and visualization, or cybersecurity, to name several. The gist of the program? Students get to do cutting-edge research in new technologies mentored by world-class researchers—possibly using a supercomputer: NCSA's Blue Waters.

According to the Director of SPIN, NCSA's Education and Outreach Coordinator, Olena Kindratenko, many of the projects “allow students to work on Blue-Waters-related issues or see the effectiveness of the work of Blue Waters.” She adds that many projects, while very technical, are also interdisciplinary, using computation to solve problems in non-technical areas, such as biology.

And not only are SPIN's projects interdisciplinary—its participants are too. Though many come from Computer Science or Electrical and Computer Engineering (ECE) as one might expect, the participants don't just come from other Engineering disciplines, like Physics; many are from across campus: Accounting, Biology, Economics, Psychology, Statistics, even Semantics. Kindratenko adds that SPIN is also seeking to increase female participation. For instance, in summer 2016, 27% of the involved students were females.

How are students matched up with SPIN research mentors? When applying, students must rank their top three preferences from among the upcoming session's projects; then mentors choose their first, second, and third choices from among the candidates that applied to their project. Regarding

her role in hooking up students with the NCSA researcher who's the best fit, based on both of their interests, Kindratenko actually sees herself as sort of “doing match-making.”

“I look not only for qualifications,” she explains, “but also we ask a set of questions in our application form to see how the person is motivated or interested.” Surprisingly, a student's GPA isn't even requested. Students are only required to be in good academic standing; grades don't necessarily play a role.



“Because sometimes it's really hard to evaluate a creative person that is interested in, for example, working for Donna Cox in her Advanced Visualization Group. So it's also about creativity; it's also about motivation; it's also about interest; and also about what students would like to get out of the SPIN experience.”

What are the benefits of participating in SPIN? Kindratenko says one of the greatest benefits is, of course, the research.

“I think that students have the experience to work along with top researchers at NCSA, and they're working on real projects.”

But according to Kindratenko, having a SPIN student on a project is a win-win; it's not just beneficial for the students, but also for mentors.

“They become a really vital part of those projects,” she acknowledges. “Student work is taken seriously here at NCSA. The researchers count on them; they count on their input on work being done...They see our SPIN students as a creative force at NCSA, because the best ideas are coming from undergraduate students.”

One NCSA research scientist who would agree is Volodymyr Kindratenko, who's in charge of NCSA's



NCSA's Education and Outreach Coordinator, Olena Kindratenko

SPIN student Zekun Wei at work in NCSA's SPIN office



Innovative Systems Lab (ISL). And he would be the first to agree that SPIN's goal, fostering undergrad research related to new technology, meshes quite well with that of ISL, which he calls “the place where we try new technology, and we look at how this new technology is applicable to the needs of NCSA at large, as well as the faculty and community on campus.” His research investigates “how new technology in processors, architecture, memory, and storage can improve high-performance computing.”

Regarding his interactions with SPIN students, he calls them “incredibly productive workers” and says the program gives researchers access to “highly motivated and educated students” whom he terms “very capable, and they know enough to be useful, and they are willing to work hard. So they do a good job.”

Another benefit for students, of course, is the money. Students receive paid internships (\$12.50 an hour), and in exchange, get an authentic research experience on cutting-edge topics. Another plus? Students are involved with a project from start to finish; working closely with their mentors, they must come up with their own research plan; plus, at the end of the internship, they're expected to produce a research report.

Another requirement which helps students hone their presentation skills? Each student must give at least one presentation—dubbed a lightning talk—about their project. SPIN students take turns

explaining their research to fellow SPIN students and others, then respond during a Q-and-A period. This component allows students to not only talk about their projects but to also learn about other NCSA projects.

Like most summer research programs, SPIN has an eight-week summer internship. But that's where most similarities

end. Because, unlike most other undergraduate research programs on campus, SPIN works only with Illinois undergrads, which allows for another unique program component: SPIN encourages students to make more permanent relationships with their research mentors...

sometimes over a period of several years. So while most research programs are for the summer only, SPIN also offers internships for the full academic year (from the end of August to May of the following year). In fact, some students receive internships for both the summer and academic year over a period of a year or two.

Another unique characteristic of SPIN? Its funding comes from a variety of sources. While the program's state funding can only support 15 interns financially per summer or academic year session, some SPIN students are completely supported by their mentors. Or sometimes, SPIN might support a student for a normal work week, with his or her mentor providing support so the student can work additional hours.

So why would a researcher who can afford to completely support a student in his or her lab go through SPIN at all? For one, it provides the

researcher access to a larger pool of qualified candidates. In addition, it provides more structure, such as the above-mentioned research reports and Lightning Talks. But SPIN also provides professional development (PD) activities.

For instance, one popular SPIN PD activity is an informal meeting with the NCSA director, Bill Gropp.



Dr. Eliu Herta gives a brief presentation during SPIN's Lightning Talks

“Those events are really successful and popular with the students,” Olena Kindratenko explains, “because this way they can have direct access and opportunity to talk to the director. It's exciting for young professionals to talk to such an outstanding person and researcher.”

SPIN also organizes other activities: a Blue Waters tour and the Advanced Visualization Lab's scientific phenomena

demonstration. In fact, because of SPIN's emphasis on PD, students are paid for one hour of PD a week in order to encourage SPIN students to attend presentations done at NCSA.

However, SPIN isn't all work and no play; students are also encouraged to socialize: do movie nights, see Fourth of July parade. “Our students in the past developed really close relationships,” Kindratenko reports.

One measure of SPIN's success is past students' achievements. For instance, because of SPIN, some past interns have successfully landed their next position or decided to go on grad school.



SPIN student Derek Glennon, who works with researcher Charalampos Markakis, presents his Lightning Talk: "Simulating Neutron Stars With Computational Fluid Dynamics."

And according to Olena, another benefit of SPIN is the guest speakers she invites to the lightning talks, which provide students "an opportunity to network and to expand their professional network as well."

One participant who agrees that networking is one of SPIN's benefits is computer engineering senior Yan Zhan, who got involved the summer of 2016 and has been participating ever since.

"It's a very good resource to work with and to network with researchers and other knowledgeable people on campus. NCSA, in general, has a particular concentration of very good people to know."

Yan also appreciates both the financial benefits, and developing relationships with other students. "Since SPIN is also a paid internship program, it's a nice way to cover some living expenses. And it's also a good way to learn about your peers. There's a lot of brilliant students here."

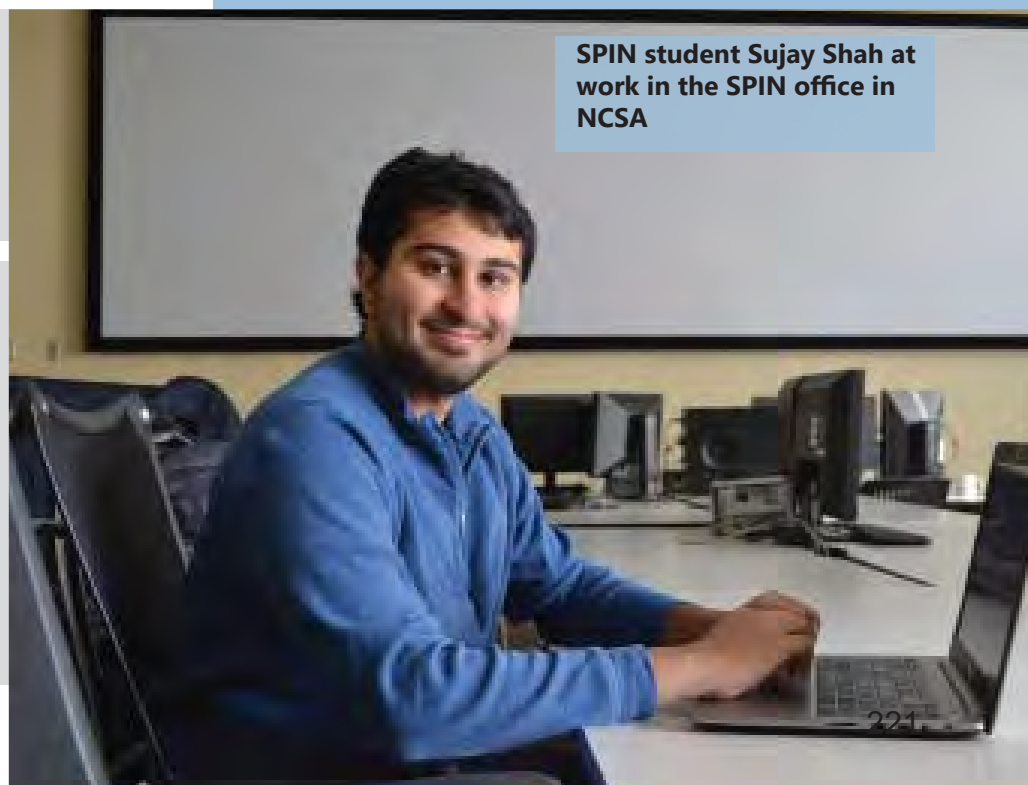
In all, Yan calls SPIN a great experience, and cites some additional benefits of SPIN: the people. "I mostly enjoy the working environment here, both the people and the environment in general."

One of the people to whom Yan is referring is his SPIN mentor, Volodymyr Kindratenko. The research Yan has been doing for Volodymyr is in the area of HPC architecture: testing a box of

Olena shares an anecdote about one student who had worked on an auto text recognition SPIN project and is currently interning at Amazon. The student told Kindratenko, "Because of my SPIN experience, I was chosen to work on the project."

"The success of our students is really encouraging and motivates us here at NCSA to continue this program," she adds.

Kindratenko claims that folks at NCSA are "really proud of our SPIN students. They are really great, out-going, hard-working students. We are so lucky to have them here at NCSA, and we are always excited to talk to students about opportunities at NCSA."



SPIN student Sujay Shah at work in the SPIN office in NCSA



Computer Engineering senior Yan Zhan (left) and his mentor, NCSA's Volodymyr Kindratenko (right).

new NVIDIA GPUs (Graphical Processing Units), which Volodymyr calls “incredibly high-performing compared to everything else that’s available.” The GPU’s performance is measured in how many FLOPS (floating point operations per second) they can do. (For instance, a 1 teraFLOPS (TFLOPS) system is capable of performing one trillion FLOPS.)

Yan has also dabbled in teaching: Kindratenko has hired him to be his TA for his ECE computer engineering course, admitting, “Each time I teach a particular course, I hire him because he’s very helpful.”

Yan has been involved in quite a number of projects during his time at NCSA. For example, he was a member of ECE’s student team that visited Washington, DC on Congressional Visit Day in late April. During this event, scientists and engineers from all over the nation go to Capitol Hill and talk to congressmen about funding for STEM education and research.

And this past summer, Yan helped provide tech support for NCSA’s Inclusion REU; working with the IT team, he helped to find resources then set up a new office for the REU students.

Also, with the help of Volodymyr Kindratenko, Zhan began the Illinois team that competed in the Student Cluster Competition held at the SC 17, a large, international, super-computing conference in mid-November 2017. This competition was created to provide undergrad students with early exposure to HPC (High-Performance Computing) and to integrate HPC education into undergraduate curricula.

Olena says Yan is also interested in SPIN’s social activities, and has also demonstrated leadership skills, such as serving on NCSA’s student board, where “He provides a lot of insight.”

Yan’s current plan, once he graduates, is to find a job as a systems engineer in the HPC field. While he’s looking into some of the national labs, there’s another position he’s also looking into... at NCSA.

Volodymyr thinks quite highly of Yan, calling him “A very productive member of the SPIN team as well as the cluster competition team. He is always there to do the work, and he is always willing to do what needs to be done. He’s always willing to learn something new. Everything he does now, he did not know it a year or two ago. But he’s willing to go and learn this, and he’s willing to commit time and build up on that. So he’s working with us so he can use his new knowledge.”

Based on stories like Yan Zhan’s, Olena considers SPIN to be quite successful. However, she’s devised a couple of new strategies to make it even better in the future. For one, she’d like to have more grad students involved with the program, plus she’d also like to broaden SPIN’s impact campus-wide. While SPIN has students from LAS (the College of Liberal Arts and Sciences), she hopes to also recruit students from other, non-engineering colleges, like Education, Business, and Applied Arts and Design.

“We strongly feel that even on this campus, students, especially undergraduate students, are not aware of the SPIN program and about wonderful opportunities at NCSA. So we are planning to do more outreach activities in order to promote the SPIN program and also to get more attention from different departments across campus, not only engineering,” she says.

NCSA'S NEW CIP INTERNSHIP PROGRAM TRAINS CYBERINFRASTRUCTURE PROFESSIONALS

November 29th, 2017

According to NCSA's Daniel Lapine, the number of qualified people who have experience working in advanced cyberinfrastructure (CI) is rather limited. So over the next three years, he and some folks at NCSA hope to do something about it. As part of the NSF-funded CyberTraining CIP: NCSA Internship Program for CI Professionals, they are seeking to add to the nation's pool of qualified, advanced cyberinfrastructure professionals.

Lapine, the project PI, along with Co-PI Volodymyr Kindratenko, says they developed the project because of "an awareness that we really lack qualified candidates when we're searching for people to come in and fill these positions." He's referring to the difficulty NCSA has had finding qualified CI professionals for several job openings there.

Kindratenko agrees, admitting that their motivation in designing a project to train cyberinfrastructure professionals wasn't completely altruistic:

"Being selfish, we looked at all of the open positions at the NCSA; at that time, we had several of them, the level of system engineers, system programmers, and we had basically had difficulties finding people for these."

After doing some research, they discovered that it wasn't just NCSA who was experiencing a shortage, but that there was a wide-spread need nationally. On websites that list job advertisements, such as indeed.com, there was "in excess of many thousands of positions open for systems engineers, but not enough people to fill them all," says Kindratenko.

Another related issue that might be contributing to the shortage? There's a dearth of 4-year or community-college programs that focus on the operational side of cyberinfrastructure. Lapine says most 4-year college programs, for instance, address creating cyberinfrastructure applications



CIP intern, Vikram Mudaliar.

or working on new hardware, while for community-college programs, two years of study isn't long enough to make students effective at advanced cyberinfrastructure.

"It's a good stepping stone," he suggests, "but it's not sufficient to deal with petabytes of storage or thousands of computers or the hundred gigabit bandwidth."

But NCSA, with its ten different cyberinfrastructure areas and its Blue Waters Super Computer, has, according to Kindratenko, "Enough of the technology to put to use together so that you expose interns to enough of the complexity."

So, deciding to address the problem, Lapine and company sought funding from the National Science Foundation, and NCSA's CIP project recently received \$499,999 in order to provide internship opportunities. Their goal? To train a total of 30 CI professionals (five per semester) over the three years of the grant, beginning with four interns in Fall 2017.

Surprisingly, it wasn't just applicants with computer science or computer engineering degrees who were interested in the program. While the majority of applicants had backgrounds in those two areas, students who majored in the humanities were also interested in becoming CI professionals. And following their time in the program, the interns might be qualified for some of the following

positions: a network engineer, systems engineer, storage engineer, or a security engineer.

Well qualified to undertake such a training program, NCSA has ten functional operational groups that address specific areas that comprise cyberinfrastructure, each with their own unique niche, such as storage, network, security, computer architecture, etc. (see below). Each intern will be imbedded in one of these groups during their time at NCSA.

- HPC Systems Group (Systems)
- Storage Enabling Technologies (SET)
- Advanced Visualization Lab (AVL)
- Innovative Technology Services (ITS)
- Data Analysis and Visualization (DAV)
- Innovative Software and Data Analysis (ISDA)
- Science and Engineering Application Support (SEAS)
- Incident Response and Security Team (IRST)
- Network Engineering (NERD)

Matching the interns with the groups was a well-thought-out process. To begin with, when applying, fall 2017 applicants were asked which groups they wouldn't want to work with. Then interns were selected based on having one person per group. (While CIP leadership are aware that prospective interns might change their minds once they learn more about the different groups, their goal, if at all possible, is to recruit five people each semester, whose focus, at the onset, is on five different groups.)

Then, for the first couple of weeks in fall 2017, each intern spent a day in each of the different groups in order to get an idea of what each group does.

Lapine then collected each of the interns' first and second choices. Plus, he sought to give the groups a say in whether or not they thought a person would be successful with them, so the groups also got to pick their first and second choices. Lapine indicates that he was able to match first choice for three of the interns (and the groups) and second choice for the fourth intern.

In addition to providing more trained CI professionals, the project is also seeking to increase the number of underrepresented minorities in CI. They've been reaching out to minority-serving institutions and trying to ensure that persons from underrepresented groups who would qualify are given a chance to apply. Among the fall 2017 group of interns are three Asians and one Caucasian female.

While Lapine's goal is to train more CI professionals to "create a pool of more talented people," he recognizes that CIP alone will not be able to meet the need:

"We also realized that what we're doing has to go to other institutions or organizations that have similar capabilities, or it won't be very effective." The idea is to disseminate the information, techniques, and processes they're developing in the hopes that other national super-computer centers might pick up the baton, saying,

"We could start a program and use these techniques and methods to help train some people with the capabilities that we have."

While Lapine acknowledges that NCSA is fortunate to have ten operational groups they can call on, he knows most centers won't necessarily have that many distinct areas, but knows that most will have personnel focused on systems, security, networking, and probably storage. "Even just being able to bring a few people in at every center would make the program more effective," he says.

So, with this in mind, CIP is also developing instructional materials for dissemination. Each semester, NCSA groups will be asked to produce a one-hour presentation on a topic of interest or of use to them. Thus, by the end of the project, they will have amassed quite a number of CI-related training presentations. And they've made a start. "The networking group produced a really nice, one-hour presentation on how the internet



CIP intern, Yogesh Bhandari



CIP intern, Pranav Baitule.

works at a deep networking level,” adding that it was “quite interesting to observe the presentation because I learned a lot about things that I normally would not need to know but were very useful in knowing,” Lapine reports.

Intrigued by the wealth of knowledge to be gained through the program, the first batch of interns say they’ve been learning a lot. For instance, Vikram Mudaliar got involved with CIP because he thought “there was a unique learning opportunity associated with the program. It is something that hasn’t been taught or done during my undergrad college career. It was interesting to touch upon topics where you’re dealing with high-performing computers and what infrastructure is needed to support these applications and computer systems.”

Mudaliar believes “collaboration between many different teams to solve one problem” is one thing he’s learned so far that will be of import in his career. “I think there’s a lot of cross collaboration,” he adds. “Therefore, in order to solve a problem, you need to have knowledge in different aspects of it and not necessarily just in one aspect.”

And during his internship, in order to solve a common bug on a website, he’s had to “talk to lot of other people and learn about how they would look at the solution to the problem from different aspects. That is, I think, a very important thing to take away from this internship program,” he admits.

Another intern, Katherine Koch, whose background was mostly in math, got involved in CIP because she was interested in the many areas of research being done at NCSA. Because she doesn’t have a technical background, she hoped to “learn skills that would enable [her] to participate and contribute to that interdisciplinary environment because

there are so many different areas of study that are involved or that are supported by the NCSA.”

Katherine trained with NCSA’s data analysis visualization group, which helps scientists uncover aspects not apparent in their data without visualization. One skill Katherine has learned that she feels will be beneficial in the future is to determine how people of different disciplines work together to accomplish a task and what she would need to learn in order to contribute.

“I think there are very specific technical aspects of the work I’m doing that I’m learning about,” she explains, “but I’m also placing all those into a framework of ‘Who does what?’ and ‘How do people work together?’ If I were to pursue a particular area, what do I need to know in order to know what to learn further? Just getting a sense of what already exists and what I would need to investigate more.”

Working with NCSA’s Incident Response and Security group is another intern, Pranav Baitule, who has a Master’s in Telecommunications from George Mason University and hopes to eventually work in network engineering and cyber security.

Some of the skills he’s gained that he thinks he’s going to be able to apply in his career down the road include working with firewalls and time management. “So I didn’t study firewalls in school, and I’ve been learning firewalls from scratch. That will be helpful in the future. Also I’ve been looking into projects simultaneously and managing the time and dividing time—time management basically—which will also be helpful in the future.”

According to Baitule, one aspect of the program that’s allowed him to do some personal networking, as well as learn a lot, is getting to work with the security team. “There’s a job shadowing session throughout each day with a different member,” he reports, “so I gotten to learn from them, how they work daily on different projects.”

While Baitule’s time here as an intern hasn’t changed his career plans—he’s been interested in networking and security from the beginning—he reports that he’s grown through the experience:

“I took certain courses during my Master’s program, and I see this as a continuation of things that I’ve learned in school and gained more practical experience.”

The fourth intern, Yogesh Bhandari, got his BS in India in Power Systems Engineering, Here at Illinois, where he's working on a Masters in Energy Systems in the Nuclear Engineering Department, but he's also taking courses in Electrical Engineering. As part of CIP, the NCSA group he's working with is ISDA (Innovation Software and Data Analysis), for whom he's updating their data libraries. Bhandari hopes to go into an industry focused on energy, using software and analytics.

Regarding skills he's acquired in CIP, Bhandari reports, "It's very simple— it gives me the overall experience working with github workflow, more understanding in coding over python. This experience was helpful as the skills I picked during my internship are agile and modular in nature. Thus, I can use them in software development for power and energy industry."

According to Bhandari, participating as an intern in CIP strengthened his career goals. "So, I always wanted to go into the energy software industry," he admits, "and with this experience, I think, down the road, I can go into that."

Like the interns, Lapine believes the program has been going well, despite working out a few kinks. For instance, the idea was that interns work 40 hours a week to get the full opportunity to learn from other people; however, one participant, a graduate student, was limited to 20 hours a week per University rules. So for this first semester of training, they were trying to determine whether he would be able to pick up enough information for the program to be helpful.

Lapine also stresses the notion that interns wouldn't just be assigned tasks to do, but would be doing what he terms, "job following" or on-the-job-training.

"It's not just come in and they assign you a task," he stresses, but trainees "actually sit side saddle with someone doing work so they can understand the processes and decision making. That's the part that you can't get in a textbook."

Regarding the job-following component, Lapine says, they're "looking at the effect of on-the-job training in addition to the formalized training...we're trying to leverage that capability. To bring someone in who has had some training and then bring them into a real operation to give them more awareness of what happens— real-world choices and limitations. Hopefully that's where we will get some effective skills and knowledge and activities from interns."

So while making some adjustments to ensure that this aspect of CIP was implemented, Lapine believes the interns integrated well into the various groups. "We see activities where the students actually come up and participate in meetings. So if there's a group meeting and there's a representative, we'll see students from the different areas show up as part of the group representatives. I think we're doing well there."


Kindratenko sums up their hopes for CIP: "I think we are glad that the NCSA has this infrastructure—enough of the activities going on so that we can provide a really productive training environment for the interns so that they can go into the real world. We are in a good position to provide this internship program."





INCREASING REPRESENTATION OF WOMEN IN STEM



A young woman with dark hair tied back, wearing a grey and blue t-shirt with an eagle logo, is focused on soldering a small electronic component. She is using a soldering iron with a black handle. On the table in front of her is a blue sponge and some electronic components. A name tag is pinned to her shirt. The background is a plain wall.

A student
soldering her
lady-bug bot.

Hello
my name is
Lindsey Serlinsky
JAMES
JAMES
JAMES
5

GIRLS DISCOVER THAT ENGINEERING IS SWEET AT INTRODUCE-A-GIRL-TO-ENGINEERING DAY

March 7, 2017

About one hundred girls (and their parents) from around the state (and even a couple from out of state), showed up at the 2017 edition of SWE's Introduce-a-Girl-to-Engineering Day (IGED). The largest SWE (Society of Women Engineers) outreach of the year, it was held at **Illinois** on Saturday, February 18th. Not only did the participants learn a bit about the different engineering disciplines, they learned that like many of the female role models at the event, they too could do engineering and make a difference in other peoples' lives.

The theme of this year's IGED was "Engineering is Sweet." So what could be more apropos than having candy littered throughout the different venues. "I mean, who doesn't love candy, or everybody has a little bit of a sweet tooth," acknowledges Molly McGiles, one of SWE's Outreach Co-Directors. "So we're trying to just relate everything to what girls understand."

Along with Hershey's Kisses, the day's events were also designed to show the girls just how sweet Engineering can be! So the keynote speaker, Engineering Ph.D. student Aadeel Akhtar shared with the girls how he's making a difference in people's lives by designing low-cost prostheses as part of his research, and his new start-up company, PSYONIC.

Then, the high-schoolers rotated through several hands-on activities related to different engineering disciplines. They extracted DNA from strawberries; soldered lady bug bots; electroplated quarters with copper



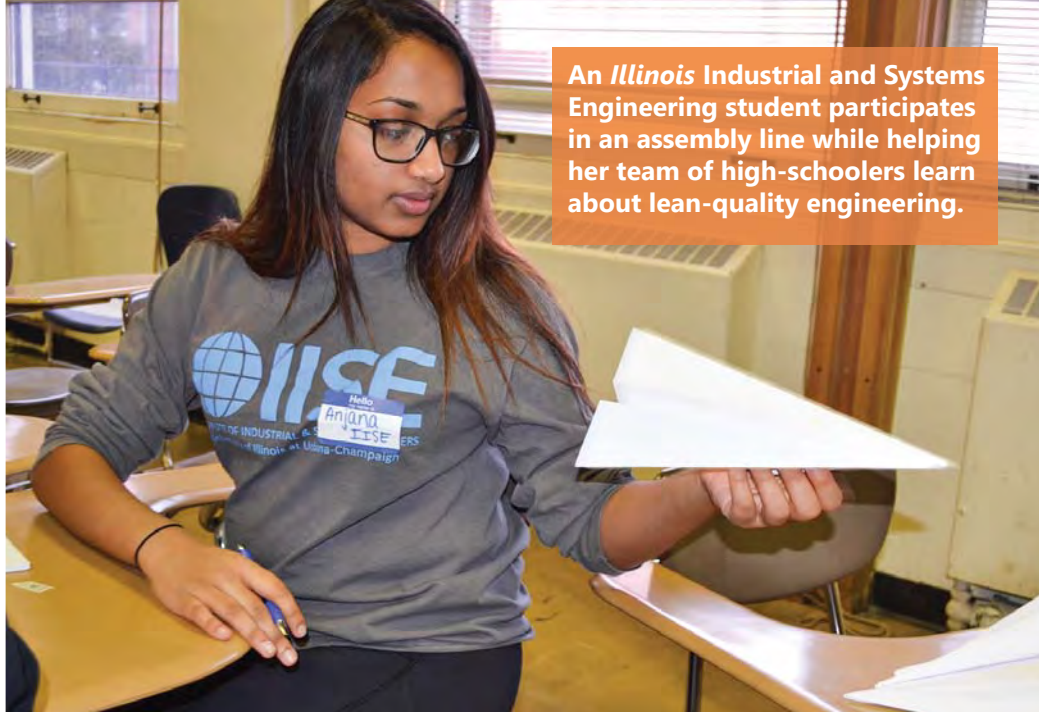
An high school participant makes an airplane during the Aeronautical Engineering session of Introduce-A-Girl-to-Engineering Day.

from pennies; experimented with drinking water purity; experienced rapid prototyping; designed, built, and flew wooden gliders, and even learned about industrial engineering through a paper-airplane-building assembly line competition which stressed not only speed, but quality.

McGiles shares an anecdote about the Lean-quality engineering activity. Girls were to make paper airplanes from a stack of paper, assembly-line fashion. Then they had one final colored piece of paper and were to see how long it would take them to get it through, and if it was the same quality at the end. Before the activity, some girls were skeptical, exclaiming, “Oh my god, we’re going to make paper airplanes!” and then towards the end they were like, ‘No, I think we can make this better if we do it this way!’ I was like, this is what we need! This is why we do this, to see these girls become engineers and fix these problems!”

Leading these activities were around 30+ volunteers from nine different RSOs (registered student organizations), who were on hand to share their love of engineering with the girls. IGED co-chair Katherine Kiang explains:

“So we like to invite a large number of RSOs to come so that the students can see a wide variety of student groups, and also allows us to have



An Illinois Industrial and Systems Engineering student participates in an assembly line while helping her team of high-schoolers learn about lean-quality engineering.

smaller rotation numbers so they get more personal interaction.”

Following are the participating RSOs:

- AIChE (Chemical Engineering)
- ASME (Mechanical Engineering)
- BMES (Bioengineering)
- Illini Aerospace (Aerospace Engineering)
- ISESE (Industrial Engineering)
- Material Advantage (Materials Engineering)
- SEM (Mechanical Engineering)
- WECE (Electrical and Computer Engineering)
- WEF-AWWA (Environmental Engineering)



High school students do an experiment electroplating a quarter with copper from pennies

Following the hands-on engineering activities, over a pizza lunch, a panel of current Engineering students shared what it's like to be a student at Illinois, some tips for success as a student, plus answered participants' questions.

IGED organizers also hoped to help the high-schoolers understand a bit about research. So instead of the lab tours offered in the past, they came up with a Poster Walk featuring research done at Illinois by undergrads, grad students, and postdocs.

The event planners felt it would “be really helpful for them not only to meet graduate students who are doing really cool work, but also

to be able to see it and actually learn about the research,” Kiang explains. Typically in lab tours, “They just see the lab,” she continues, “and when the professor’s speaking, it can go over their head.” So IGED organizers felt hearing from students would be more effective.

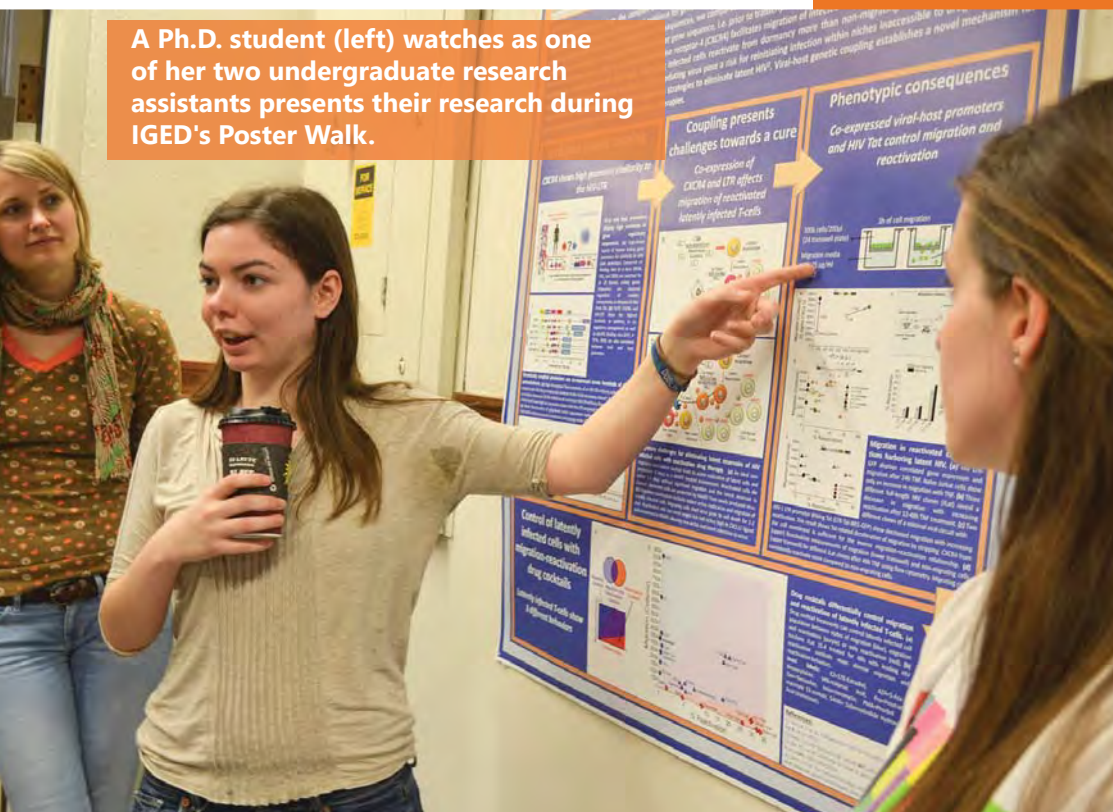
According to McGiles, the Poster Walk was also intended to prepare the girls for one of the key events of the day—the design challenge. So during the Poster Walk, girls would get “A first-hand experience of what a designed poster should look like when they go to create theirs at the end of the day...because they do a design challenge, so they get to see what real people here at Illinois are working on and how those projects look on paper, so they can reproduce something of similar value.”

During the afternoon design challenge, the girls were to come up with an engineering solution to address a present-day problem, design a prototype, and create a poster to present their idea to visitors (including parents) during the end-of-the day poster presentation.



Members of the Materials Advantage RSO explain a bit about materials science during their hands-on activity.

However, parents didn’t just kill time waiting for the final poster presentation. After attending the opening session with the girls, they had their own set of activities: talks from an admissions representative and Angie Wolters, Assistant Director of WIE (Women in Engineering), a tour of Engineering campus, and even a Trivia game. In charge of the parent activities this year, McGiles reports that some of the categories included what their daughters had been learning in the morning, fun facts about Illinois, fun facts about sweets, and one that was a bit more informative, like “How can you advocate for your daughter?”



A Ph.D. student (left) watches as one of her two undergraduate research assistants presents their research during IGED's Poster Walk.

In a nutshell, the goal of Introduce-a-Girl-to-Engineering Day, was to pique girls’ interest in engineering as a career. According to Katherine Kiang, it’s:

“About exposing girls to engineering, and showing them that they can be an engineer, and giving them that confidence.”

She adds that exposing the girls to women who currently do engineering is a big part of the goal:

“Just showing them that there are very strong female engineer role models who make a difference and that they can be one of those, too, and just trying to inspire them to consider engineering.”

Relishing the opportunity to serve as a role model for the girls, SWE Outreach Co-Director Abbie Gerth, reports that her friends got her involved in IGED a couple of years ago, and she's been involved with SWE outreach ever since.

“My good friends and roommates, they really love doing this outreach, and I saw how much joy they got from seeing these kids learn, and I was like, ‘Hey, I kind of want that. That looks exciting!’



IGED participant prepares to test the airplane she just finished designing.



An IGED participant extracting DNA from strawberries.

So I thought I'd try it. I've always loved helping people, so it kind of just goes hand in hand, sharing my love of engineering and helping, reaching out to these girls.”

Similarly, McGiles indicates that she participates in IGED to recruit more girls into engineering.

“As a woman in engineering, I'm passionate to see more women in engineering, and this is the next generation of girls who would be going into that.”

McGiles says the high-schoolers find discovering that one of the Engineering students grew up near them to be particularly significant. “I also find it so fun when girls come to this event,” she admits, “and they're like, “Oh I'm from Winchester!” or “I'm from Jacksonville!” and they're close by, and you just have that connection with somebody... “Oh,

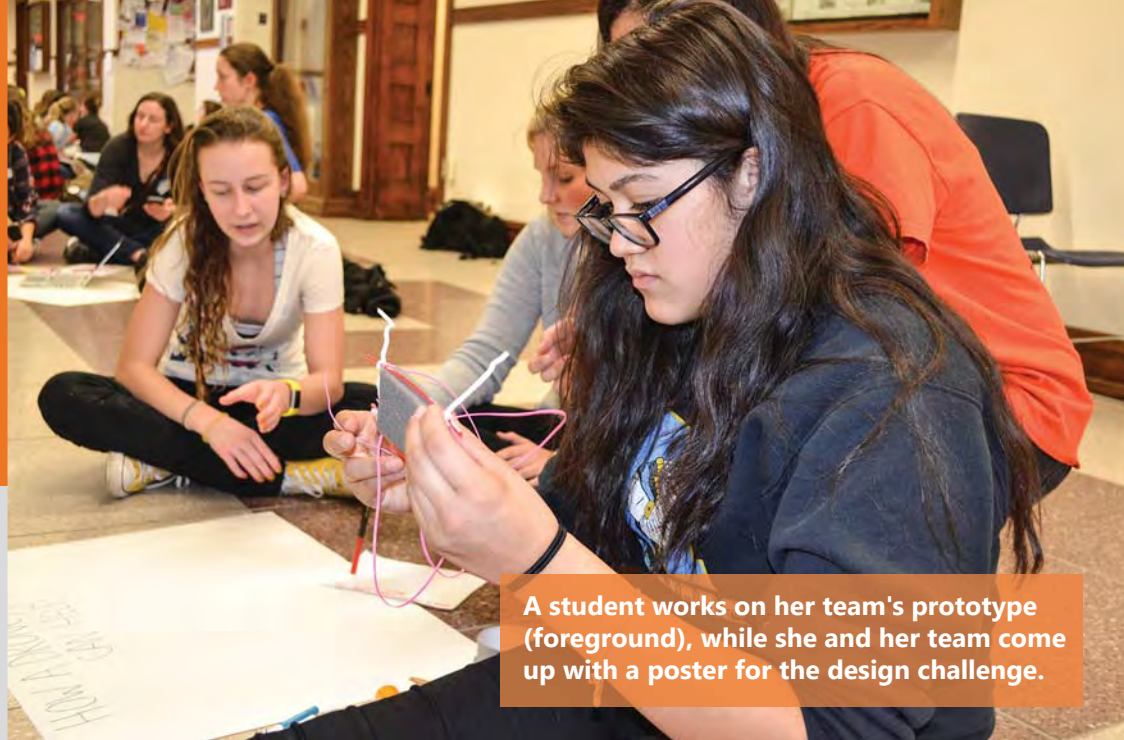
this girl lives next to me, and now she's doing all these big things! I can do it!"

What kind of impact did the outreach have on the visiting high-schoolers? Gerth, a senior in Mechanical Engineering, who looked in on different activities from time to time, reports:

"I was actually just with the soldering, with the electrical engineering group, and I could see those girls really getting into it. They really loved having that hands-on, real-world engineering experience, and I could see their eyes light up. They really wanted to do it."

McGiles, who also dropped in to watch the girls doing the activities, shares a couple of anecdotes. She reports that one girl doing the soldering hearts activity was asking, "'What temperature is this actually at? And could you do it at a lower temperature?' I was like, when I was in high school, I would just do the activity; I'd be like, 'Oh this is fun!'"

Several participants share why they came to IGED and what kind of impact it had had on them. For



A student works on her team's prototype (foreground), while she and her team come up with a poster for the design challenge.

instance, Hannah Cannon, a high school junior came, "Just to learn more about engineering and the different fields that are here. To maybe know what I want to do when I get older."

Of the disciplines she'd been exposed to, she appeared to be leaning toward mechanical engineering.

"I liked mechanical a lot. It was fun to do all that—design and build things." She particularly enjoyed the collaboration aspect of the design project: "It was fun to talk about everyone's different ideas for one problem to find an eventual solution that everyone can agree on. Nice to see how different everyone is and their different points of view. It ended up being a really good thing to do, and I learned from it."

In the Environmental Engineering activity, two high-schoolers examine their water purity experiment.



Anisha Narayan, a junior at Cohen High School in Winchester, Illinois, participated in IGED because she has been on a college tour here and had started following the Women in Engineering website. So when she learned about IGED, she signed up!

Anisha wants to go into computer science. While she's known it's been computer science all along, she acknowledges, "but it was kind of nice to get exposure to the electrical



IGED participant Kelsey Belle throws the airplane she just finished designing.

be presenting the department. Everything's been wonderful," adding that the event had been, "Answering all the questions we've had."

Matthew, an Illinois alumnus himself, wanted them to attend IGED because, "They both enjoy math and science, so I thought they might enjoy seeing the campus and taking a look at the engineering program." Plus, because Hannah had gone to and enjoyed an engineering camp at another university last year, Dad admits:

"We wanted her to see the campus here, and take a look at and see what the opportunities are for women."

McGiles indicates that many current Engineering students, like IGED co-chair, Maddie Pool, ended up at Illinois as a result of participating in IGED as high-schoolers—which makes the event particularly rewarding. "So to just see people come back,"

engineering side, 'cause I've had some exposure to circuits, and I didn't really like it, but I really liked what I did here today." The activity was a little lady bug bot they were programming for the lights to turn on when they soldered on the battery. "Mine didn't work," she confesses, "but other people's did work."

Another participant, Kelsey Belle, a senior at Naperville North High School, admits that, "Weirdly enough, I more of an art person. I enjoy computers in engineering, and I like the creative aspects of it. It's kind of a weird way to look at it, but that's how I view it. It's an art form." Her goals are to do computing and digital media. "It's a little bit of both!" she admits.

Sydney Nichols is a junior at Blue Ridge High School. "It's about 20 minutes from here. I'm local," she says. Regarding math and science, Sydney proclaims, "I love it. I love it!" Sydney, who thinks she wants to be an engineer, proclaims, "I really liked electrical. When we did the circuits, that was really fun."

The parents appeared to enjoy it too. One set of parents, Matthew and Linda Surlovski, who brought their two daughters: Hannah (a junior) and Lindsey (a freshman), report, "I think it's really great—very excited. Everybody seems to



Matthew and Linda Surlovski, brought their two daughters: Hannah (a junior) and Lindsey (a freshman) to IGED.

admits McGiles, “and to just see them being successful is really awesome.”

Take IGED chair liaison, Isabela Pelikan. A freshman in Bioengineering, she got involved because she knows first-hand what kind of an influence IGED can have. A participant herself as a high school sophomore, she calls its impact:

“A huge one, because it made me decide to come here, actually. It was a great experience.”

What in particular about IGED influenced Pelikan the most? “The promotion of women, specifically in engineering, because I did not know a lot about engineering. My mom actually pushed me to go to this, and I was like, ‘Okay, you know, why not?’ because I didn’t know much about it. I don’t know, I loved the whole inclusion of women because we’re so underrepresented, so that was really cool. And then the design challenge was a huge thing, because we actually won it, so that was really fun. But, yeah, it was awesome!”

Dad was supportive too. “My dad’s like, ‘Oh, I can see you doing this one day!’ she acknowledges, “and now...” Here she is, studying Bioengineering at Illinois!

Kiang expressed the IGED committee’s appreciation:

“We just want to thank everyone who’s helped out with this event, from our speakers to our judges, our student organizations, and our volunteers from the Society of Women Engineers, this day wouldn’t be possible without them and it’s always really cool to see it all coming together.”

Freshman Bioengineering major, Isabela Pelikan.



“DOUBLE BIND” STUDY EXAMINES OBSTACLES WOMEN OF COLOR FACE IN ENGINEERING

“You don’t want diversity just for the sake of diversity, don’t want them just for the sake of having them in the room. You want them for their perspective.” – Kelly Cross

April 10, 2017

Kelly Cross and several colleagues have begun a three-year study funded by the National Science Foundation to examine the experiences of women of color in engineering. Aptly named “The Double Bind of Race and Gender: A Look into the Experiences of Women of Color in Engineering,” the study Cross is conducting, along with Jenny Amos, Kathryn Clancy, Princess Imoukhuede, and Ruby Mendenhall, is looking at how women of color are doubly disadvantaged. They not only have to overcome historical gender inequities inherent in engineering, but also face the many challenges racial minorities encounter.

Begun in September 2016, the three-year study (an unexplored facet of Cross’s dissertation she is finally getting to pursue) involves a survey open to all women in the College of Engineering in a large, Midwestern, public, research-intensive school, plus interviews, to be conducted in the immediate future.

To recruit engineering women to take part in the study, the investigators created an email briefly describing the study and providing a link to the survey. Then, just before Christmas break in December 2016, the directors of Engineering undergraduate programs, like the Society of Women in Engineering, sent the email out to their memberships. To date, 400 participants have responded; 300 have completed the survey, with less than 50 women of color. The investigators intend to repeat the survey again next fall.

Additionally, to delve deeper into students’ experiences, Cross and colleagues will also conduct individual interviews with all survey respondents who volunteered to be interviewed further about the topic.

Both the survey and interviews will deal with identity, which Cross calls “The core piece of this,” while the guiding theoretical framework is intersectionality, which “basically says that you have multiple ways in which you experience anything,” Cross explains.

She describes how identity intersectionality works via a personal example. She identifies as:

“A black, female engineer—those are three different identities—that’s my race, my gender, and my profession. And intersectionality simply says that I can’t separate those out. I experience them all at the same time. And they interact with each other. So in different contexts, my race becomes more salient, or becomes more important in a particular context.”

She clarifies that during our interview, her identity as a professional engineer was at the forefront. “Not so much my race, or my gender, my religion,



Kelly Cross, Bioengineering Visiting Research Scientist (photo courtesy of the Engineering Education Research Group)

or my socioeconomic status. None of that matters. Right now, as a researcher, and as a representative of this department, I need to be a professional engineer. So the context determines which one of these dimensions of identity become more important to us.”

While the grant specifically focuses on women of color, Cross says they will obtain data regarding obstacles all women must overcome to study engineering. “We did want to capture women’s experience in engineering. Period.” She also expects to capture other things they didn’t necessarily target in the study, such as one they discovered early on regarding White women’s racial identity.

“White women don’t always consider their race,” she admits, “because they’ve never had to define or think about their race. So having them in a setting where they could actually think about their race was a kind of unintended tidbit of information that we didn’t intend to collect, but was certainly there.”

She was excited to “actually have data to say that not all white women think about their race because they’re never really forced to,” a concept she was familiar with as a researcher, adding that this survey gave them the opportunity to reflect on, ‘What does it mean for me to be a white female?’ and reports that, based on the data so far, white women’s experiences and what they thought about race were completely different than what students of color thought.

Based on previous literature, “Identity development around race is very different for whites than it is for ethnic minorities,” she states. “...If you’re a majority person, you don’t necessarily think about your race and what it means, whereas a minority person, they constantly think about ‘What is my race? What does it mean? How is it impacting my experience?’”

“Race is a socially constructed thing,” Cross continues, shedding further light on how the term “white” came about historically in the U.S. According to Racial Formation in the United States, immigrants to America originally considered themselves to be German Americans, Irish Americans, or Italian Americans, etc.

“Now that you’re making laws regarding that, you need this terminology to justify making laws and segregating the population,” Cross explains. “But, no, originally they were German Americans; they were not white; they were Italian Americans; they were not white. But now we know them all as white.”

However, Cross indicates that there’s a trend now among people in the white community saying ‘No, you can’t just throw me in this white pile...People are saying, ‘Hey, I want to hang on to that. I’m not saying that I’m not American, but what I am saying is that I do have some history behind it.’”

What do the investigators hope will come out of the study? One noteworthy end product mentioned in their proposal abstract is a “framework and model that women of color can use to overcome challenges that they might face in engineering and other STEM disciplines.”

Although they’ve gathered some data thus far, Cross says it’s too early to make any predictions as yet regarding what that framework might look like, or any other programs they might like to put in place: “We have to see what our data are telling us first. Because this is such an unexplored area, it is very difficult to propose a solution when we don’t completely understand the problem.”

So, to help them more fully understand the problem, the next step is interviews to find out which of the women’s identities are impacting their experiences in certain situations: the classroom, when talking to an advisor or TA, or in a student group environment.

“So in those different educational environments and settings, whatever they described as important to their academic experience here, we want to ask them, ‘Ok, now that you’ve articulated that, was it your race? Was it your gender? What do you think was most influential in that interaction?’”

Another mitigating factor when extrapolating from the data is what departments women are in,

“Because the departmental culture for women also varies,” Cross admits.

She goes on to describe the differences between, say, Bioengineering (BioE), where half of the engineering students are female, and other

departments. “So our culture in this department will be very different from ECE (Electrical and Computer Engineering) or even ISE (Industrial and Enterprise Systems Engineering).”

Part of this involves women's sense of belonging—whether students feel welcome and included within their department. For example, Cross recently discovered that women in some departments have formed student groups to support each other. But she reports that while (Mechanical Science Engineering has a group for female students, BioE doesn't—ostensibly because with BioE's high ratio of female vs. male students, women don't have a diminished sense of belonging.

Cross-departmental differences could be significant. For instance, ECE, with its sheer numbers, “is absolutely going to function and look differently,” Cross explains. “But, again, this is where I think intersectionality is so important.” She believes it will prevent them from making any gross generalizations.

“That is why it is important to talk to them, for them to tell us what is going on, and what becomes more salient for them, and why? Because we don't know the ‘why?’ either.”

What potential impact could the study have? Cross believes it could aid in reforming engineering education here at Illinois, for instance, in her work to redesign the engineering curriculum as part of another NSF initiative, RED (Revolutionizing Engineering Departments), where she's working with faculty on “how to be more inclusive in their teaching practices.” Further, she hopes to take, “what women are saying about their classroom experience back to our faculty, to say, ‘In your department, your women are having trouble with this.’”

Cross is also hopeful that the study will provide the impetus for some much-needed dialogue regarding fostering diversity and inclusion: “But I think that this will be a useful lens for us to do a meaningful thing, and start conversations that we have not had in engineering before. So for me, as a black engineering woman, I think it's important that we start these conversations, because as long as people are not talking, then we can't learn, and we can't grow.” And she sees part of her job as an educator “to help people to think, to grow, to go beyond what they think know, and to learn more.”

Ultimately, Cross believes this study could be significant regarding the kind of engineers Illinois produces. She wants every student to have a good experience at Illinois, and reminds other faculty:

“We are training the next generation of engineers, and that is a huge responsibility. What skills do we want or need them to have before they go out into the world and design our world? I don't want the engineers from this university to leave without understanding the importance of ‘women is perspective’ around the concepts of engineering, how we inform design.”

Along with impacting engineering education here at home, the investigators also believe their study could impact it nationally. For instance, they intend to publish in several journals. Plus, if they can develop “practical teaching practices, there are other venues and journals they can publish in. “Yes, this could take off,” she predicts.

The investigators also hope to seek funding from WEPAN (Women In Engineering Proactive Network), which gives awards for groundbreaking projects. “WEPAN would be huge,” Cross envisions, “because that would be on the national stage.”

While the Double Bind project may seek to address the interests of NSF's Broadening Participation program, or to right historical inequities and disadvantages, Cross would be the first to say that her main objective is the notion that diverse perspectives are integral to innovative engineering design.

“You don't want diversity just for the sake of diversity. Don't want them just for the sake of having them in the room. You want them for their perspective. And that is so key to design, which is the fundamental perspective of what engineering is. We design stuff. And the more perspectives we have, the better the design will be. So achieving a diversity of thought is critical for us as a discipline.”

LEAL'S CAREER GRANT: RESEARCH IN SOFT MATERIALS, GLAM-MID CAMP FOR GIRLS, WORKSHOP FOR INCARCERATED ADULTS

April 24, 2017

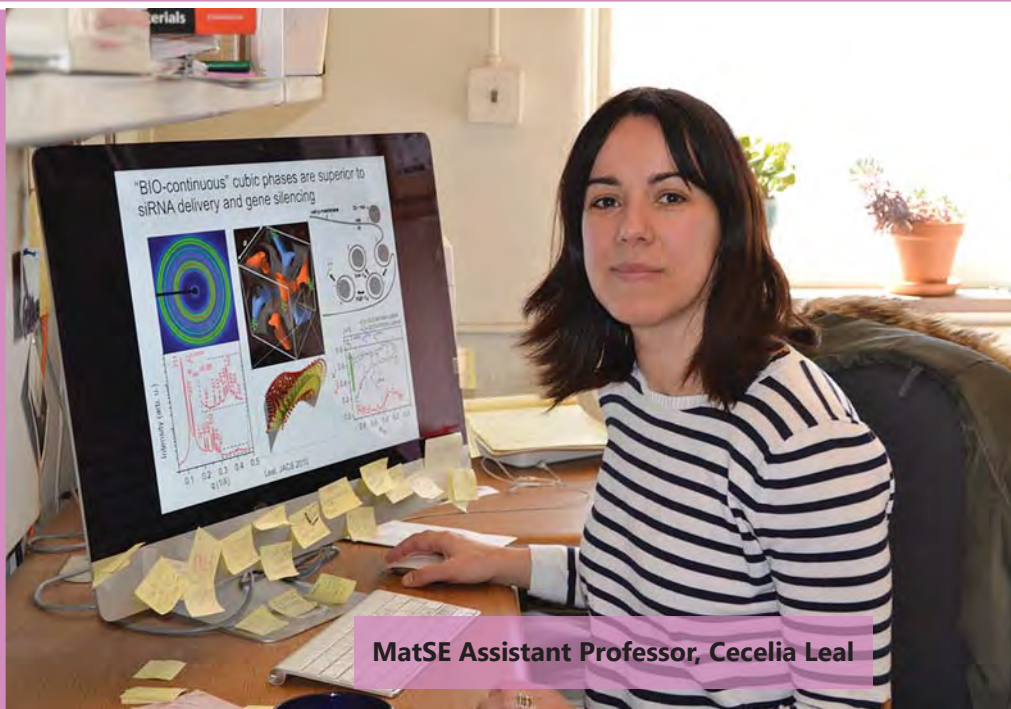
Cecelia Leal, an Assistant Professor in Materials Science and Engineering (MatSE), was recently awarded a 5-year National Science Foundation Grant called, "CAREER: Nanostructured Soft Substrates for Responsive Bioactive Coatings," to study key fundamental properties of biocompatible lipid materials. Because Career grants also require researchers to do an educational outreach component, in addition to the graduate students she'll be training and mentoring, Leal will be doing a new summer camp for middle school girls and a workshop for incarcerated individuals as part of the Education Justice Project.

Leal's Research

Leal's research is in soft materials.

"I'm interested in studying the way that materials self-organize, or come together, to form a structure, how the geometry and how the properties of that structure affect the way they function." Many of the materials she works with are biological, such as lipid membranes, which mimic a cell membrane, and nucleic acids. "So basically we are trying to understand how the structure of these materials, when we put them together in a test tube, how it affects the way they function when we use them in a biological application."

Leal says one starts seeing especially interesting behavior of these materials at the nanoscale. "So these materials, if you look at them at the macro scale, or what you can see with your eye, they don't look anything interesting, but when you start going



MatSE Assistant Professor, Cecelia Leal

down into the smaller and smaller sizes, you start seeing that they organize in spectacular structures, pretty much like what happens in biology. So there's this magic range from micro scale to nanoscale where you see beautiful structures that actually have a meaning to them, and we're trying to uncover what that meaning is."

One practical application of her research would be to transport medicines, drugs, vaccines, antibiotics, etc., by designing smart materials able to interface with the human body to heal wounds, repair bones, plus "deliver medicine by a remotely programmable delivery system with the desired drug load at the correct location and predetermined time point."

While some research on campus uses real viruses as a delivery system, Leal doesn't, but uses materials that emulate viral properties. She takes materials similar to those in cell membranes, then makes "materials or particles that are pretty much like a virus; they can contain DNA inside," she explains, "and the idea is to use these materials or these nanoparticles to go from the outside of the cell to the inside of the cell and deliver cargo." These nanoparticles could be designed to respond to a certain stimulus—an increase in temperature or a magnetic or electric field—by opening up to release cargo. "In essence, you could say this



Leal at work in her MatSE Lab.

is nano-machine that we are operating from the outside.”

Although the nanoparticles don’t have a biological cell membrane, some lipids they use are compatible with biological and, in fact, actually do exist in the cell membrane too. While hers is a “very simplified membrane mimetic system” (a cell membrane has hundreds of different lipid categories; she uses three), they are compatible. The cell membrane recognizes them and says, “You’re okay, please come in!”

Leal calls her work “fundamental,” in the sense that it’s very far removed from the actual clinical application or translation. “There’s a lot to do before that. So my work is really understanding those first steps.”

In fact, she claims there’s even a need to understand particles or materials that are in use right now, for example, Doxil an FDA-approved product that’s been on the market for 20 years and is used in certain types of cancer treatment. Like the materials she uses, it’s a nanoparticle similar to a cell membrane that attaches to cancer cells and releases the cancer drug that’s inside. So “it works,” she says, “but there’s so much we don’t understand still about that system. What is exactly

happening at the molecular level? What are the exact mechanisms at which these particles approach a cell and make their way in? And sure, you found something that works, but it doesn’t work for everything, but if you know exactly how it works, then you could possibly design something that works for many things.”

So Leal’s work is, “Not so much pushing to offer yet another product in the market, but trying to understand the fundamental properties of these particles and how they work in the human body... I’m very far from offering a real medicine, but that doesn’t mean it’s less important.”

Mid-GLAM

In addition to the research, another key aspect of a Career grant is educational outreach. So Leal chose to do something she’s passionate about: outreach to girls. With the help of colleague Robert Maass, this summer, she’s launching a day camp for middle school girls. Called Mid-GLAM, it’s patterned after its GAMES counterpart for high school girls, GLAM (Girls Learning About Materials). And like its name (part of which it borrowed from its older sibling), the camp will similarly address Materials Science. However, unlike its big sister, Mid-GLAM will not be a residential camp, but a day camp, and will, thus, draw only from local clientele. For Mid-GLAM’s inaugural run, Leal is partnering with Campus Middle School for Girls, and already has 15 girls signed up, with attendance to be capped at 20.

One reason Leal chose to do a GAMES camp was so she wouldn’t have to reinvent the wheel.

"I wanted to basically build on efforts that were already in place at the university. I didn't want to start anything completely new. So I went to an information session organized by the college on the outreach activities our campus is running and how I could tag along in some of those."

So Leal and Mass will have some help in running the camp. Under the GAMES (Girls umbrella, they’ll have help from Sahid Rosado and her team that oversees GAMES; plus Illinois grad students will help in developing the curriculum for the camp; and undergraduate students to help run it.

While Leal's research is keeping her busy, she's still finding time for outreach because she's committed to inspiring girls, especially, to pursue STEM; she hopes to inspire confidence, to deliver the message, "We can do this. We can do math; we can do science, right?"

The need for this message to girls flies in the face of the social paradigms that appear to be instilled in youngsters at a very young age. Leal shares an extremely apropos anecdote about a recent demonstration she did at her daughter's preschool class:

"This happened. This is a true story. When I gave my little crystallization experiment for the class of my four year old—this is a true story—a four-year-old boy, beautiful, sweet little boy had a question after I did my demonstration. He said, "So you are a scientist?" and I said, "Yes." And he said, "Don't you have to be a boy, first?" (This is true story. This happened two weeks ago.) And I said, "No, you can be a boy and be a scientist. You can be a girl and be a scientist. You can be whatever you want and be a scientist; it's fine!" And then he asked, "Can I be a superhero and a scientist?" and I said, "You sure can!" And then they asked me, "Can I be a princess and a scientist?" "Of course" And then my daughter said, "Yes, you are a Mommy and a scientist," and I was like, "That's right, I'm a Mommy and a scientist."

Based on that interaction, Leal believes it's never too early to start encouraging little girls that they too can be scientists. "So yeah, I'm very passionate about that. I think females you need to encourage from early on, 'It's possible; we can do this; we can be scientists; we can be parents; we can do anything. If you're curious, and if you're hardworking, your gender shouldn't be in the way.'"

Another outreach effort that's up and running that Leal

has gotten involved with is the Education Justice Project, a program designed to offer college-level courses to incarcerated students in order to promote the positive impacts of higher education. However, it's quite different from her outreach to middle school girls.

"For the Education Justice Project, it's a different goal," Leal explains. "These are adults who have been incarcerated and have an interest in learning." Right now, the program offers courses in many different fields such as robotics, programming, physics, and mathematics. Leal's goal is to soon establish a four-credit hour Material Science and Engineering course. "We started by offering workshops where basically I go to Danville, and I spend three hours with the students, and we discuss."

Leal is hoping that in her last two years of her career project, she will be in a position to offer a full course. Although hands-on activities are difficult to do because of regulations, she still finds a way to keep the students interested and engaged. Leal says that she "just brought paper and we have old-school class where there's only a blackboard. It worked out great actually. They were very engaged." She gives the students exercises and problems for them to solve about different topics, such as how DNA can store information. "We go over the math on the board, so it's more interactive in that way."



Leal discusses the properties of one of the materials she's researching.

Recent Illinois engineering graduate Lara Flasch gets a graduation photo by the Quintessential Engineer. (Image courtesy of Michelle Rice.)



PIONEERING

INNOVATIVE

PASSIONATE

NEW FEMALE ENGINEER STATUE TO INSPIRE WOMEN—PAST, PRESENT, AND FUTURE—TO EMBRACE ENGINEERING

May 30, 2017

Confident. Passionate. Intelligent. Courageous. Innovative. Resilient. Pioneering. Successful. Inspirational. These character traits describing Illinois' women engineers are emblazoned on the platforms which support the Quintessential Engineer, Illinois' newest statue: a female engineer. Unveiled on April 28, 2017, the statue, located just east of MNTL, was four years in the making. While Engineering grad student Sakshi Srivastava is quick to credit Texas Instruments, artist Julie Roblatt Amrany, and the many folks across campus who helped to bring it about, it was Srivastava who first dreamed of a statue to serve as a role model for young women. And it was Srivastava's courage, confidence, and determination (plus a little help from her friends) that helped that dream become a reality.

Why did Srivastava decide we needed a statue of a woman engineer on campus?

"I think it is nothing new when it comes to seeing how few women are enrolled in the College of Engineering...I think even in general in the STEM fields the numbers are not very good," Srivastava explains.

ECE graduate student Sakshi Srivastava, by the Quintessential Engineer.



She recalls writing a paper her freshman year on the underrepresentation of women in the science community. One of the things she discovered was that

“Women don’t have many role models, hence young girls don’t see themselves as being in the STEM fields,” she says. “That could be a reason that holds them back from moving forward or considering STEM as a possible career choice. I think the statue can help young women see themselves in engineering, and that was the motivation behind why we should get the statue.”

A shortage of female role models was never an issue for Srivastava. As a little girl in India, she had some great ones. Her mom was a doctor. Her sister was an engineer. Also, she attended an all-girls school. “So I think I always had women to look up to, and I never had that issue of not having role models in my life.”

Srivastava, who got her undergrad degree in ECE (Electrical and Computer Engineering) at Illinois, and is currently working on a Master’s in ECE, got the idea of doing a statue four years ago—the summer after her sophomore year. She said to herself, “Let’s do something. Let’s do something...Oh, let’s get a statue!”

So in July of 2013, she started the ball rolling. She sent Dean Susan Larson an email, asking about the possibility of having a statue of a woman engineer on campus.

“We were like, ‘Yea, that’s great,’ recalls Angie Wolters, Associate Director for Women in Engineering. ‘How would we do this?’ So the conversations ensued.”

The idea initially was to do a statue near the new ECE Building, but decisions regarding art had already been made. So Srivastava started an online petition to see if there would be support.

Next she met with student senator, Josh Baalman, and calls that, “one of the big steps, because after that, once the Student Senate endorsed it, we went to the Academy Senate, and they sent a resolution to dean.”

Srivastava and Wolters stress that they didn’t bring the statue about all alone. They had a lot of help.



Two local girls meet the Quintessential Engineer.

For instance, a student committee, comprised of representatives from a diverse group of engineering student organizations helped make many of the decisions about the statue.

One key decision, according to Srivastava, was to define a target audience.

“While the statue is definitely for our current students and graduating students (many of them took a picture with the statue this graduation), at the same time, the statue is also for young girls who come to EOH. I think that is very important to me, to not only promote women currently in engineering for retention purposes, but also to get young women excited about engineering and the possibility of changing or shaping the future.”

Another important decision was what the statue should look like. Questions for debate included: “What should she look like? What feel do we want her to have? We agreed that there should be movement, and she should look empowered and dynamic,” Wolters says, and that all decisions—how she might be built, what she might resemble, attributes, what she would wear, where she would be located—were student driven.

“The student committee helped drive the vision of how she would appear,” Wolters says. “The fact that she is wearing pants vs. a skirt. What she's doing: she's in motion. You'll see that she's crafted from the bottom up. There are some circuit boards and books that form from her leg; it's like her base of knowledge. That's her past knowledge, her base, and it forms her into the person that she currently is. And she's reaching forward to the future, creating from her finger tips on a plasma screen, where she's creating the future. So her foundation builds her up to then create the future. That was part of the sentiment that came from our discussions with the committee, and then the artist.”

““The artist, Julie Amrany. Julie did a fantastic job,” says Srivastava. What was really striking for me was the books forming part of her leg, which was Julie's creation. I truly believe that you can't change the future without knowledge.”

According to Srivastava, the committee wrestled with “How would she look as an engineer? How to make her inspiring, empowering, and confident, and someone that young women can look up to and that older women can see themselves in.”

Srivastava says the committee also wrestled with what to put on the base of three hexagons. “Equations? What should symbolize women in engineering, and what would be fundamental to us? Again, it was the student committee that said, ‘Why don't we put words there?’

So the committee came up with the nine words.

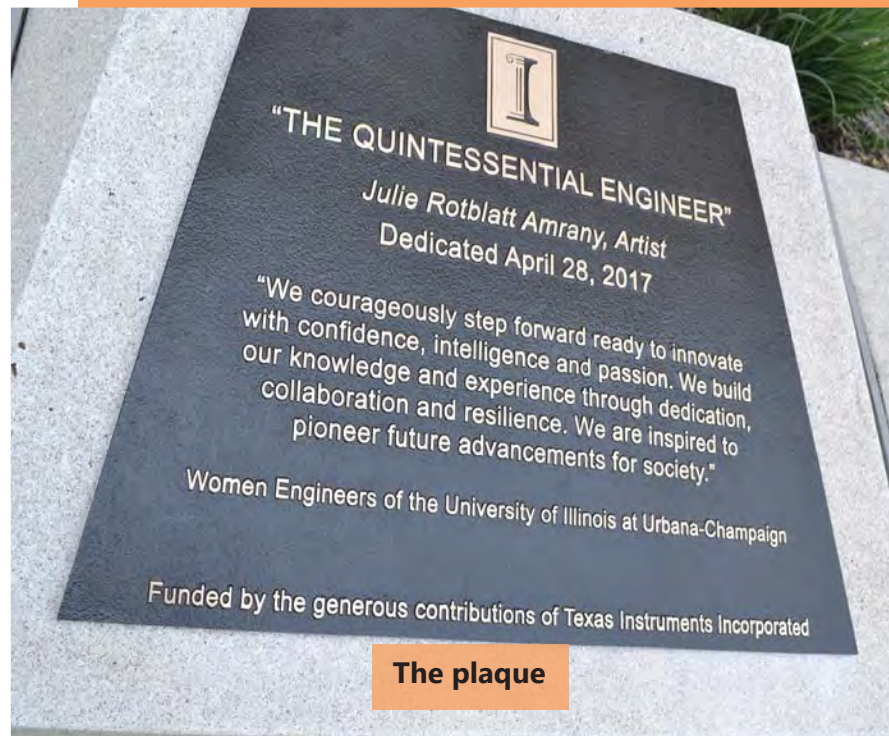
“Each hexagon has three words, and it follows the journey of an engineer—how first you need to be confident and passionate, and intelligent to be an engineer. Then the second step is that you innovate. Eventually you become successful, inspirational. And you find

resilience, because you've failed too... “Which is super cool. Because how I interpret that is you need knowledge and you need excellent character,” she explains.

And behind the statue is a plaque (see image below) which echoes the character traits on the statue.

Where's the statue located? They found the perfect spot: a brick alcove just east of the Micro Nano Technology Lab on Bardeen Quad, which had been crying out for something since a previous renovation. “It was meant to be,” Srivastava exults, “because that little alcove was already there. It's so beautiful.”

Key in procuring the statue was the Administrative Committee. Led by John Kelly, an Engineering Advancement Officer, it was comprised of folks from across campus, such as those from Facilities and Services in charge of art and architecture.



The plaque

Wolters calls this type of ‘grass-roots’ initiative a unique situation, so this committee was key: “There really aren't that many projects like this that happen on campus, where you're just starting from scratch...So we were kind of in uncharted territory. A lot of work was done by the Administrative Committee.”

In choosing who should make the statue, the committee had to look no further than upstate sculptor Julie Roblatt Amrany, who, along with her husband, created the famous statue of Michael Jordan at Chicago's United Center. Wolters commends the committees' decision to hire Amrany, calling it "the perfect choice. We have a female artist, who is a woman, who is very passionate about the STEM fields."

However, in the four years it took to make the statue a reality, it wasn't always smooth sailing. For example, there was pushback: people with whom they interacted—and not just men—couldn't see the need.

"Sometimes when people come from a place of privilege, like me, having a role model throughout," Srivastava says, "it is difficult to see how other women do not have that privilege. I think that could have been a reason why certain people couldn't see the point of the statue."

Wise beyond her years, Srivastava says they drew upon negative feedback to strengthen their argument: "Because I think the best way to pacify your critics is to actually listen to them."

While she admits that even when the feedback was "really hard to read through because it's rude or it's harsh, or just mean, there could be something that would help us make our argument robust, so that if someone else asks that question, then we're prepared."

Her motto was, "It's your choice how you use it, and I think how I tried to use it was to be like, 'Ok, thank you. That was helpful. Ha! Now my argument is stronger.'"

So Srivastava considered the feedback, because while the idea for the statue originated with her, she doesn't claim ownership of it.

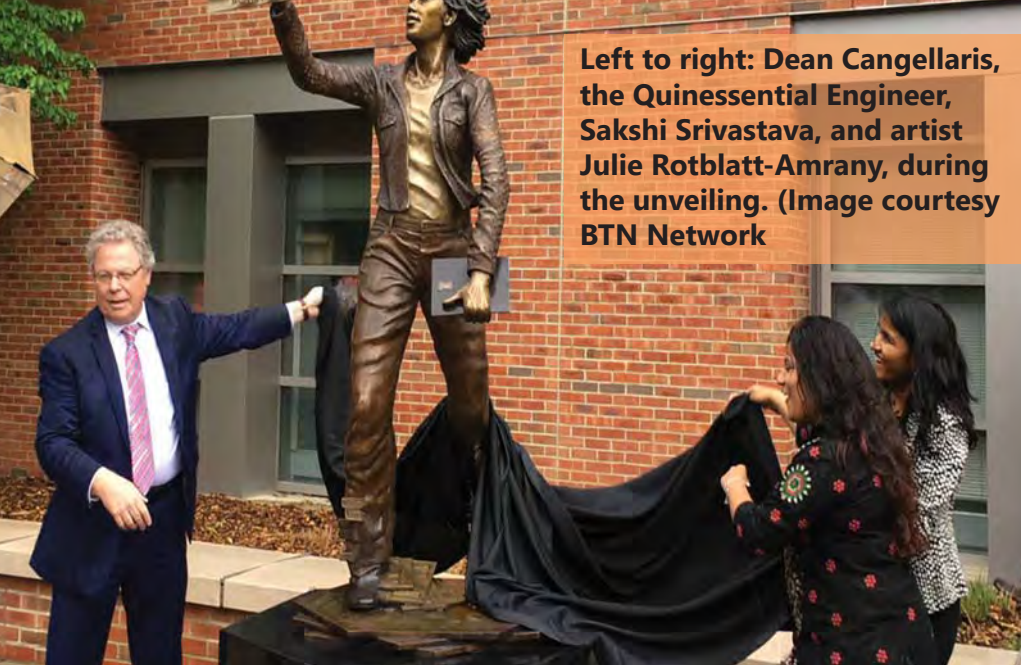
"Because everybody has their opinion, and this is a student project. This is not my statue. It is not Angie's statue. It is not even Women in Engineering's statue. It is our statue. It is the students' statue."

One sentiment they had to address was related to Grainger Bob. In fact, this reporter, at least a year or more ago, had heard the rumor that Bob was getting a girlfriend—there was to be a female counterpart.

Srivastava rejects that notion: "While it's easy to think of the statue as a counterpart—the word has been used a couple of times, the idea is that it was never meant to be there because of Bob, even though there might have been times when people might have talked about it as a counterpart."



Four Illinois engineering grads get a photo with the Quintessential Engineer during the May 2017 graduation. (Image courtesy of Michelle Rice.)



Left to right: Dean Cangellaris, the Quinessential Engineer, Sakshi Srivastava, and artist Julie Rotblatt-Amrany, during the unveiling. (Image courtesy BTN Network)

"It's easy even for Angie and I to do that," Srivastava admits, "and we have thought of it in terms of, 'People can take pictures with her the way they take them with Bob.' But it was never the motivation behind it, and it's very important to draw the difference between the two...It is only from the point of view of giving people a hook, but not with the intention of saying that's our motivation. It was always about, 'We need more women in engineering.'"

But while they encountered pushback, they also got lots of support. Says Srivastava,

While the two admit that it's easy to draw the comparison and say, 'Oh, this is our rebuttal to Bob,' Wolters says, "It isn't necessarily the true sentiment of the message that we want going forward. It's more about the inspiration."

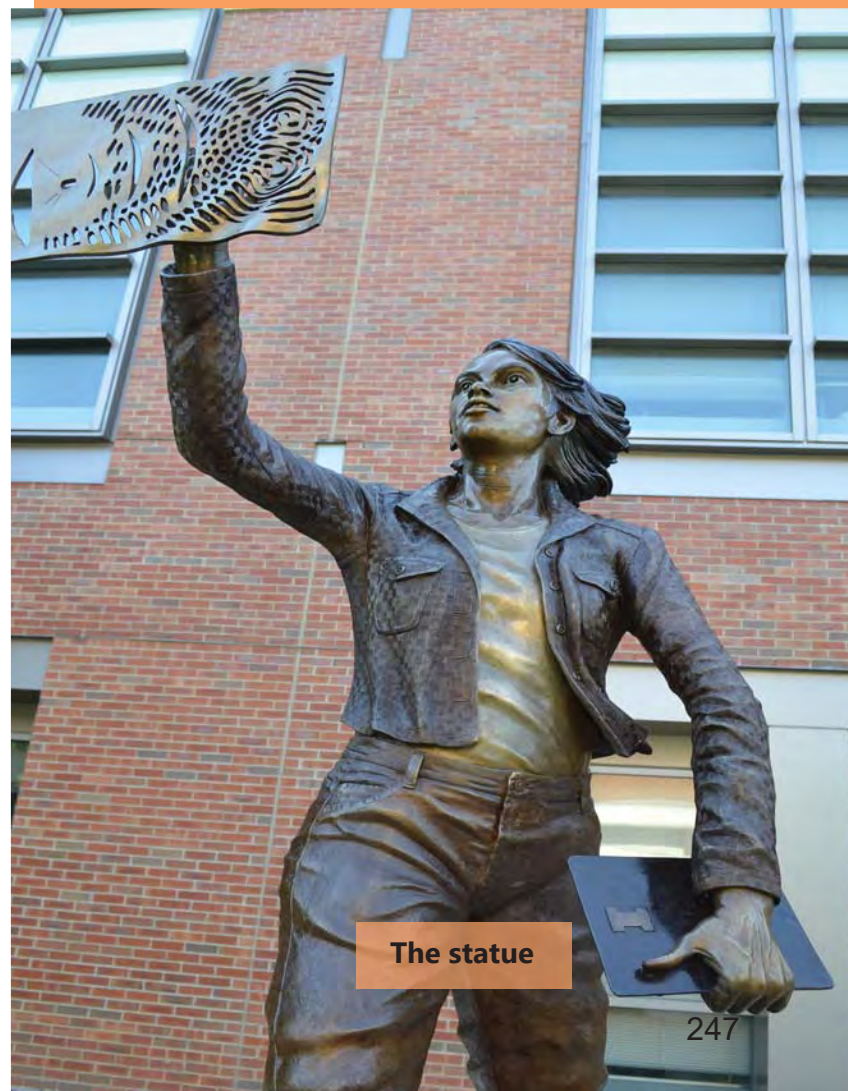
Wolters envisions that the statue will serve as a multi-generational nexus, providing the opportunity to:

"Sometimes it's easy to focus on the negative things, but what kept us going was knowing that there was support...It wasn't just negative comments. There were people, and there were women and men who were willing to help us get the statue."

"Recognize the alums that came before us that worked so hard to achieve their goals, and now they're out making differences using their engineering skills to make the world a better place. And then we have our current students here feeling supported and that this community is one in which they belong and can achieve in. And that the younger students as they visit, like Sakshi said, for EOH, or they're here during summer camps, that they see themselves represented in a way that they can identify with and be inspired from. So that's her value."

To people who asked, "'Is it because of Bob?' Srivastava says, "Then I was like, 'No, it's because we don't have women.'"

Another issue that cropped up to muddy the waters as to their motivation behind the statue was that it was a comparative hook, another statue to take pictures with, like how students take pictures with Bob and Alma Mater during graduation.



The statue

Along with the many women and men on campus who helped make the statue a reality, both Wolters and Srivastava have high praise for Texas Instruments, who provided the funding.

"In my remarks at the dedication," Wolters recalls, "I specifically said that other corporations could look at Texas Instruments as an example of the type of corporation that gives of their time, talent, and treasures to truly support diversity efforts."

She goes on to cite Women in Engineering activities Texas Instruments has funded to increase recruitment of women: freshmen orientations, technical workshops, professional development luncheons for students.

"At the statue dedication," she continues, they provided an announcement of scholarships for ten women in electrical and computer engineering, and then of course the statue. So they have truly shared of their resources in a way to make a difference in the diversity of our engineering population...They care about this pipeline of students finding their way into these disciplines of electrical engineering," adds Wolters. "They've truly shared and championed efforts that a lot of companies speak of, but they've given."

Srivastava also applauds Texas Instruments, whom, she says "genuinely cares about 50% of the world that tends to get ignored."

How rewarding was it for Srivastava to see her dream finally become a reality? "I feel blessed," she admits. "I don't know if there are other schools in the world where you can do this with one idea, one student starting it, but I felt blessed to be surrounded with people in a school where student voices truly matter and people are willing to put their time in making something like this happen. Angie, Dean Renee, and Dean Larson have been a part of it from almost the very first day, and after that we had student senators. It brought north of Green and south of Green together, in a way."

She commends the people on campus who helped, Dean Cangellaris, Professor Sanders, members of the administrative committee, calling them:

"People who would listen to you when you have something to say. They are all busy people. For me it was amazing that this thought in my head, this idea, was actually being considered and people were putting their heart into this."

Her greatest reward, of course—seeing young women interact with the statue: "Nothing is like seeing young women taking a picture with that statue. I cannot wait for EOH or summer camps to happen because those pictures are going to be nice." A final anecdote: It was raining really hard the day the statue was unveiled. According to Wolters, "Dean Cangellaris said, 'The statue's right out there. I'm not going to unveil a picture of the statue...No matter what, we're going out there!' And it was pouring! It was raining really hard." So, many female engineers at the dedication, including Srivastava and Wolters, trooped out to unveil Quin, despite the deluge—a perfect example of their courage and resilience in the face of a storm.

But whether they opted to get soaked or not, for women engineers who attended the dedication, it was an emotional moment. "There were lots of people that teared up," Wolters reports. "Some of our women faculty, Cinda Heeren in CS, she teared up. I did, Dean Larson did. There's a lot of power to her presence."



LOCAL MIDDLE SCHOOL GIRLS LEARN ALL ABOUT MATERIALS AT NEW MID-GLAM DAY CAMP

July 7, 2017

From playing with Oobleck, the non-Newtonian fluid made famous by Dr. Seuss (fun but quite messy), to making (and tasting!) chocolate ice cream frozen with liquid nitrogen, 20 local middle school girls not only had a good time at the first-ever Mid-GLAM camp held June 26–July 1. According to the camp's co-directors, Materials Science and Engineering (MatSE) Assistant Professors Cecelia Leal and Robert Maass, the plan was that while the girls learned some things about materials science, their participation in the camp might also pique their interest in science, or even plant the seed that they too could be materials scientists.

Patterned after its older sister, GLAM (Girls Learn About Materials), a GAMES camp for high schoolers, Mid-GLAM not only similarly addressed materials engineering via engaging, hands-on activities, but borrowed part of its name from its older sibling. However, while GLAM is a residential camp for high school girls from around the state, Mid GLAM is a day camp for middle school students, and, for its maiden voyage, served only local students from the Campus Middle School for Girls.



A camper enjoying her time at Mid-GLAM.

Regarding the overall emphasis of their camp, Leal describes it in this way:

“There’s a future out there, and as a material scientist, you want to know what that future will be made of. What will cars be made of? What will medicines be made of? What will our clothes be made of? What will our cell phones be made of? So as a material scientist, you are very interested in stuff, what it’s made of, and how you can make it better.”



Leal (center) and a team of campers celebrate when their LED, powered by the eco-friendly battery they made, lights up.

So that was the overarching theme of this summer’s camp—how to make stuff better. Specifically, the topics were: Making Stuff Stronger, Making Stuff Smarter... Smaller... Cleaner...and Tastier. Activities were related to what materials engineers do to make things better in the real world, which perfectly meshes with Maass's teaching philosophy.

"As an engineer, I think we should teach about what that means in our real world. So for me, it's always sort of this bridge between the discussion of something that you can basically hold in your hand and something that we can pull out from a book. This is probably one of the essences, or key factors, or cornerstones of my teaching philosophy."

Maass emphasizes that their teaching style for the middle-schoolers was "Not a lecture! Because a lecture at that age is not going to fly. I mean that's just going to be super boring; basically they need to be involved." Thus, Maass and Leal used interactive demos.

Each day's agenda also included videos and hands-on activities about the main subject they were addressing that day. Then, each afternoon, the girls did a design challenge, where they were encouraged to "do hands-on—do something on their own." These also involved making stuff better, as they were challenged to make things stronger... safer... faster... colder...and wilder!

To accomplish all of the different activities, Leal and Maass recruited some helpers: a grad student from each of their labs, plus a couple of summer un-



Leal stirs the ice cream concoction while the Mid-GLAM campers eagerly watch.

dergrads from the department. And while the team designed some activities themselves, or expanded on things they'd been exposed to before, some were designed by the Materials Research Society and the National Science Foundation. Maass also reports that they left nothing to chance. They did trial runs of all the activities— testing them out in the lab to make sure they would work and to determine how much time they would take...all except the liquid nitrogen ice cream. They gambled on that activity...but got it down cold (this reporter got a spoonful!).

On Saturday, at an end-of-the-camp poster session, teams of girls presented the posters they'd created to show parents a bit about what they'd learned that week.

Why did Leal and Maass decide to create a new day camp for middle school girls? While they needed to do some sort of activity to fulfill the required outreach component for the National Science Foundation Career grants both received this past year, both were intrigued by the idea of doing an outreach to a younger age group—middle school students—in hopes of possibly impacting their career trajectories toward science—and possibly materials science, of course.

While Maass' general goal was to "reach out to the public and to help to promote fundamental science out there among the non-scientific community," he also wanted to reach out to youngsters at a more impressionable age.



A MatSE Ph.D. student helping with the camp (right) watches as Mid-GLAM campers light up an LED light with the power produced by the battery the team made.

“So I wanted to target groups where I felt that it could be useful—where it can affect younger people's lives towards a certain direction.”

In fact, Maass believes it's never too early to start exposing kids to STEM. “I like the idea of going down on the age bracket. I think it is easier to influence directions in young people when they are a little bit younger—they can't be too young, I believe—so middle school, absolutely.”

Leal agrees about impacting girls at a young age: “I'm very passionate about that. I think females, you need to encourage from early on. ‘It's possible; we can do this; we can be scientists...we can do anything.’”



Mid-GLAM campers play with oobleck.

Also, both had the idea of doing something new, but not reinventing the wheel. For instance, Maass didn't want to “start something new that is not embedded in the machinery of the university somehow, because then you do it and then it's dead, finished, because you're going to move on...That's a lot of energy that will be lost.”

Similarly, Leal hoped to take advantage of already-existing campus programs. “I didn't want to start anything completely new, so I went to an information session organized by the College on the sort of outreach activities our campus is running and how I could tag along in some of those.”

When she heard about GAMES, she thought: “This is a perfect opportunity where I'm not starting something new. GAMES is already in place. There's a lot of infrastructure already for that, except now we are offering activities that are more suitable for 6–12 year olds.”

Leal's vision for these middle schoolers is that they “develop an appreciation and a curiosity for what material science is and the problems that it addresses.”

She goes on to explain that materials scientists address problems in making materials for medicine (her research), making better batteries, and making materials that can withstand extreme conditions like turbines on an airplane.

“So this camp is devoted to that; it's to spark that curiosity and that interest for material science as a whole.” According to Leal, their plan was to “touch on these different classes of material—very simple, very hands on.”



A Mid-GLAM makes an LED light light up by immersing copper in salt water.

Should they include some activities about the materials they research? While Maass felt that Leal's work with soft materials or bio-materials would be adaptable to activities, he wasn't sure about the suitability of his. "I'm on the completely different end," he explains. "I do metals. I was a little bit hesitant. How fun can it be for young kids, especially girls, to work with metals? How interesting is that to them?"

In fact, he reports being "a little bit scared that it would be a complete disaster. I wasn't sure that would fly—a piece of steel!" So he decided to do a trial run. He contacted Leanne Cunningham, the Communications and Outreach Director at the Campus Middle School for Girls, begging her, "Let them come and visit."

How'd the visit go? It went so well that the girls didn't want to leave.

"They came and visited me, actually, a class, here, in my lab, and we had a whole bunch of little experiments, and they really liked it, so we had to cut it off. We all took too much time, because they asked so many questions, which encouraged me."

And Maass liked the interaction so much that he agreed to do it for a whole week in the summer. "I was impressed by the intellectual capability of the girls [who] were here in my lab...That was fun, and this really motivated me to a part of this middle school range bracket," he admits.

However, Maass calls distilling his metals research down to a level middle-school students can understand "a bit of a challenge."

"Probably we're going to be less sophisticated than with the high school level...How much can you stretch in order to still convey a correct scientific picture, but without being too complicated. But again, the little test I had with this class here worked out fine, and I really liked that."


Maass's teaching style fit right in with the middle school students. He indicates that it involves getting feedback from his students, and reports that when he gives a lecture, "I always bring demo stuff. So something fun."

He also seeks to foster dialogue with his students, something he employed with the middle schoolers. "I don't give lectures where I just 'Blah, blah, blah.' I do a lot of questions, back and forth."

Although the first year is barely in the books, Leal is already making plans for the future: "We start just with one school as a pilot study in the first year, the first iteration of the camp, and then next year we are going to offer two more schools, but what we are going to do is that we are going to always make it local. We don't want to have overnight."



Maass and Leal kid around with the two robotic hands they created.



One Mid-GLAM camper adds chocolate to their liquid nitrogen ice cream mixture while another stirs.

GIRLS HAVE FUN WITH CHEMISTRY AT THE WCC GIRLS DAY CAMP, BONDING WITH CHEMISTRY

July 13, 2017

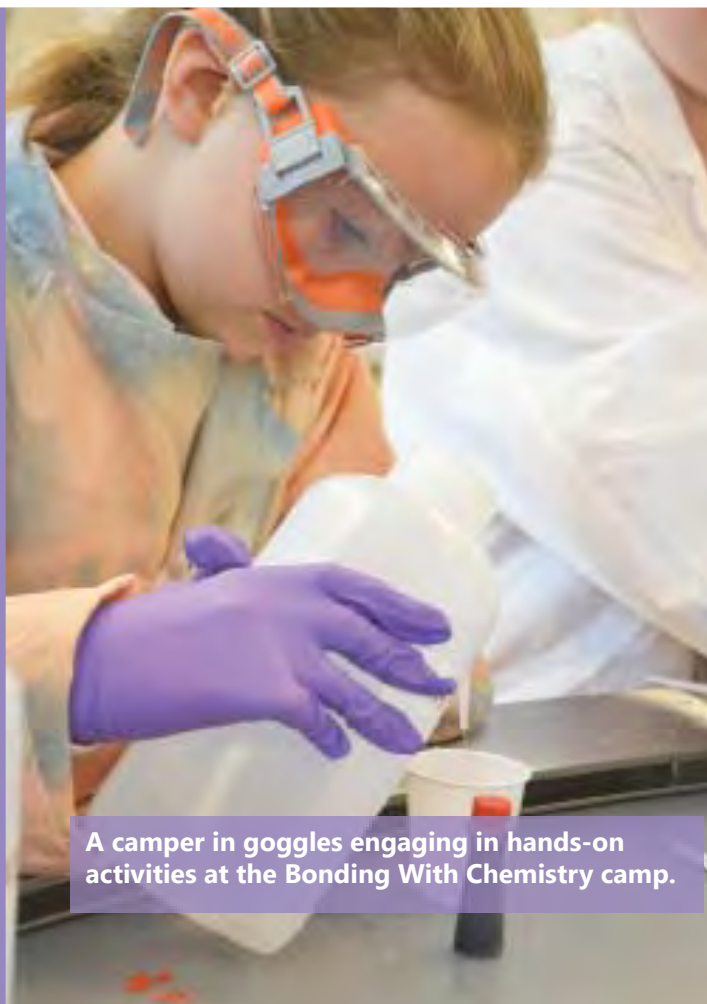
This summer, the 10th annual WCC Girls Day Camp, Bonding With Chemistry, brought 90 rising 6th–8th grade girls to campus to do as its name suggests... bond with chemistry. Held at the Chemistry Annex from 9:00 am to 3:30 pm on both June 24th and July 8th, the day camp provided hands-on, chemistry-related activities for the 45 students who participated each Saturday.

The outreach was sponsored by the Women Chemists Committee (WCC) of the local chapter of the American Chemical Society. The WCC is comprised of 50–100 women (and men) who are interested in attracting, developing, promoting, and advocating for women in the chemical sciences. Funding for the camp was provided by the East Central Illinois American Chemical Society (ECI-ACS), and the Chemical Biology Interface (CBI).

Heading up this summer's event were Michaela Carlson, a 4th year Chemistry graduate student, who was in her 3rd year helping with the event, and fellow Co-Chair Courtney Ford, also a 4th year grad student helping with the outreach for the 2nd year.

Here's one indicator of how fun and engaging the camp is: some of the girls who have taken the camp in previous years came back again this year. According to the co-chairs, about 20% of the participants had attended the camp before.

While having repeat attenders is rewarding, it also makes for more work, since the camp volunteers



A camper in goggles engaging in hands-on activities at the Bonding With Chemistry camp.

must come up with brand new, hands-on activities. "We have new designs each year because we get a lot of repeats," Carlson indicates, "so we want them to learn new things."

Did any of the activities they planned involve blowing things up? "No," Carlson indicates, laughing, "at least not planned." But students did get to see some fire. As they were arriving, to get them in the mood, several Illinois chemistry grad students presented fun and engaging demonstrations—some involving fire, of course.

For most of the day, the girls rotated between five stations, spending about 45 minutes at each. One station during which the girls expressed their individual creativity was Tie-Dye Chromatography (the

one station they repeat every year), during which the girls tie-dyed camp t-shirts and a tie-dyed a flower to take home. Other stations were: Cosmetic Chemistry, where the girls made cosmetics such as lip balm, sun screen, etc.; the Chemistry of Macromolecules, Symmetry & Chirality, and Nanochemistry, where the girls suited up in lab coats and goggles and did some lab work.

Also, to ensure that the middle-schoolers have sweet memories of the day, they were rewarded with candy every time they got an answer right during the chemistry game at lunch. Another cool thing about the day? The girls got some liquid nitrogen ice cream just before they went home.

In addition to Carlson and Ford, numerous chemistry grad students volunteered, based on the amount of time they could contribute to the project. Some were involved months ahead of time, planning the stations; designing and ordering

A camper expresses creativity at the camp.



the t-shirts; compiling the experiments into a lab notebook the could students use, then take home. Some volunteers who couldn't invest as much time, but still wanted to be involved, helped on the day of the event with the stations, which generally needed 3–5 folks in addition to those who planned them.

Ford and Carlson admit that their goal in doing the event is to target younger girls and get them interested in STEM in hopes that they remain interested as they get older.

“People always quote that the time when most girls kind of lose interest in going into STEM fields is right around middle school age,” acknowledges Ford. “So our goal of getting middle school girls to come in and have positive grad student roles models and also do all these fun, exciting hands-on activities is to help continue the interest in science and in chemistry.”

In order to pique and retain the girls' excitement about chemistry even after the camp is over, Carlson indicates that they're also intentional regarding the different components of the day camp—such as the lab notebooks and even the different experiments they choose.

“Yeah, part of the reason we do the lab notebooks is so that they can take that home and repeat some of the experiments as well. So generally we do household items so they'll be able to do that. We also give them goodie bags of fun chemistry



A camper engaging in a demonstration using fire.

talk about the chemistry and the environment, or whatever is going on, that are aimed at middle schoolers.”

She adds that they're also intentional about the cost, in hopes of enabling the underserved to participate: “This camp is completely free for the participants! We provide lunch, and everything is free for them. We really want to draw in as many people as possible, and don't want anyone to be excluded.”

So to recruit from a broad spectrum of participants, the co-chairs contacted 23 middle schools in the area, plus sent out an announcement on the university's e-week listserv. While most of the participants were local, several came from as far away as Chicago.

“This is a great way of getting middle school aged girls interest in science,” Carlson acknowledges, “and continue their interest in science. We try and make it so students can come and take some of these experiments home and show their parents, so that they don't forget about it the day after. So we really want this to be something that they look back on fondly, and by the rate of return we get (we get about 20% come back), obviously we're doing something right.”

Another proof that they're doing something right: Bonding With Chemistry is, after all, in its 10th year. But how about when this reporter's granddaughter gets old enough to participate in the camp in two years? “It will still be going on,” Carlson avows.

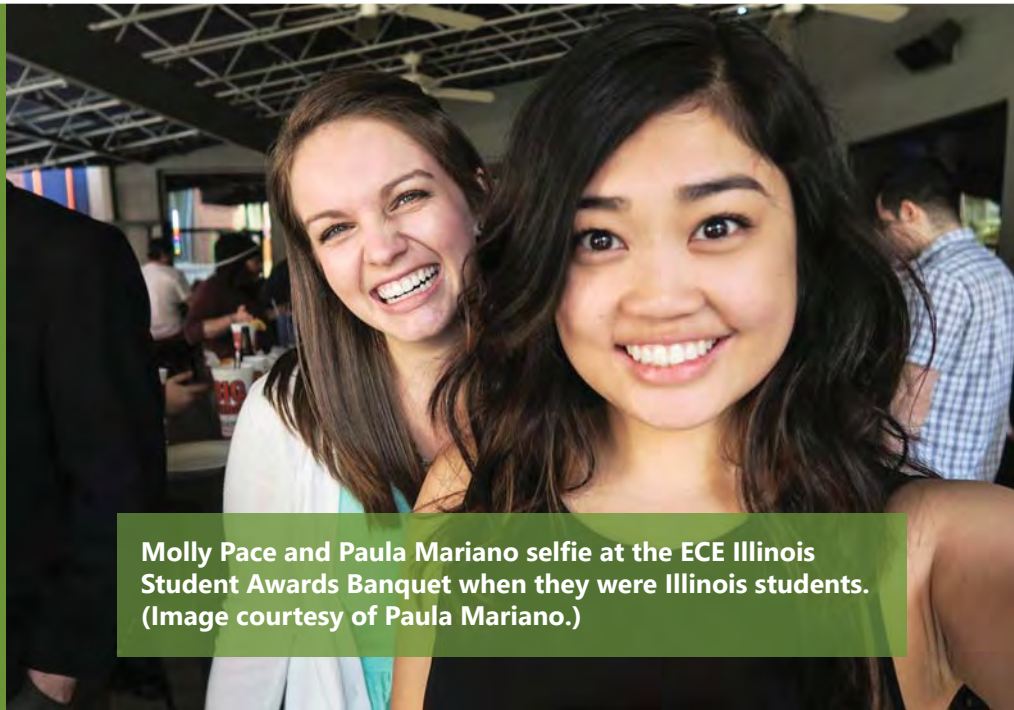


Graduate students helping campers with different camp activities.

MARIANO & PACE ENCOURAGE FEMALE ENGINEERING STUDENTS: "YOU TOO CAN SUCCEED!"

August 29, 2017

On August 22–24, two rising stars at Texas Instruments (TI) were back at their Alma Mater for the Women in Engineering (WIE) Freshman Orientation, an event designed to give incoming female engineering students a jump start on their semester and community building. Since one of the program's objectives was for older and wiser women to impart wisdom to the rookies, these two recent (May, 2016) ECE (Electrical and Computer Engineering) graduates, Paula-Angela Mariano and Molly Pace, were the Keynote Speakers for the event, plus taught a workshop related to internships with TI. The two were on hand to share not only about their triumphs, but their somewhat rocky beginnings; to recommend resources that helped them overcome challenges they encountered; and to pass on some sage advice about how to not just survive but thrive at Illinois. Their main goal? To encourage their younger sisters that they, too, would someday be proud Engineering graduates.



Molly Pace and Paula Mariano selfie at the ECE Illinois Student Awards Banquet when they were Illinois students. (Image courtesy of Paula Mariano.)

While both ladies are currently very passionate about electrical engineering, it wasn't necessarily love at first sight. For example, Mariano ended up in ECE via a rather circuitous route. Admitted to Illinois' Department of Nuclear Engineering, she discovered early on that she had chosen the wrong discipline. "After the first semester, I wasn't really feeling it," she acknowledges. So during her second semester, she explored her options to transfer to a different engineering field.

Proactive about finding her niche, she started sitting in on other lectures. The first one she attended was in ECE, and the professor listed different areas of focus one could go into. "One thing I liked about electrical engineering," she reports, "was that it's such a wide discipline, that you could go into different areas and see what better suits you. Maybe at some point I would want to learn a little more in a different area. It's just so wide that I could apply



Paula Mariano and Molly Pace, keynote speakers at this year's WIE Orientation.



Molly Pace and Paula Mariano by a cardboard statue of Illinois alumni, creator of the integrated circuit, and TI great Jack Kilby.



Molly Pace and Paula Mariano presenting their workshop on internships at TI at the recent WIE Orientation.

In high school, Pace hadn't really known that much about electrical engineering besides learning about Ohm's law in physics (it defines the relationships between power, voltage, current, and resistance). But because she liked math and science, she settled on engineering, and it was "up in the air between chemical engineering and bioengineering."

So how'd she end up in ECE? It was sort of a dare. Her sister's boyfriend at the time, who was in ECE, had told her she wouldn't like it, and it would be really tough.

To the implied slight, 'You can't handle it; you're a woman!' she reports, "I was not happy about that; I didn't like that," she continues, "so I was like, 'You know what, I did like Ohm's law. I'm going into ECE!'" So she did, just to prove him wrong. And prove him wrong she did, when in spring of 2016, she graduated with honors from one of the top engineering schools in the country.

And she now works at TI as a failure analysis engineer, using skills she learned in school to pinpoint the electrical and physical failure on TI parts, either from within TI or from their customers. Her job? Find out what went wrong and spread the information so it doesn't happen again.

The two women's tenure at Illinois was not without some pitfalls. For instance, both discovered early on that the degree of effort they had expended in

anything I learned from the U of I into a different area."

Luckily, while auditing those classes, she discovered her passion was electrical engineering.

"After that first lecture, I attended several others during that month, and I started doing the questions that he would ask up on the screen on my own too. Most of those were circuits." She reports beginning to understand those and "kind of getting into problem solving that way. I think that's what first made me interested in electrical engineering." What she does now at Texas Instruments applies that macro circuit knowledge that she learned into the microscopic scale as a Test Engineer.

Paula Mariano and Molly Pace, who are currently roomies as they begin their working careers together at Texas Instruments in Dallas, TX. (image courtesy of Paula Mariano).



high school would no longer suffice, but that they were going to have to diligently apply themselves.

For instance, Pace acknowledges being a bit "cocky" when she showed up on campus, but she soon discovered that operating in her high school M.O. because she used to breeze right through courses, wasn't going to cut it. When the first midterms rolled around, she discovered that she was going to have to change her mindset—and her study habits.

For instance, one lesson she learned early on was that although practice midterms were similar to the homework, the exams would be changed up a lot and not what she expected. "And that's something that you kind of have to get used to. You can't just be, 'Oh, if I'm fine on the practice exam; maybe there's a couple of topics missing, but if it's not on the practice exam, I won't be tested on it,' You most likely still will be!"

So after doing not-so-well on some midterms, Pace panicked, then quickly sought help. First she visited

her major's advising office, then CARE (Center for Academic Resources in Engineering) in Grainger Library, and was able to turn things around by the second midterm. "It was about three to four weeks of really intense work," she reports. After that, she knew how hard she would have to work to succeed.

Mariano went through a similar experience:

"One of the first classes that made me realize this wasn't going to be a day in the park was the introductory class into semiconductor solid state physics," she reports. "I think that I learned that I'm not just going to go along and get straight A's from just attending lectures, but I have to push myself a little further. I think that was a transition from out of high school, that common mentality, 'Oh, yea, I've done this before. I know how to study!'"

Mariano shares how she set about to undergo a paradigm shift: for one, she went to people who were doing well, and asked them, "Hey, is it ok if I sit down next to you while I'm doing my homework and ask you every now and then, whenever I struggle, if I think I'm doing something wrong?" From that point on," she admits, "I felt a little bit more comfortable talking to other people about the questions I had. And then I went on further to talk to TAs, and then professors."

Based on their own experiences, both ladies were quick to offer students advice, citing resources that had helped them thrive at Illinois. For example, one piece of advice offered continually throughout WIE Orientation, and which both ladies echoed, was community—to start working in groups early on. "It's not a one-man show" Pace stresses. "You're going to need help to get through this. Start that early and get used to that kind of collaborative feel."

Mariano agrees: "Be collaborative with your classmates. A lot of you guys could be struggling together, and someone might understand point A, and you understand point B, and together you can make the complete picture."

So both mentioned utilizing various resources that fostered collaboration. For example, Mariano got involved in Women in ECE RSO (registered student organization), "because they understood exactly what I was going through in one of the most male-dominated fields in engineering here, and we



Molly Pace encourages the incoming Illinois freshmen during her keynote presentation at the WIE Orientation opening session.



Pace and Mariano meet the Quintessential Engineer, the new female engineer statue on campus (top right).

needed to be supportive of one another...they were a great community for me to join and be a part of."

Both Pace and Mariano encouraged students that getting into study groups is key.

Mariano made friends and formed a study group early on. In fact, she and the members of her group tried to schedule classes together. But if members of her group weren't interested in taking a class she wanted to take, she saw it as an opportunity to meet new people, build more relationships, and create her own little study group. "I always talked to the people next to me the first couple of classes," she says, with the idea of forming a study group since they would also be working on the same assignments.

Both fostered reciprocal, give-and-take relationships where they and a fellow-student would encourage and hold each other accountable. For

example, Mariano formed a relationship with a girl she met during WIE Orientation who was also taking the ECE introductory class with her, "and we struggled together to get through that," she admits. Although her friend was in industrial engineering, they had some core classes together, and Mariano says she "learned how to tutor her because industrial and electrical have different mindsets, and she helped me in other things as well."

Similarly, Pace recalls "finding a few core friends who were more in the same position as me and ready to really study together." She acknowledges the importance of "having that network to rely on and kind of keep us grounded," then shares a scenario where a friend would be a positive influence on her, saying: "Yea, well, I was going to study," to which she would respond: "Aw, man. She's studying; I'm going to study."

According to Pace, it wasn't just freshman year that had challenges to be overcome. "Every year there was probably something," she admits. "So sophomore year, it was the computer engineering classes that were completely new to me. I've never coded before, or seen code, so getting up to speed was definitely difficult. I'd Google, 'What is a terminal?' And next I had to Google, 'How to open a terminal.' So I was extremely lost at that time, kind of catching up there."

Plus, it didn't help that at that time, she'd had to listen to classmates brag about their experience, and all the apps they'd made, to which she'd reply, "'I don't actually know what you're saying.' So that was tough."

Other pieces of advice the two offer reaffirm several other resources that cropped up continually during WIE Orientation. One was office hours.

"Start going to office hours," Pace suggests. "Try to go to a lot, even if you're there and maybe you're done with the homework. Sometimes they'll do example problems, or they'll do the problem that you've already done, but it's a totally different way of thinking about it, and you need to know that. So that can happen, where you get the right answer the wrong way, and you want to catch that early."

Mariano also utilized office hours:



Paula Mariano during Illinois' May 2016 graduation. (Image courtesy of Paula Mariano).

"I was able to talk to the TAs, and any problems I had I was able to approach them, and they would explain things to me. And another resource I would suggest to use is your professors. They're there to help you, and they want to be here to help you guys, and possibly push you to grad school if you're inclined towards that, and they want to make sure that you succeed. They won't think any less of you if you ask questions."

Another resource Pace suggested is CARE "for getting those coaches and tutoring. Start going there early; start doing your homework there, and that's one way to make friends in the class and then you could start studying together. They're there; they're kind of like-minded as you; they're trying to get that work ethic going early."

Pace also recommends studying with students in your classes who live in your dorm. "We would all go to the computer lab that is in the dorm, and we would work on homework together. And that was just nice. We didn't have to leave the building. It was just easier. There were some really smart people, and we could all just kind of work together. I learned a lot from them."

Both offer some pieces of advice which seem to be no-brainers, but might be related to the freshman

propensity to assume college requires the same effort as high school. Mariano suggests: "Read the book! Don't think that you're going to slide by just by going to lectures and listening to whatever they teach you. There's a lot more information that they cannot squeeze into just a 45-minute class. And a lot of the homework problems that you'll be assigned will reference those points, and you don't want to be picking and choosing some information; you want to get all the details you can to do well as an engineer."

Pace offers some advice that she says she would have liked to have known when she started off: "Stay organized.

So you have so many things due every day; you need to start writing them down so you don't forget. Multiple times I would go into a lecture and realize I didn't do the pre-lecture, and that's a couple of free, easy points that I could have gotten that I missed."

One final piece of advice both offered, not only to the freshmen, but all women in engineering at Illinois, is that they too can succeed

"I told some of the other students this. Just don't let anyone kind of try to bring you down or denigrate you because maybe you're starting out in Calc 1, maybe you did poorly, but they did excellently," urges Pace. "People can really brag or try to bring themselves up. They can kind of play



Molly Pace on the south portico of the Engineering Hall during the second day of the WIE Orientation.

mind games with you, so just try to ignore them in classes; just worry about yourself. Who cares if they're getting straight A's. Just focus on yourself."

Mariano adds a further word of encouragement:

"Don't be discouraged. This is a difficult major; it's hard. And the College of Engineering here at Illinois is highly ranked for a reason. You're with top caliber people. And it'll be hard, but you know you can do it. You have resources available to you, and if you utilize that, and keep your hopes up, you'll be able to graduate with flying colors."

While both women had known that Illinois is a good Engineering school, neither realized the prestige of an Engineering degree from Illinois until they hit the work world. Says Mariano:

"The University of Illinois is so widely known; I feel proud saying it whenever I introduce myself when someone asks me."

What makes it even more special is that both of her older siblings are Illinois graduates.

"So it's kind of a family thing now. My mom's so proud, with us all being from the University of Illinois."

"It's really an honor; it's humbling to think about all the people that have come from here, and have gone on to do such great things," Molly adds. "I almost kind of feel like I'm in this really exclusive club. I didn't really realize that would happen. But you have these brilliant people that have also graduated. You know people are always kind of shocked: 'Oh, you went to U of I?' And that's just such an amazing feeling. I didn't think that I would be able to do it, and now, it's just fantastic. It opens up so many doors, just because they know, 'This is going to be a good engineer; they got through it!'"

Paula Mariano and Molly Pace in the ECE Building during Graduation 2016. (Image courtesy of Paula Mariano).

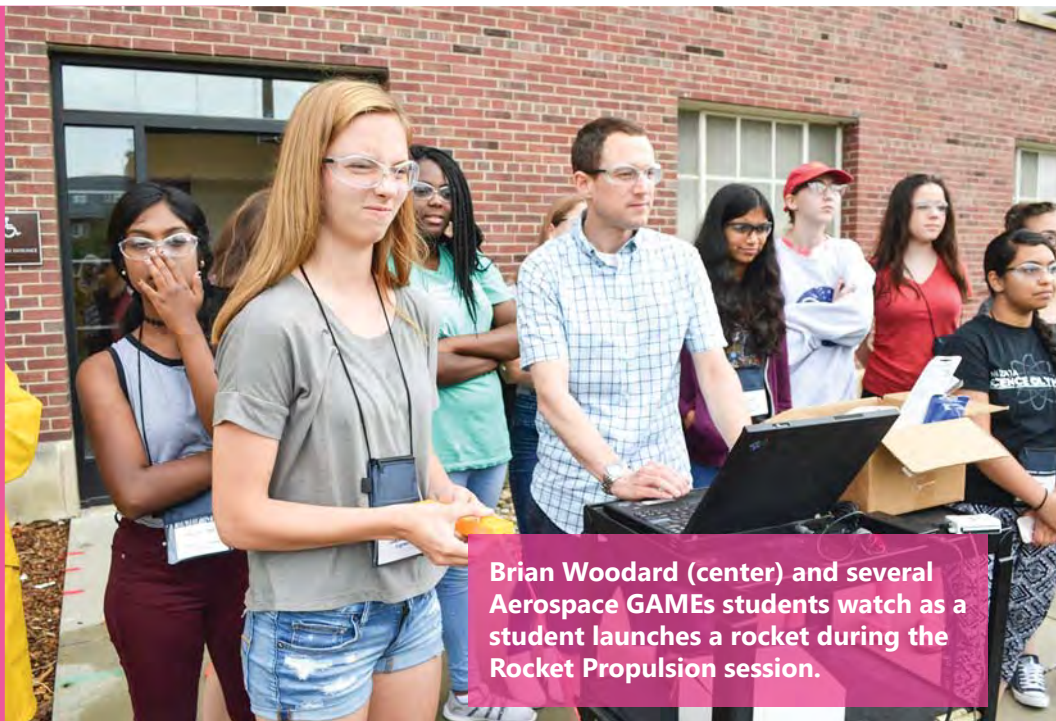


CAMPERS BUILD MODEL AIRCRAFT, EXPLORE POSSIBLE CAREERS DURING AEROSPACE GAMES

September 5, 2017

Twenty-seven high school girls were at Dodds Park on Friday July 14th to launch the glider or the rocket each had built during Aerospace GAMES camp. Eyes glued to their aircraft's trajectory, some experienced the thrill of victory as it soared in a picture-perfect flight, while others experienced the agony of defeat as their aircraft flew erratically because of a faulty design, or flew briefly then plummeted to the ground when it lost a crucial part. But despite the performance of their aircrafts, the students learned a lot about aerospace during the week-long camp from July 9–15th. They not only learned some principles of flight, and were exposed to possible careers in the field, but, most importantly, they interacted with a number of role models—women either in aerospace careers or preparing for them.

In its sixth year, the Aerospace GAMES (Girls' Adventures in Mathematics, Engineering, & Science) camp for high school girls employed a



Brian Woodard (center) and several Aerospace GAMES students watch as a student launches a rocket during the Rocket Propulsion session.

curriculum the camp's director, Brian Woodard, developed and tweaks a bit every year. But while the highlight of the camp was building and launching a model airplane and rocket, before doing so, the girls first needed to learn some physics—the principles of flight—and about aircraft design.

So first, the students learned some of the many important baseline principles about aerospace:

aerodynamics, rocket propulsion, flight mechanics, orbits, structures and materials, and missions. During a number of sessions, the girls participated in the camp's major hands-on projects—designing and building their own model glider and model rocket, which the girls then got to test during the Friday launch event.

Students also visited an aerospace-related campus lab, Talbot's Wind Tunnel Lab, and took a field trip to Willard Airport to the Institute of Aviation run by Parkland College. There students got to find out what flying is like using aircraft flight simulators, took

Aerospace GAMES campers test their gliders the final day before the big launch event.



a behind-the-scenes tour of the control tower, plus got a ride on the fire truck.

In addition, to serve as role models for the campers and to give them a glimpse into what a career in aerospace might be like, a number of Illinois alumnae served as guest speakers, several via Skype. For instance, Joanie Stupik, who got her Master's degree in aerospace engineering at Illinois and currently works at NASA's Jet Propulsion Laboratory in Pasadena, California, called in and talked to the students for 45 minutes, answering a lot of their questions as she shared about her work on the Cassini mission that's studying Saturn. Other women who shared with the girls were Julia Laystrom-Woodard from CU Aerospace; Heather Arneson from the NASA Ames Research Center; and Melanie Ciancio from Northrop-Grumman, a global security company providing technologies for undersea, outer space, and cyberspace applications.

According to Woodard, he and his team also worked hard to "get good role models for all these young students from our department." Helping out with the camp were two undergrads and a graduate student who helped him run the program. And in a major coup, Woodard and company were "actually really lucky," when they got some unexpected help: a student who had helped him run the camp for several years in a row, Laura Richardson, who had "graduated, and gotten a real job, like they do," had



A camper flying a flight simulator at the Institute of Aviation.

volunteered her time to come back and work with the camp again for the week.

Also a plus, according to Woodard, the two Illinois undergrads are really involved with a number of student projects which they shared about with the campers throughout the week. This was relevant because some of these student projects—which involve building model airplanes, robots, or rockets—were things the girls might want to try their hand at during the first semester of their freshman year at Illinois, should they decide to come here. "They can get involved with those things right away," he says.

Were there any among this year's crop of high schoolers who might end up in aerospace? Woodard and company indicate that a number of the girls were serious about the field. For instance, he reports that in his session on rocket propulsion they "had a really good discussion. I mean some of the students were asking detailed questions, clearly paying attention, thinking about it, and wanting to know more. There are several students that I would imagine, if they continue to do well in high school, would be great candidates for our program for college—several who seemed really engaged."

Regarding recruiting, Woodard reports that that's one reason he participates in the camp—because it appears to be working:



An Illinois Aerospace senior (right) gives a camper some pointers about her glider.

“It seems to be paying off,” he says, while acknowledging that, “It’s hard to correlate exactly one-to-one that the GAMES camp has been the only cause, but we’ve seen, in the last few years, an uptick in the number of women in our program,” he continues.

He claims that in fall 2017, “Aerospace Engineering will have over 20% women in its freshmen class, which is the first time Aerospace has ever had that.

We’re lagging a little behind some of the other engineering departments in that way, but at least we’re over 20% now.” While he acknowledges that GAMES camp might not be the only reason for the increase in the percentage of women, he finds it rewarding “seeing that these kinds of programs are working, that we’ve had a major increase in the last few years of women in the program.”

And it’s not just about the numbers. He also does the camp because he enjoys it:

“It’s fun. I like working with the high school students and getting them excited about aerospace,” he says. “We have so many neat labs and stuff we can show them in this kind of program.”



An Aerospace GAMES camper building her glider.

Similarly motivated was Jessica Hart, an aerospace engineering student at Illinois. She reports working as a lab assistant for the camp because she loves to recruit girls into STEM fields and teach aerospace engineering:

“I do this camp because I love seeing how all the girls get excited about aerospace, and I love empowering women to go into STEM fields. She also enjoys “teaching them about aerospace stuff because I think it’s cool, so I want other people to think it’s really cool too.”

Like Woodard, does Hart think some of the campers might end up in aerospace down the road? “There are definitely a lot that have a huge interest in the aerospace field,” she says. “And a couple of them are very knowledgeable about aerospace already, so it’s really exciting. I can definitely see them going into aerospace.”

One of those who might is Ahriel Tyson, a high school sophomore, from Palos Heights, Illinois. She hopes to be an astronaut one day and has “always been interested in aerodynamics and things like that.” In an effort to achieve her career goals, Tyson hopes to gain insight into the field early on. What did she learn at the camp? “Rocket science is as hard as they say it is!” Determined to



Campers watch a model aircraft in flight.

pursue her career goal of becoming an astronaut, however, she admits, “I like the challenge that it poses on me.” Tyson acknowledges some of the obstacles she will have to overcome with regards to coursework needed to go into aerodynamic engineering. For example, according to Ahriel, “I definitely need to get into calculus. I know that for a fact.” Tyson has the University of Illinois within her list of top choices for college.

Harriet Hunt prepares to launch the glider she built.

Another camper, Harriet Hunt, a senior from Naperville Central High School, attended Aerospace GAMES to help her make some career decisions: “I know that I want to be an engineer,” she admits, “and I’ve been leaning towards aerospace. I knew a girl who did this camp last year and I wanted to check it out and see if it would give me a better feeling of whether this is the right path for me.”

Is it the right path for her? Probably, plus she may have even narrowed her choice down further:

“I think so,” she acknowledges. “I’ve had a lot of fun this week. Before I came to the camp I’d never really thought about the aero side, as in planes. I only was really thinking about rockets when I thought of aerospace. But after learning all the stuff about airplanes and actually building the gliders, I really enjoy it, and I’m really interested after I heard the people talk about the companies they work at. Now I think I’m set on this.”



Harriet Hunt prepares to launch the glider she built.



Aerospce GAMES camper, Ahriel Tyson, shows off her finished product.

Given that her sister is an alumna (“My sister went to Illinois, so it definitely runs in the family,”) Illinois is among the list of top engineering colleges Hunt plans to apply to: “Tough to decide. I do like a lot of the staff here, and after meeting different professors and different students here, I really like the family that they have here, especially in the aerospace program. It’s very close, and I feel like you’re in good hands, so I like that a lot.”

BIOE GAMES CAMPERS ARE EXPOSED TO BIOENGINEERING, ENGINEERING'S GRAND CHALLENGES, & ENCOURAGED TO STAY IN STEM

September 6, 2017

Besides being exposed to “cool science and engineering stuff,” such as cutting-edge research like quantum dots, according to director Jenny Amos, the 32 high school girls who attended the 2017 Bioengineering (BioE) GAMES camp this past summer were also introduced to some of engineering's Grand Challenges. However, the main intent of the camp, according to Amos, was to encourage the girls to stay in STEM and, hopefully, recruit some of them into Bioengineering.



A Bioengineering graduate student (right) shows GAMES campers how to properly prepare equipment they're going to be using in order to do a cell culture.



A Bioengineering GAMES camper does a lab activity.

One goal of the one-week BioE GAMES (Girls' Adventures in Math, Engineering, and Science) camp from July 8–15 was to expose the girls to the broad spectrum of opportunities available to bioengineers. So during the camp, the girls participated in lectures, demonstrations, and hands-on activities related to different types of bioengineering-related research, such as tissue microenvironment, biomimetics, cell patterning, and cardiac physiology. Plus, to help campers see how bioengineering affects medicine, the camp included an all-day field trip to the JUMP Simulation Education Center in Peoria, Illinois, a simulation and training center for doctors to practice life-saving techniques.

Another goal of the camp was to introduce the high school girls to some of Engineering's 14 Grand Challenges—a to-do list of the 21st century's top engineering challenges if our planet is to survive. Some of those directly related to bioengineering include: reverse-engineer the brain, engineer better medicine, and advance health informatics. So during one camp session, girls were given the opportunity to do a case study related to one of the Grand Challenges.

Regarding the BioE GAMES camp's activities, a few years ago, Amos and her former co-director, Olivia Cangellaris, developed the current curriculum, which incorporates lots of hands-on activities, and to which Amos makes slight adjustments every year to strengthen it.

"I think we've hit our stride," she remarks, regarding the various activities they've incorporated.

"We've developed the camp; we have a really good model that we're really happy with infusing grand challenges and social science into engineering. That's really unique from even the other GAMES camps. We really talk about girl power and how to persist and stay in STEM; it's part of our mission. And we do cool science and engineering stuff."

Integral to the conversation about women in STEM are the hour-long group sessions held every day where they break the girls into small discussion groups "to let them reflect on what they learned, and talk about their interests, and talk about women's issues, like persistence in STEM and women's health issues."



A Bioengineering student (left) interacts with a BioE GAMES camper during a hands-on activity in a lab.

Amos reports that the group of 32 high school girls who participated in the 2017 Bioengineering GAMES camp were from all over the U.S., with the majority being from Illinois. Regarding this crop of campers, Amos reports:

"This group is very energetic. They seem to be really engaged. They're doing projects this week, and they have some really innovative ideas that they're going to be presenting tomorrow to their parents when they come to pick them up."

Why does Amos keep doing the camp year after year? For one, she finds it very rewarding each time she encounters a freshman engineering student and recognizes her because she participated in the BioE GAMES camp a few years back, and that's why she matriculated to Illinois.



A Bioengineering student (right) supervises a Bioengineering GAMES camper during a lab activity.

"This camp is addictive," Amos admits. "It's girl power. It's everything fun about being a woman in STEM. And I love that I can see these girls here in GAMES camp, and then I see them actually come to college here pursuing engineering, and it's really fun to see that pipeline of girls continuing through."

HIGH SCHOOL GIRLS DISCOVER CHEMICAL & BIOMOLECULAR ENGINEERING AT GAMES CAMP

September 7, 2017

From extracting DNA from strawberries, to making silly putty, to operating some lab equipment, the 24 high school girls who participated in the Chemical and Biomolecular Engineering (ChBE) GAMES (Girls' Adventures in Math, Engineering, and Science) camp from Sunday, June 18th through Saturday, June 24th, got to experience a bit of what chemical engineering is like. After hearing mini-lectures about a variety of chemical-engineering-related themes, the girls got to do fun, hands-on activities about the subject—including some things that might appeal to girls—like making foaming face wash, for example. Plus, during field trips, the girls got to see first-hand what a career in chemical engineering might be like. Even more importantly, they were exposed to women in chemical engineering who served as role models.

Director of the Chemical Engineering GAMES camp, Diwakar Shukla, and a team of students from

his lab led a number of activities, such as making foaming face wash on Sunday night. The campers also participated in a number of hands-on activities where they learned about and got a chance to do procedures using some of the lab equipment: they learned about pumps; DNA extraction, during which the girls extracted DNA from strawberries; the polymer extruder; enzymatic cleaning; continuous distillation; and acid rain. Students also took field trips, such as to the Abbott Power Plant and to the Urbana waste water treatment facility.

Although Shukla and his students led several activities, he explains that he was just coordinating the ChBE GAMES camp and had lots of help from his colleagues. “The best part has been that nearly half of the faculty in our department—they decided to do a one-and-a-half-hour activity about their own lab...I'm just an organizer who is making sure the schedules are fixed and everything is in place.”

Most of these faculty activities usually consisted of a short lecture about a subject, then a hands-on activity related to it. So during the course of the week, the students learned about polymers



ChBE GAMES campers extract DNA from strawberries.



A camper plays with silly putty she made during a hands-on activity.

apropos that Shukla and a team of students from his lab were integrally involved...he appears to recognize the need and has been actively working to increase the number of women in STEM.

"Since I came to Illinois" he acknowledges, "I have always tried to take at least one female student in my group every year, as a graduate student, which is very difficult for a computational group. So at this point, my lab has five female students doing computer science and biology and chemical engineering."

Did Shukla see any future chemical engineers in the group of high schoolers?

and recycling from Dr. Sing & Dr. Guironnet; Dr. Kong taught about biotransportation, then he and his students led a hydrogel activity. Dr. Diao and her students taught about "Crystals All Around Us," then led a crystal-making activity. Dr. Flaherty and his grad students taught about catalysis, surface science, and materials science, then led an activity on catalysis. Dr. Kraft and her students did an activity that involved making gold nanoparticles, which are used for immunoelectron microscopy. And finally, Shukla and his team also taught and led an activity about computational games.

In his first year as Director of the ChBE GAMES camp, Diwakar Shukla explains why he got involved with the project.

"Yes, they are all very curious," he says. "They're already talking about what type of courses they can take and credit transfers. So they're asking very detailed questions about the program already. Some of them have clearly made up their mind that they will apply to an engineering school. But there are others who are freshmen, so they are really exploring."

"I really enjoy teaching undergraduates and you know, this is even a lower level than undergrads. So there are always a lot of interesting questions, and it's a lot of fun to teach them basic scientific ideas and get them curious about chemical engineering and, in general, engineering and STEM fields."

Professor Diwakar Shukla (center), director of the ChBE GAMES camp, interacts with two students doing an activity about using enzymes to clean.



Since the ChBE GAMES camp was for girls, it is

AT ESE GAMES CAMP HIGH SCHOOLERS EXPLORE CAREER OPTIONS IN ENVIRONMENTAL & SUSTAINABLE ENGINEERING

September 7, 2017

From July 9–15, 20 environmentally-concerned high school students were on campus to participate in the Environmental and Sustainable Engineering (ESE) GAMES camp. In addition to learning about several key environmental and sustainability issues, campers also learned about career options available in the field—which according to several high school students, was why they participated in the camp.

Most of the camp's sessions were comprised of a mini lecture, followed by a hands-on activity related to the topic. Two addressed environmental issues: environmental footprints and climate change. Several dealt with renewable energy, such as solar, and wind and tidal. In one lesson, after learning about the air pollution produced by cookstoves, students made their own solar cooker. Several sessions also addressed water: water for energy, which included a trip to Abbott Power Plant, and some lessons about water purity, including a lab about water quality done at Boneyard Creek.

New this summer was a field trip to the Urbana's waste water treatment plant... which compliments the camp's water quality module. They also incorporated more hands-on data activities and, according to camp coordinator, Nicole Jackson, who admits to being "kind of biased towards my research," there's more on water resources and agriculture.

Jackson acknowledges that "Every year we

who's helping in a given year." For instance, one of Tami Bond's students taught a module on solar cookers. "So, they are going to make s'mores," Jackson says.

Camp director Sotiria Koloutsou-Vakaki, in her sixth year running the camp, feels she and her grad student coordinators have hit upon a successful formula.

"I think that we are succeeding at this, now, six years into the process, because [the students] seem to be very responsive, and they seem to enjoy it. At least, that's what they let us know at the end of every lesson. We ask them to tell us how they felt; if they felt they learned something; they had fun. It's a summer camp, right? So, they seem to enjoy it. So far, so good!"

Besides teaching about the environment and sustainability, she and her grad students also enjoy giving input to high schoolers grappling with future



Campers test the quality of the water in Boneyard Creek.



Mary Foltz works with two campers taking measurements using a solar cell.

According to Koloutsou-Vakakis, the main reason for GAMES camps is to “explain to other girls that STEM—whether it’s environmental engineering, civil engineering, mechanical engineering, or physics, or chemistry—it’s something that is interesting and something that they can do as well as everybody else. It can also be rewarding in terms of career and compensation.”

Helping Koloutsou-Vakakis with the camp this year were around 8–10 Civil Engineering graduate students, including one of the coordinators, Mary Foltz, who just finished her Masters in Environmental Engineering and will be starting her Ph.D. in the fall. Helping with the camp for the second year in a row, Foltz got involved because she loves teaching.

career choices. She says the camp gives “a very nice perspective for the students who are kind of stressed out as they start the application process for college, to take a step back and say, ‘It’s okay, I have many options...I have to think of what I like.’”

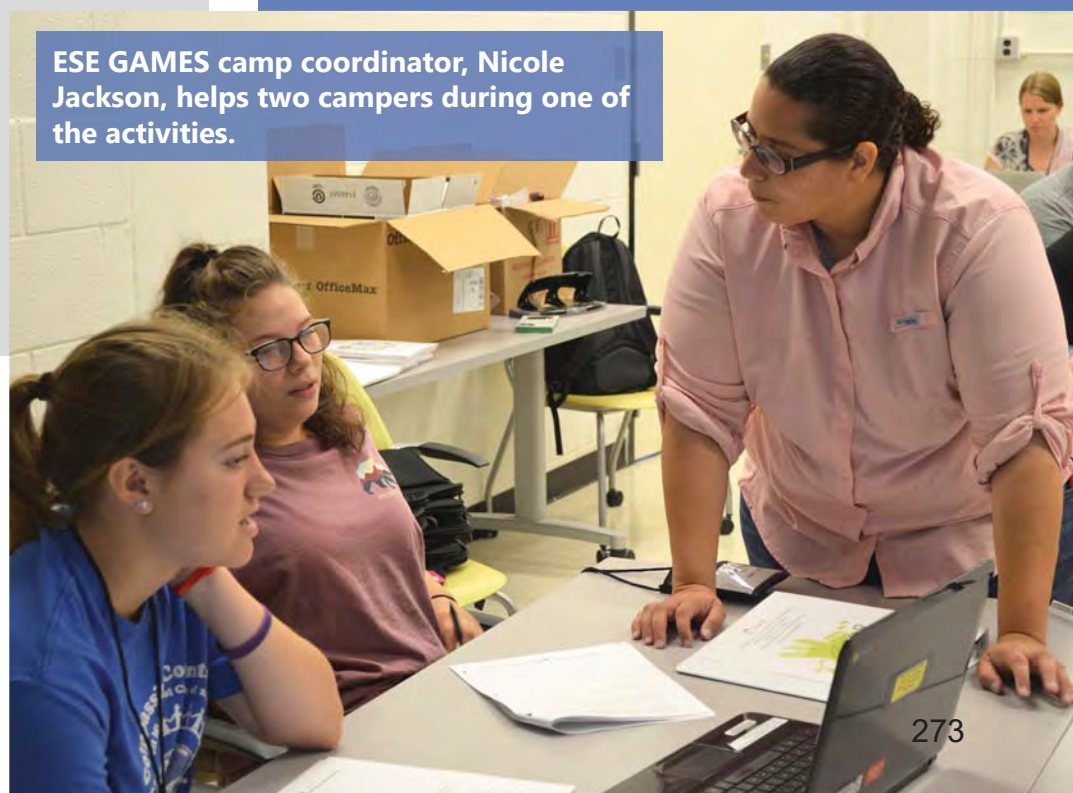
In fact, Koloutsou-Vakakis reports that during one session, the grad students shared their personal experiences regarding choosing their fields:

“They said not everybody knows what they want to do the first day they apply to college, but that it’s something that develops. Of course, they emphasized the benefits of being an engineer, a problem solver, along with minoring in something else which gives the scientific perspective, because engineers build things for people. And for environmental engineers, that’s even more important.”

“I want to be a professor, so this is kind of the right fit for me. Teaching high school is what I did before I came to graduate school, and so this is really similar to that but a little different.”

She also hopes to help the campers figure out what they want to do, and serve as a role model. Foltz’s favorite activity of the camp? Water quality and water treatment (the one she helped teach, of course), which was done at the Boneyard Creek.

She also indicates that they’ve been seeing long-term results in terms of campers matriculating to Illinois: at least seven students have applied and been admitted. From the last two camps, at least one student applied, was admitted, and is currently in Civil Engineering at Illinois.



ESE GAMES camp coordinator, Nicole Jackson, helps two campers during one of the activities.

Regarding how many participants reported being interested in careers in environmental engineering, Foltz reports a mix: some were saying, "I want to be a civil engineer," and took the camp because there's no civil camp; some might want to do civil with maybe a concentration in environmental engineering. However, a number were environmentally focused and trying to decide between being an engineer or scientist, something Foltz could speak to.

"That's where I come in handy here," she says, "because my undergraduate degree was in environmental science, and now I am doing environmental engineering. So I have both aspects, and I can tell them what the differences are."

"The girls here ask a lot of great questions," she adds, "and I love answering them and being honest and giving my perspective and being a good role model for them—showing them that there are women in engineering, and there are women in graduate school, and there are women doing everything that men can do."

Alluding to the need to get more women in STEM, fellow Environmental Engineering Ph.D. student and camp coordinator, Nicole Jackson, refers to Civil Engineering's wall with pictures of endowed



Two ESE GAMES campers collaborate on an activity.

professors: "Well, I used to call it the wall of men.... all of the endowed professorships," Jackson says. "But now, Dr. Bond (a woman) is a named professor. So now it's a wall of men plus Dr. Bond."

In her third year as a camp coordinator, Jackson shares why she does it every year:

"I've always been motivated to be an engineer. So, it's kind of cool to see how young people decide that for themselves. So, the camp does a good job showing one facet of engineering and hopefully it sparks some, in general, to be interested in engineering, because I think it's awesome. So every year is different. You never know who you are going to get at these things, which keeps it fun. I work with a great group of grad students too."



Nina Crawford and Paige Jenekowitz

Does Jackson think any of the students might end up to be environmental engineers?

"I think there are a few," she says. "There are a few that are dead set on, 'I want the planet to be a healthy place.' I think, though, there are definitely some who are environmentally focused, but may not know how they want to do it in practice, which I think is totally fine and helpful. So, yeah, there's a lot of eager minds amongst our 20 campers."



Paige Jenekowitz and Nina Crawford do an activity about solar cells.

She reports that during camp, they were discussing the message that Microsoft sends regarding the shortage of women in STEM:

“You turn on your laptop, and the moment you turn it on, under the Microsoft sign, it says ‘See, only 6.7% of women graduate with STEM degrees.’ So, this is not a Microsoft commercial, but I focus on the 6.7%, which is a very low number. So, I said to the student yesterday, ‘Well, what does that show? It shows a big opportunity, right, for more women in STEM.’”

Koloutsou-Vakaki shares why she does the camp every year: “Well, it’s fun; it’s educational; it’s very rewarding to see these girls interacting.”

She says she also finds interacting with graduate students rewarding:

“They are teaching; they’re preparing the materials; so they are very excited. They come with enthusiasm.”

She shares why the grad students appreciate interacting with the high schoolers. “As they prepare to go out and teach at the college level, most of them, they get to interact with students from different backgrounds and who have different motivations, different future plans.”

Koloutsou-Vakakis and company are not shy about acknowledging that their main purpose in doing the camp is to recruit more women to STEM:

“That’s why we’re here! Ask all the questions you have; see what we are doing; we cannot show you everything, but we try to show some of the things that we’re doing. We are also trying to emphasize the science; we try to split between some hands-on and some theory.”

Like Koloutsou-Vakakis, Jackson also believes the camp is making headway toward increasing the number of women in STEM:

“I think it’s a really exciting time to be a woman in STEM. These programs are pivotal towards improving diversity. So, it’s great to be at Illinois and have a combination of a supportive college, which kind of provides the back-end to the program, and then a supportive department that allows students to donate their time, in a way, to promote the next generation of people.”



Cori Robinson and Chloe Walls

And several campers believed that they would end up in STEM, and maybe even environmental engineering.

For instance, Nina Crawford, a rising junior at Glenbard West High School, indicates that her purpose in participating GAMES was to check out the field as a potential career:

"I came to this camp because I heard about it from my ecology mentor, and I'm interested in being an environmental engineer. It's kind of like a trial run for me to see if I like this and if I want to do it with my career."

What does she think of the camp? "I like it a lot," she admits. "I've met a lot of great people, and it's really good to get experience in the field and getting experience in the math and trying different opportunities in the math and science field."

She also believes she'll end up in environmental engineering: "Yea, I think I'll look at some of the career opportunities and majors that go along with engineering and environmental science."

Does she hope to end up at Illinois, too?

"Yes," she affirms. "Both of my parents went here, and both my brothers go here."

Like Nina, Paige Jenekowitz, a rising junior at Conestoga High in Pennsylvania, also participated in the camp to check out the field careerwise: "I came here because my environmental science teacher told me about it, and I wanted to be an engineer so she thought this would be a good idea to come here.

Paige reports that she was enjoying the camp: "I like it," she admits. "It's a really fun learning experience."

Similar to Nina, she also thinks she'll go into environmental engineering, and she's interested in attending Illinois.

Like the other two girls, Cori Robinson, a rising senior, at Oak Park Forest High School in northern Illinois is also exploring her career options, and came to the camp after her mom told her about it.

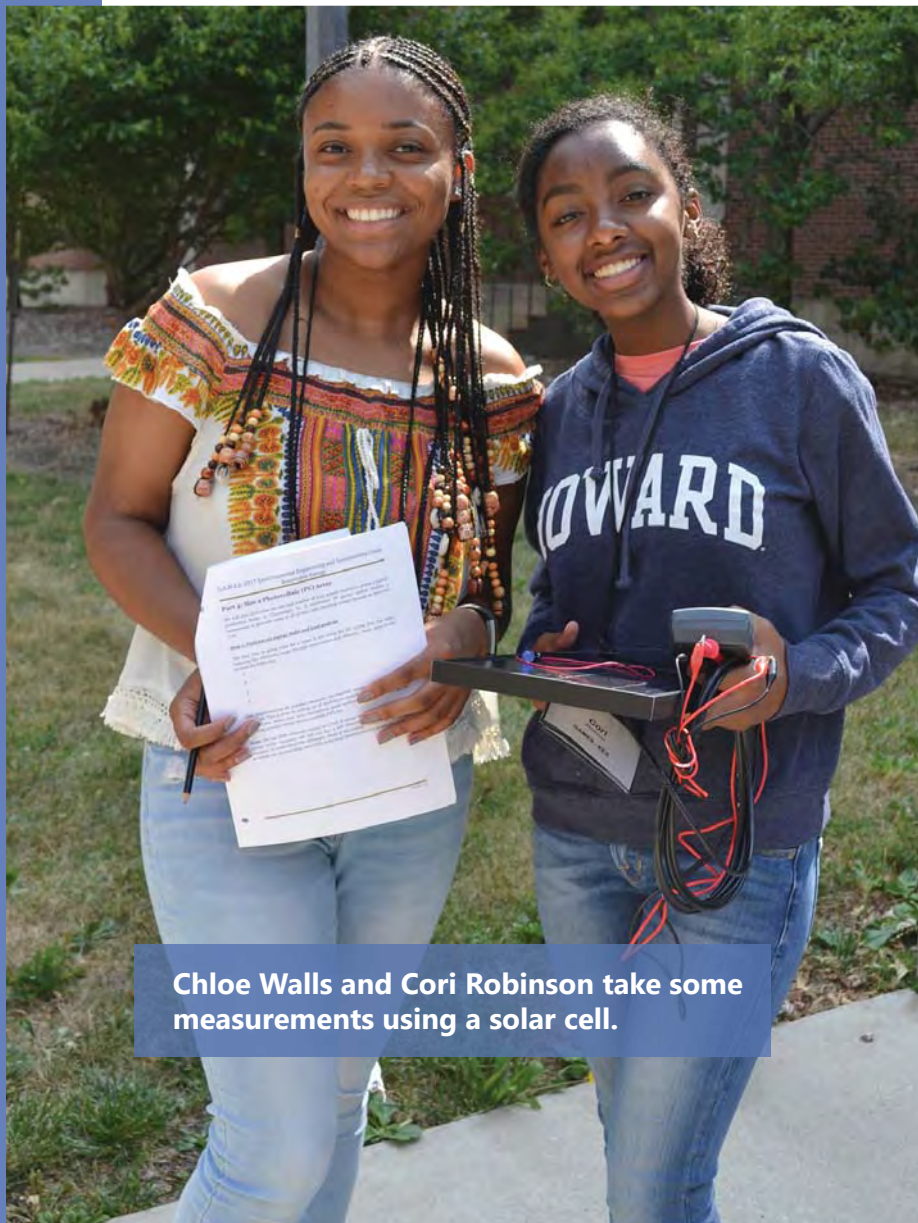
"I've always been interested in engineering. I've never been sure of which type of engineering, so I thought it'd be a great experience to be exposed to some other aspects that I don't usually see," she says.

Robinson says she really enjoyed it. "It's been fun. I enjoy a lot of the measurements when we go outside and have to take measurements, test things. I enjoy math a lot, so it's fun."

Robinson thinks she might do some type of environmental science and engineering. Does she you think she'll come to Illinois? "Yes, that's the goal," she reports.

Chloe Walls, a junior at Homewood High School, shares why she came to the camp: "Because I took environmental science this year, and I really enjoyed it, and I also like physics and engineering, so I thought I should come to a camp and Illinois had one so I'm here.

While it's the first GAMES camp you've been to, she believes it might have tipped the balance for environmental engineering: "It did," she admits, "because I wanted to see if this was something that I like before I decided to major in it so I thought this would be a good way to try it out but I have enjoyed myself so far." Like some of the other campers, she says Illinois is her top choice right now.



Chloe Walls and Cori Robinson take some measurements using a solar cell.

SISTAS IN STEM (SIS) SEEKS TO PROVIDE SUPPORT FOR MINORITY WOMEN IN STEM

September 7, 2017

Back in August of 2015, there didn't seem to be a specific organization tailored to meet the needs and interests of minority women in STEM fields. So five women on campus, including Shelana Martin, decided to start one: Sistas in STEM, a Registered Student Organization (RSO) that's geared toward the cultural background of minority women. "We wanted to hone in on that cultural aspect and give them a safe space for coming with their problems," Shelana acknowledges. But it was also important that the organization take into account the fact that they're women.

Shelana, 2017 SIS co-president, along with Chezalyn Grant, shares why she felt an organization for minority women in STEM was important. She admits that when she started out as a physics major, she was struggling with some classes. But even though she was a member of the National Society of Black Engineers (NSBE), it didn't meet her needs.

"It was sort of male oriented," she reports, adding that she felt like her opinion was dismissed a lot. "With SIS," she explains, "it was about being able to get a broader expansion—so something that is not only related to me being Black, but also me being a woman."

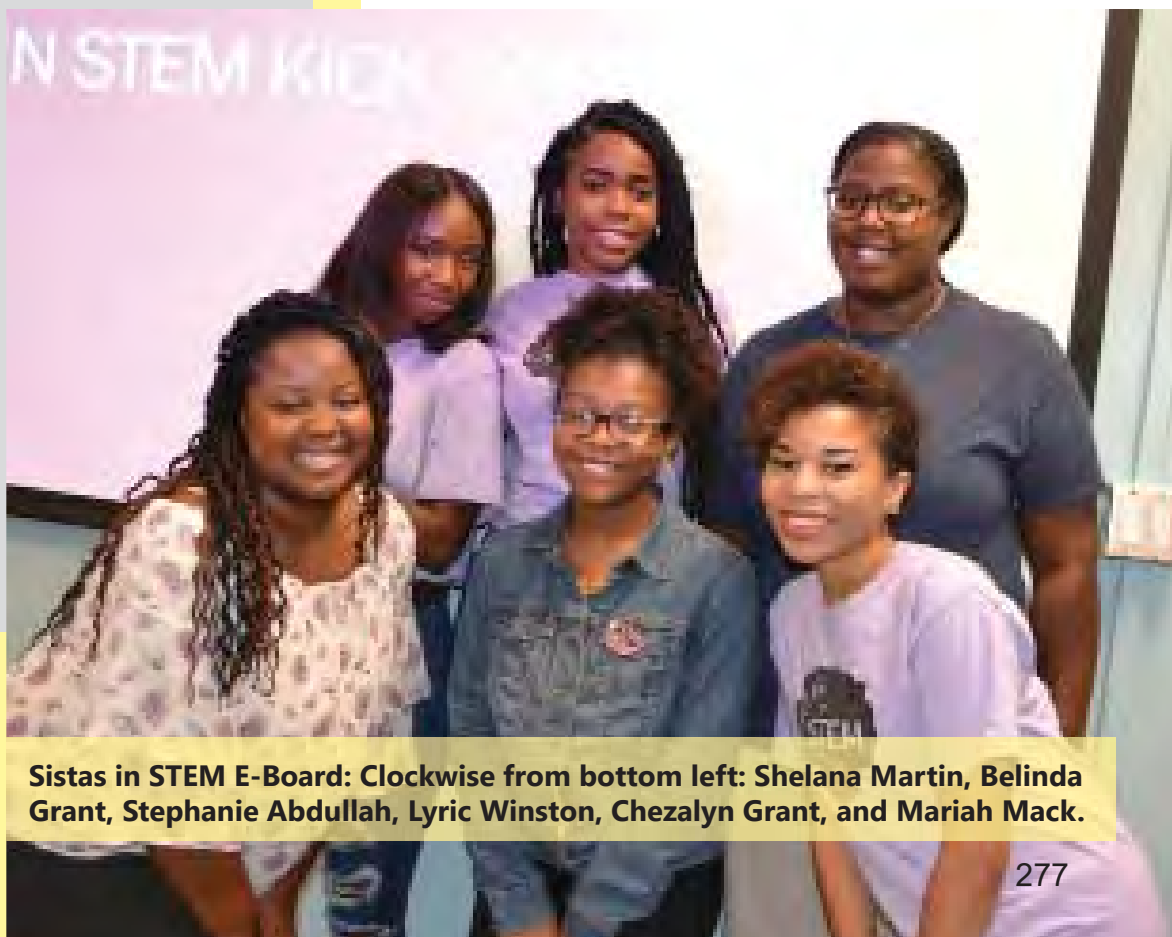
So the idea behind SIS was to provide a safe space for minority women, not just Black, but any minority...Latino,

Pacific Islander, etc....and give them a place where they could go to get the same benefits as someone in NSBE or Latino Students in Engineering.

"We want to provide that kind of mentorship to women who haven't found an organization that they can be part of and get that experience with," acknowledges Shelana.

Stressing that one of SIS's strengths is community, SIS co-president Chezalyn Grant shares that, in fact, that's why she joined Sistas in STEM:

"In order to get a sense of community with other Black women who are in STEM fields, because Black women are underrepresented in STEM fields. I wanted to not only gain a sense of community, but I also wanted to learn more about my peers in STEM and gain support from them."



Sistas in STEM E-Board: Clockwise from bottom left: Shelana Martin, Belinda Grant, Stephanie Abdullah, Lyric Winston, Chezalyn Grant, and Mariah Mack.



Shelana Martin, 2017 Sistas in STEM Co-President

Plus SIS's goal isn't to just focus on the "sisterhood between other women," Shelana acknowledges, "but create a safe haven so they can get the professional experience." So along with community, SIS offers professional resources, such as resume building and workshops on basics like what to wear to an internship or interview.

Since it was begun, SIS has grown to include 18 members, including 10 who actively serve on the Executive Board, or E-Board. In addition, 64+ girls joined the group's email list this fall.

SIS activities throughout the academic year range in frequency from once a semester, to monthly, to even twice a week. For instance, an important, once-a-semester event is the Fall Kickoff, designed to introduce SIS to the campus and to give students, especially incoming freshmen and others who signed up on Quad Day, an idea of what the organization is all about.

During the recent Fall 2017 Kickoff held on September 14th, after an icebreaker, co-presidents Chezalyn and Shelana gave a brief introduction, and introduced the members of the E-Board and the committees: Fundraising, Professional Development, Outreach, and Social. After sharing what the organization is about, its mission, and what it stands for, as well as some of the benefits of membership, they opened the meeting up for questions. In addition, interested students could sign up on the email list, or even to be involved in one of the committees.

Another of SIS's main activities is its annual Professional Development Luncheon usually held in

April. It features a panel of mainly minority women who teach at the university or are professionals in a range of STEM fields. During the panel, the women share about their experiences, their backgrounds, what they do, and how they navigated college, followed by a time for questions and networking.

SIS has about one social activity once a month, usually focused on academics and professional topics, plus general meetings that are once a month.

In addition, throughout the semester, SIS has a number of events, such as fundraisers and workshops. And finally, twice a week (and more often as finals approach), SIS reserves study tables, such as in Grainger Engineering Library, for members to study together and receive extra help, if needed. According to Chezalyn, this is another reason for belonging to SIS: "to join study groups and power through classes, eventually earning A's in hard classes."

SIS appears to have lived up to its billing in the college careers of SIS members. Regarding the impact SIS has it made so far on her education



Chezalyn Grant, 2017 SIS Co-President.



Belinda Grant, SIS's Community Service Chair.

at Illinois, Chezalyn, a senior in Psychology & African American Studies, with a concentration in Behavioral Neuroscience, Pre-Med, admits:

"It's made a huge difference for me, because I talk to other women who are in the same field as me. Most of the time we share a lot of the same classes. What Sistas in STEM does is put you in GroupMe's with other girls who are in the same classes or major as you, so that you can connect and join study groups—really strive for an A in the class. It helped improve my grades tremendously."

In fact, Chezalyn recommends that new girls on campus meet as many girls as they can in order to network. "One of the girls they meet might be in the same class as them," she adds, "and from there they might be able to help each other in the class so they can eventually get an A in it."

Similar to Chezalyn, Belinda Grant, a senior in psychology, pre-physical therapy, and SIS's Community Service Chair, reports joining the RSO for academic support. Her high school chemistry course hadn't prepared her for college chemistry, and because she didn't have anyone to do pre-labs or Lon Cappa homework with, she was struggling.

"By joining Sistas in STEM," she explains, "I was able to connect with people in my classes or people who had already taken the classes already. That helped me out, because they would still remember the topics or say 'Oh, you could go to the CLC,' and that's how I was able to access other resources on campus to help me get through."

Like Chezalyn, Belinda also has a piece of advice for freshmen:

"Do not lose sight of what you're aiming to do. Even though classes get hard and you're going to get tired, you have to just push. Those nights that you stay up in the UGL while you're working and everyone else is having fun, it's all going to pay off in the end. Just keep going; keep smiling, you'll get there."

For Shelana, a senior in the College of Education's Learning and Educational Studies program, with a concentration in DELTA (Digital Environment Learning and Teaching Agencies) and a minor in Informatics, she hopes to leave a legacy on campus, and shares how she hopes SIS can fill that niche for her personally.

"Not only would I be helping in starting something that could culturally be beneficial towards myself, I felt it would be something that I helped accomplish—making this organization and making it big and known on campus. We don't just want to wipe away all of the other organizations; we want to



SIS Vice President Lyric Winston participates in the icebreaker at the RSO's recent Fall Kickoff event.

According to Shelana, SIS also hopes to impact younger women in high school or even elementary school.

“We want to be able to show them they can have fun doing this; you can be a woman and be in STEM.”

Part of that involves serving as role models younger students can emulate, as they “see a model that they can be interested in science and pursue that in college.”

So SIS also has an outreach component, and has worked with the C-U Boys and Girls Club, the Douglas Community Park Center, as well as Booker T. Washington STEM Academy. SIS is also partnering with the Urbana Neighborhood Connection Center at the YMCA beginning this fall, to do outreach activities there. Which ties in to another hoped-for impact: recruiting more young women into STEM.

“Sistas in STEM is a really good organization for anybody of all races and ethnicities,” Chezalyn says. “It’s really just a support network to help women become more involved in STEM fields so we won’t be the minority in these fields. We can eventually conquer the world in all the STEM careers!”

be a part of that group that pinpoints certain things that we want to see within our population, within our culture, and within the students.”

What impact do SIS members hope to have on students?

“Encouragement to keep going, to pursue more, to explore more,” says Shelana. “Perseverance. You may be in that class that’s kicking you down a little bit, but to we want be that support group. We want people to say, ‘There is an organization that has been helping me. They have been a major part of why I’m still doing what I’m doing!’ I want them to be able to come back and tell other students once they have graduated and have gotten into their professions, that SIS is an experience that they won’t forget because it has helped them a lot and been a part of their life since they joined.”



Chezalyn Grant shares about SIS during the recent Fall Kickoff event.

ENGINEERING FRESHMAN WOMEN GET FAMILIAR WITH CAMPUS, LEARN ABOUT *ILLINOIS* RESOURCES, AND BUILD COMMUNITY AT WIE ORIENTATION

September 25, 2017

The “WIE by the Numbers” slide presented during the introductory session of WIE (Women in Engineering) Orientation, from August 22–24, 2017, says it all. Since its inception 15 years ago, 2,724 female freshman engineering students have participated in Orientation, with 268 students from the fall 2017 freshman class attending. Another impressive number? The 268 women attending Orientation were a just bit more than half of the total number of female engineering students in the fall 2017 clas. This represents the largest number (496) and percentage (25%) of women ever in a freshman engineering class at Illinois—a milestone for Women in Engineering and a cause for celebration. And celebrate they did, as they arrived on campus a few days ahead of all-campus-move-in day, eager to get a head start—to get familiar with campus, make friends and build a community, and to receive sage advice from some older and wiser women in engineering.

Two older and wiser women engineers who shared from their wealth of knowledge and experiences were recent ECE (Electrical and Computer Engineering) graduates, Paula-Angela Mariano and Molly Pace, keynote speakers for WIE Orientation. Both work at Texas Instruments (TI), one of the corporate sponsors who, along with Abbot, sponsored Orientation for the second year in a row.

Mariano and Pace shared not only their triumphs, but their somewhat rocky beginnings at Illinois, then recommended resources that had helped them overcome challenges they had encountered, and passed on advice about how to not just survive but to thrive during college. Their main goal? To encourage their younger sisters that they, too, would someday be proud Illinois graduates. The two also taught a workshop about TI internships.



Left to right: Keynote speakers Paula-Angela Mariano and Molly Pace (front row) and WIE Orientation leaders Brooke Newell and Angie Wolters (second row) enjoying the introductory session of WIE Orientation.

The WIE Orientation planning committee included Angie Wolters, Director of Women in Engineering; Brooke Newell, WIE Program Coordinator and Academic Advisor; Co-Student Coordinators Siobhan Fox and Elizabeth Sanders; and WIE Administrative Assistant, Amy Cain. The team not only kept Orientation running smoothly, but during the introductory session, they shared the agenda and introduced the various speakers, but they also gave some advice to the freshmen.

To get the girls more engaged, so they weren't just sitting there listening to people talk to them the entire time, the student coordinators led the freshmen in an ice breaker. For the Trivial-Pursuit-esque game, the girls signed in to Kahoot, a free, game-based learning platform, responding via their cellphones to ten multiple choice questions about Illinois and WIE, such as, “What year did we start?” and “What is the name of our statue on campus?” Kahoot would then immediately show the response rates so they could see how well they had done compared to the other girls.

“They're actually engaging with us in a way that they would in their classes,” Sanders explains.

Also on hand to welcome the freshmen was Dean Sue Larson, who also gave a mock lecture to give the girls a taste of what a college lecture might be



Counterclockwise from the bottom left: Elizabeth Sanders, Amy Cain, Angie Wolters, Brooke Newell, and Siobhan Fox, the members of the 2017 WIE Orientation planning committee.

4. Get familiar with campus and gather tips from upperclassmen.

In previous years, a scavenger hunt had helped freshmen become familiar with campus. However, this year, the committee implemented the new-and-improved WIE Olympics. Comprised of team-building activities, the different stations took place in departmental buildings and other key locations around campus. For instance, one activity was in the crane bay of Civil Engineering's Newmark

like, then led the girls in a hands-on activity about weaving that emphasized listening to instructions, collaboration, and creativity. To her surprise, Larson was also awarded the WIE Champion Award for her years of support to Women in Engineering, including starting the WIE Orientation 15 years ago.

The top five things WIE Orientation planners hoped the girls would take away from Orientation, in descending order, were:

5. Learn about extracurricular activities to join.

Throughout the entire event, presenters recommended that students get involved in extracurricular activities. For instance, during the introductory session, one slide showed nine engineering women's RSOs (Registered Student Organizations), and keynote speaker Mariano shared how significant one, Women in ECE, had been in providing support she needed during her years at Illinois. One workshop on the final day, "Getting Involved in RSO's," explained the academic, social, and professional benefits of participating in RSOs, while another, "Greek Life," touted the benefits of joining a sorority.

Lab, so freshmen could experience a giant lab. The Electrical and Computer Engineering Building (ECEB) was the location of the Introductory Session, plus other activities; girls hiked to Loomis Lab, the home of Physics, because most freshmen will take an introductory-level physics course there. In addition, various activities were held in other key locations (the Engineering Building, the Materials Science Building, Illini Union, Grainger Library, etc.). Plus, while competing, the girls were awarded points based on how quickly they finished or how well it was done. The team with the most points received an award.



A team of girls do a teamwork and communication activity in Civil Engineering's Crane Bay during an event at the WIE Olympics.

However, the Olympics had another emphasis: it underscored five facets of leadership—adaptability, ambition, communication, entrepreneurial spirit, and leverage—to be highlighted in WIE Lead, a leadership lecture series during the upcoming academic year.

For instance, emphasizing adaptability and communication was the “Toxic Waste” event at the Illini Union. Each team received several balls in a bucket, which had been placed in their “toxic waste pile” (a string of yarn on the floor designated the area they weren’t supposed to step into). As a team, they used eight ropes attached to their bucket, to lift and move it out of the waste pile, then dump the balls into a different bucket a couple of meters away. To foster adaptability and communication skills, once they’d begun, their proctor blindfolded one girl. To prevent her from stepping into their waste pile, they had to communicate, telling her, “You can’t step forward; you have to step to your right!” to. (Whoever stepped into the toxic waste wasn’t allowed to use the offending part of her body; if it was a foot, she had to hop on her other foot. If it was her hand, she could only hold the string with her other hand.) “So girls the entire time just have to learn how to communicate and how to adapt to unforeseeable circumstances,” explains Siobhan Fox.

To expose the girls to other campus venues, the freshmen visited Noyes Lab, where most would probably be taking introductory-level chemistry, to experience the ever-popular Chemistry Demo, with its explosions, loud noises, and even a glowing pickle. Along with all the stunts they pulled, Don



Mentor Jennifer Luebbers (in pink) measures the tower a team built during a WIE Olympics teamwork event at Grainger.

DeCoste and Gretchen Adams also imparted some practical tips, like go to classes, don’t be afraid to approach your professor, and don’t neglect the essentials, like sleeping and eating.

Also, instead of friendship bracelet making and movies in Engineering Hall’s basement like last year, the girls were introduced to the Illini Grove, where they roasted marshmallows, and played sports.

Tips from upperclassmen. The notion of older and wiser students giving advice and mentoring freshmen was built into the fabric of practically every event and group during Orientation. Beginning with dinner the first night and over the remainder of the event, upperclassmen both formally and informally shared, not only about academics, but practical tips on how to navigate the college scene. From meals shared with mentors in their departments, to the introductory session on Wednesday morning, to the WIE Olympics, and in numerous workshops on day three, such as “All Things Google,” “Awesome Apps,” “Campus Bus System,” and “Study Smart,” older engineering students showed the newbies “the ropes.”

3. Meet professors, faculty, mentors, and classmates in their departments.

To encourage freshmen to get acquainted with others in their departments, students were organized by majors for several meals, such as dinner the first night, and breakfast on day two, both held in the Illini Union basement. At the beginning of the orientation, students were grouped by their major, and the mentors were in their major. Plus, departmental luncheons



Two freshmen enjoy breakfast before the opening session of WIE Orientation.



Gretchen Adams and Don DeCoste doing a chemistry demonstration.

on Wednesday encouraged students to not only meet other freshmen and older students in their departments, but administration, faculty, and other key staff.

2. Discover academic and non-academic resources available on campus.

Academic resources incoming students were introduced to included key people; in fact, two helped run the event—WIE Program Coordinator and Academic Advisor, Brooke Newell, and Angie Wolters, Director of Women in Engineering—who both encouraged freshmen to come see them early and often. In addition, during the workshops, both Larson and Wolters were available for advising sessions.

Numerous other folks advised students to take advantage of other academic resources, including keynote speakers Mariano and Pace, who encouraged students to take advantage of professors' and TA's office hours and CARE (the Center for Academic Resources in Engineering) on the 4th floor of Grainger Library. Nonacademic resources mentioned included "Study Abroad," a workshop presented by IPENG (International Programs in Engineering) representatives; two workshops, "Career Fair Success," and "Why Freshmen Should Attend Recruiting Events" by Caterpillar's Mark Niemeyer, underscored that recruiting events are a great resource. "Getting

Involved in RSO's" explained the academic, social, and professional benefits of RSOs.

1. Build a community and make Illinois your home!

The #1 piece of advice students received was this: start building a community! To help students begin, girls were grouped by dorms, which could lead to relationships/study groups with students in their dorms; by department (see #3 above); and this year planners added a third layer: they took students' schedules into account when forming groups. According to Wolters, Olympic teams were formed based on similarities in their class schedules so they would "get to know each other, and this might help facilitate further community building."

While Siobhan Fox acknowledges that this was "a little bit difficult," she reports that in previous years, students hadn't had the opportunity to meet girls in different majors. "So this gives them the opportunity to...meet people that might be in their classes," she says, explaining that one down side of grouping by majors is that girls in the same major often might not have classes together until their junior or senior year, based on the strength of courses previously taken. "So to help them build their network on campus," she explains, "we've mixed up the mentor groups."



Co-Student Coordinators Elizabeth Sanders and Siobhan Fox interact with the freshmen during the introductory session to WIE Orientation.

In a kind of “afterglow” event, although Orientation officially ended at 1:15 pm on Thursday, mentors led some optional, informal afternoon activities, such as showing girls where their classes would be, so on the first day of classes, they wouldn’t be “scrambling around,” Fox explains. Some mentors took girls to the bookstore so they could give them advice when purchasing textbooks. Others took girls shopping for dorm room stuff or emergency items. Some mentors introduced girls to the bus system so they could learn firsthand how the buses work, which can be intimidating.

The idea behind these informal excursions was to “give girls the opportunity to choose the group that they were with. Maybe they had met someone that they had never had a mentor group with, or maybe they found an upperclassman that they really connected with, and this is their opportunity to continue that friendship,” Sanders explains.

Meet Some Freshmen

Making friends and building community also seemed to be uppermost in the minds of several of the freshmen, who share why they came to WIE orientation.

Abby Pucek, a freshman in Mechanical Engineering, felt WIE orientation was “a good way to get to know the campus a little bit more, and I thought I would meet a lot of friends here before I went to my classes.” Her goal? To find someone she could sit with on the first day of school. And thanks to the new strategy of grouping the girls with others in the same classes, she met someone in the same Calc class: “So we’ll probably study together and stuff,” says Pucek.

Pucek’s friend, **Haneen Said**, an ECE freshman, reports that the most important thing she had

gained (as of Wednesday morning) was “Getting to know everyone.” She adds, “Everyone here is new, and everyone here is trying to find their way on campus and trying to use all their opportunities and take advantage of everything. So I think it was cool just to see the different personalities and connect with people. That’s what I took more from this, the connections.”

Haneen came to Orientation “for the same reasons practically. I knew that I wanted to make friends, and I didn’t know that many people in engineering, from my school at least. So I figured WIE would not only help me move in early and save the chaos on that, but I would meet new people and hopefully make friends.”

Jasmine Snipe, a Bioengineering freshman, participated in Orientation because she was “super excited to be able to meet new people,” and get to know other students “in the same boat as you as a woman in engineering...And also, I just wanted to get used to the campus and see what everyone else is excited for.” She picked Illinois because of its proximity (“I live 3 hours north, so it’s nice to live close to home”), but also for the strength of the program. “But also I think I really like their engineering program, and I’m excited to be in a school with so much passion for engineering.”

Clarissa Domanus, a freshman in MatSE (Materials Science and Engineering) actually heard about WIE orientation early on when picking which school she wanted to go to. “And it actually made me want to pick U of I. I wanted to get used to the campus before I had to start class, so it’s fun.”

Did the fact that MatSE is perennially one of the top programs in the nation play into her decision?

“That too,” she admits. “It was a lot of things.”

Domanus reports having fun “hanging out with people, both from my dorm and meeting new people, so it’s good.”

Soumya Kuruvila, a Computer Science (CS) major, reports, “I’m from San Diego, so my roommate and one of my friends are the only people I know. So I wanted to meet more people in engineering, people that I’ll probably be surrounded by my next four years.”

Kuruvila picked Illinois because she had come here for CS’s SITE program. “So I was introduced to a lot of CS students, and they were talking about their

experiences and all the opportunities and the doors that were open for them, and that's when I knew I wanted to come here." Her first impressions? "So far, there's a lot of school spirit and school pride, and I'm really excited to like see more of that."

Her roomie, **Mackenzie Kirkham**, is also in CS. How'd the two happen to room together? "We found each other on Facebook," she admits. Kirkham participated in Orientation for pretty much the same reasons. "I don't know anybody, because I'm actually from out of state, too—from Indiana. So I don't know anyone on campus. I decided it would be a great way to meet other people, especially in engineering."

Kirkham picked Illinois because of the CS program's reputation, "and I really liked how it was different than other CS programs at other schools. It looked really strong," she says.

And it wasn't just freshmen who enjoyed Orientation. **Pooja Welling**, a CS junior who wanted to "pass it on," acknowledges, "I did WIE Orientation when I was a freshman, and I made a lot of really close friends through it. Also, I'm still friends with my mentor from Orientation, and I wanted to do the same for other people."

Her mentor, a year older than her, is still here in the CS program. "I ask her a lot of questions still, two years later," Welling admits. Regarding the experience, she adds, "I think it's just really fun to be here. I love meeting freshmen."

WIE Orientation Planning Committee

Members of the planning committee also share why they devoted so much time and energy to the event.

For example, Engineering senior and co-coordinator **Elizabeth Sanders** shares how Orientation impacted her as a freshman...and is still doing so to this day. She reports deciding to attend, "Because I was really worried about making friends, initially, and the whole college thing is very scary. So I thought it was a great opportunity to kind of get my feet wet a little bit early and come to college and learn all of these cool things."

How is it still impacting her college career?

"I actually met my now best friend and roommate for two years at WIE orientation...and I definitely thank WIE Orientation for that. I had met her at registration, and I recognized her face, and we both happened to come to WIE orientation, and we saw each other, and we're like 'Oh, my gosh! A face that I know!' It was really cool, because after WIE programming ended, each night we would go and watch movies, and that was definitely kind of the start of our friendship."

As a mentor, Sanders hopes to help facilitate the freshmen's friendships, "Because I gained my best friend, I want to make sure the girls have the same experience that I did. It's really cool to see that, and all the friendships form."

She's also enjoyed watching WIE orientation evolve. "It used to be a little different, but now I think it's really cool that we're on campus for the whole time, because the girls are going to be here on campus, so I think it allows a lot of opportunity for girls to get more exposure to the buildings and just become a little bit more familiar with campus. So that's one really cool thing that I've seen."

Engineering freshmen and their mentors (pink shirts) pose by the statue of the Quintessential Engineer.



She also has enjoyed being a co-student coordinator.

"It's awesome to give back to the program in this way because, like I said, I had so much fun my freshman year."

Co-Student Coordinator, **Siobhan Fox**, shares that prior to coming to college, she didn't really know what engineering was or what she could do with it. Only a handful of students from her high school had actually chosen engineering, or even STEM-related fields. Plus, engineering had never been emphasized in her family; she didn't have a relative or a parent in an engineering field.

"So when I was coming to college," she reports, "I was very intimidated by what this degree could hold. I knew that Illinois was a prestigious program; I knew that it was going to be a very rigorous curriculum that I went through, and I was pretty intimidated."

She recalls that on the first day of her freshman orientation, when the WIE Orientation team welcomed them, their words changed her attitude completely.

"I didn't know anyone in that room. I was the only girl from my high school to come study engineering at Illinois, and I didn't know who to talk to, but I just remember hearing the student program coordinators stand up there and seem very kind and approachable people. They just told us that, 'You're here for a reason. You worked hard, and you got admitted to the College of Engineering. Even if you don't think that this is something you can succeed in, you are here for a reason, and you can absolutely accomplish what you want to here in your four years.' And I remember being inspired by that, and I thought that maybe someday, I can be in the same position, and now I am. So hopefully I can tell all these incoming freshmen that they're here for a reason, and if they put their mind to it, they can succeed, too."

Participating in WIE Orientation was also significant for the other committee members. For instance, **Brooke Newell** shares,

"I think because it does inspire incoming students, so that it does give them a community, a smaller place, because Illinois is so large—a place where hopefully they can find a home, a group of friends, their departments, just a place where they feel like they belong."

Her first time participating, Newell had enjoyed watching the progression, from sending out letters inviting students to attend Illinois, to registration, to WIE Orientation. "It's a pretty neat experience... seeing it from freshmen registration right after we have sent letters out..."



CS freshmen Mackenzie Kirkham and Soumya Kuruvila enjoy the Kahoot game.



Four engineering upperclassmen share with the freshmen about Engineering Career Fair during a workshop the final day of Orientation.

meeting some of these students and how excited they were to register...to getting emails where they're super excited in replying. I think it's come full circle. It's a great thing, the academic staff working with current students and these incoming students. I think that makes Illinois unique."

Angie Wolters also loves the process—watching the students come as freshmen then leave four years later, confident engineers.

"This is my favorite program of everything we do. Because each year it's so exciting to see the new class come in, have their future before them...whether they feel like they're fully prepared and able to do this or they're somewhat intimidated. At the end of these next four years, we see them evolve from these freshmen into amazing future leaders that are going out to change the world. So when we stand up there, and we look out at the freshmen class, it really is touching to see them then and see them evolve into the Elizabeth's and Shibohan's that are here to be our next coordinators."

Wolters touches on the long-term nature of the community and relationships built during Orientation, sharing an anecdote about one student who had come as a freshman. "She was a MatSE, and she met this core group of friends at WIE Orientation. And she just sent us pictures from her wedding, and she had the picture of them from freshmen year, all the MatSE girls together!"

Regarding the Women in Engineering community WIE Orientation helps to build, Wolters received numerous emails and texts in the weeks before

Orientation, wishing the team luck.

"It really makes me realize how wonderful the community we have and the friendships that they build, the friendships we build with them, the multiple layers. Here I have alums that were here as program coordinators who are sad that they're not here. But now we have ones like Molly Pace—these girls came as freshmen themselves and they're going to stand up in front of the girls and talk about this and talk about what they're doing now. It almost feels multi-generational; it shows how important this really is."



An ECE grad student (right) gets to know ECE freshmen during Wednesday's departmental luncheon.

GLAM GAMES CAMP HELPS HIGH SCHOOLERS EXPLORE MATERIALS ENGINEERING CAREER OPTIONS

September 28, 2017

From wacky wires (memory metal) that reshape themselves when immersed in boiling water, to playing with ooy-gooey non-Newtonian fluids, to molding polymers, the 19 high school girls who participated in GLAM (Girls Learn About Materials) GAMES camp from Sunday, June 18th through Saturday, June 24th this past summer learned about a variety of materials. After hearing a mini-lecture about a given material, the girls then got to do fun, hands-on activities about the subject. Many of the participants, who were exploring materials science in order to make college/career decisions, not only learned some things about materials and what materials engineers do, they were exposed to women in materials engineering who served as role models.

The GLAM GAMES (Girls' Adventures in Math, Engineering, and Science) camp, run by Co-Coordinator Jessica Krogstad, a Material Science and Engineering (MatSE) Assistant Professor, and Kaitlin Tyler, a MatSE Ph.D. student, was in its seventh year of operation. Tyler has been serving as the GLAM coordinator for five of those years; Krogstad was in her second year as coordinator, shares why she takes time out of her busy schedule to do GLAM.

"I love it!" she admits. "It's so much fun, and the activities we do are designed to be fun, so it's great to see the girls interacting and getting excited about science."

One reason she loves doing the camp so much is because of the impact a similar camp had on her career choices.



GLAM campers are participating in a hands-on activity that involves ooy-gooey fluids.



GLAM campers are amazed by their creation.

“I did something like this in high school, and that’s the reason why I got interested in the field. It was really captivating, and it was exciting to see all of these different disciplines coming together. So we really work hard to try and demonstrate how diverse material science is to get girls really engaged with it.”

She also appreciates the impact GLAM is having on recruiting here at Illinois, and says that a number of students have enrolled in MatSE as a result of attending. She shares an anecdote about a recent encounter with one of them. Incoming freshmen always take MatSE 182, a survey course; during one session, MatSE faculty

come in and introduce themselves. “I’m so excited because this year,” she explains, “I had a girl come up to me and say, ‘I had you in GLAM, and I’m so glad to be here!’ So even if it’s just a couple, we know we have numbers for the number who matriculate in engineering somewhere.”

Krogstad has two goals regarding the impact GLAM has on girls:

“One, I want to make sure that they know what materials science is and that it’s a viable career path. It’s not as popular as mechanical engineering, so as they’re shopping around, many of these girls are already steered in the direction of engineering or sciences, which is fantastic.”

Her second goal is to keep them in the pipeline all the way—not just to college, but even when the engineering program gets challenging:

“To keep them interested and to get them excited so that they have the confidence to push through their senior year, to stick with it, and especially their freshmen year when they do get into the engineering curriculum, and they know it is so hard, but they had fun at this.”

Krogstad’s observation that many of the high school girls are “shopping around,” appears to be true for several of the campers, who reported that



GLAM camper begins the process of making her creation.

they were seriously thinking about engineering, but trying to settle on which discipline.

For instance, high school sophomore Nicole Southey, indicates that she's considering a career in engineering, but isn't sure exactly which discipline yet, and that's one reason she came to GLAM. "I've done GAMES camp in the past, and I wasn't really sure what material sciences was, so I was able to see what it was like, and it was fun."

Southey indicates that she learned about what a material scientist does. "I got to learn what they do and everything...We got to go into the lab, see all of the things they do and all the materials they have, which was really cool." She also learned what an engineer's workload might be, and also about the process of being an undergrad at Illinois.

Is she headed to Material Science and Engineering? "This seems interesting but I'm also looking at bio-engineering. But I'm definitely thinking about an engineering field."

Another camper, rising high school senior Chloe Trom, reports that she's come to Illinois for multiple engineering GAMES and WYSE camps, and says:

"I'm just exploring the different tracks and fields of engineering to see which one I have a passion for and which one I would like to do in college."

For instance, she's explored aerospace, mechanical, and electrical: "And I really liked those. And this is really cool to see what a material engineer would do. We got to tour labs and see the types of experiments and material they deal with. I'm definitely interested in a lot of the fields I'm seeing."

What did she learn this summer?

"It was mainly just getting a view of this they do. I came in blind as to what material engineers do, but we got to see different aspects of materials and learn different pieces of what they have to master and apply. It was just like all areas of what they do."



GLAM campers proudly show of the sea creatures they made.

G-BAM GAMES CAMP SHOWS HIGH SCHOOL GIRLS WHAT MECHANICAL ENGINEERING IS LIKE

October 4, 2017

On the cusp of making some important life decisions, like choosing where to go to college, what program to enroll in, and more importantly, what they want to do for the rest of their lives, 24 high school girls participated in G-BAM (Girls Building Awesome Machines) GAMES Camp might have had a few of their questions answered. Hosted by the Mechanical Science and Engineering Department (MechSE), the week-long engineering camp from June 18–24 exposed the girls to the kinds of things

they might be doing should they choose a career in mechanical engineering.

According to MechSE Assistant Professor Elif Ertekin, co-director of G-BAM, along with MechSE Associate Professor Matt West and MechSE Educational Coordinator, Joe Muskin, all in their 5th year working with the camp, G-BAM's goal was "to be able to show [the campers] very concretely what Mechanical Engineering is."

And they did so via a variety of hands-on activities, tours, field trips, and a final project. Ertekin reports that the coordinators try to have a healthy mix of tried-and-true activities that they know are very effective, but also try to bring in a couple of new ones every year. So this year, they added a couple of new robotics activities. They also strive to have a nice mix of different types of activities, so interspersed with the many hands-on activities were tours and outings, such as the field trip to the Research Park to visit Caterpillar and a couple of startup, mechanical testing laboratories.

"Mechanical Engineering is such a broad discipline itself, and we want to try to give a sense of that to a lot of the students who are coming," Ertekin explains.

For instance, in one activity, participants experienced what it's like to work in a cleanroom; in another, they designed a prosthetic device, which, according to Ertekin, was not only a good example of how to use mechanical engineering and mechanical design to build prosthetics, but was "a very nice, concrete example of helping people and having an impact."

Some activities were related to the final project they would build later on; for instance, they programmed Arduinos, and also learned how to use CAD (Computer-Aided Design), a computer application that allowed them to design a 3D object. And by the week's end, they were able to print the object they'd designed on the 3D printer they were building.

The capstone project of the camp was Build Your Own Stereolithographic 3D Printer. So



A G-BAM GAMES camper using a handsaw for the scapstone project: Build Your Own Stereolithographic 3D printer.

over the course of the week, the girls did just that, actually designing and building a working 3D printer (a quite new technology), and were able to print the tiny 3D object they'd designed during another activity. One reason the 3D printer activity was a favorite with the camp directors is that it integrated so many different elements of engineering. For the mechanical design element, students had to build a moveable stage. For the electronics, students did the wiring and circuitry needed to control the motion of the 3-D printer's stage. Students also learned some coding: they wrote small programs, which they controlled remotely, sending the signals wirelessly to the Arduino via their cell phones.

"They come up with really creative ideas for how to do this, Ertekin brags. "It's amazing."

Another fun activity the campers did was Under the Sea: Aquatic Robotics, which involved navigating fish robots that were swimming around in pools. The activity was led by MechSE Assistant Professor Mattia Gazzola, whose research involves bio-propulsion in fluids. "So swimming and flying and things like that," he explains.

Gazzola first taught the girls a few principles of biopropulsion: how a swimmer's shape, body, and the material it's made of impact its speed.



Two G-BAM campers putting together pieces for their project using a drill.

Then the girls were given a fish robot and asked to modify its shape to see if it would swim faster by, say, attaching some foil to the fins. This initial activity was also designed to help the girls become more adept at maneuvering their robot fish because, for the pièce de résistance of the event, they would have to pilot their fish through an obstacle course—a baby swimming pool filled with 3D-printed obstacles strategically placed around the pool.

Are the fish robots part of Gazzola's research? "Well, actually, you can buy them on Amazon," he confesses. "These are very simple ones. I think they are like five dollars," and explains that in his research, he mostly does simulations, "But these are still fun to play around with."

Gazzola reported that his activity had gone great. While the girls had encountered some issues because there were only two radio channels, so sometimes one group's remote was interfering with another's, he says, "But now I think they found a stable configuration. They are doing well."

The girls weren't the only ones having a good time. "I'm having fun," says Gazzola. "Actually I'd like to try one of these toys myself because I haven't yet. I should hijack one of them."

Given that the GAMES participants are high school students, are the



Two G-BAM Games campers work together on their capstone project.

activities that are done during G-BAM a sort of watered down version of the kinds of things they do in their labs every day? Ertekin says no.

“What we show them is not too many steps removed from what we do in our research laboratories,” she explains. “And I think that’s really important for them to see that what they’re doing is really not that far away from the research world, because that really helps to demystify what it is that engineers do.”

Ertekin claims that the demystification of engineering aspect is key in recruiting students into engineering:

“I think that’s very important for them to be able to understand, ‘Oh, this is accessible to me. It’s not something that’s out of reach; it’s something that I can be a part of!’ And once you can visualize yourself doing something, you become much more likely to take that on, once it stops being so mysterious.”



A G-BAM camper excitedly testing out her finished aquatic fish robot.

She adds that a lot of the camp’s activities are designed to be able to accomplish this goal:

“showing the students who come and spend time with us what it’s like to be an engineering, giving them a real hands-on design activity, and then actually connecting that activity to research activity going on at the university, so they can see that what they’re doing, it’s not so watered down. It’s actually very real.”

Why do Ertekin and other researchers who take part in the camp dedicate their time and energy to the outreach? Ertekin, for example, believes that it’s really valuable and important to bring high school students to spend time on campus and to show them what it’s like to be a student at Illinois studying Engineering.

“I think a lot of younger students have some idea of what engineering is,” she explains, “but being able to spend a week living here on campus, interacting with other students, undergraduate students, graduate

G-BAM campers testing their fish robot outdoors on the Engineering Quad.





A fish robot made for the Under the Sea activity being tested underwater.

remember what got me excited about engineering in the first place. It helps me keep my perspective and remember why it is I'm doing what I'm doing."

She also finds it quite rewarding to see how "enthusiastic and creative and bright the upcoming generation of engineers is." She likes being able to take a break from the busyness of her job, "to be able to dedicate a week to being able to work with a group of high school students who are so creative and energetic, and I just dedicate myself to that for that week, and it's refreshing, and it keeps my perspective broad."

students, and faculty, and working on engineering design projects really helps them to understand in a more concrete way what it is they would be doing as engineers. And I think that's really important and valuable for when they make their career decisions."

She further believes the impact of the camp to be "right at a time when a lot of attendees are starting to think about where to go to college and what program to enroll in, we are able to show them what it is that they would be doing if they choose to pursue an engineering career. And so I think the impact is really being able to kind of concretely show them, 'Hey, this is what you would be doing at this engineering setting studying engineering, and what kinds of options will open up to you once you get a degree in engineering.' So we're able to show them that, and hopefully motivate and encourage them to pursue this field by showing them how exciting, and dynamic, and creative it can be."

She adds that Engineering is starting to track and actually see that most of the students who attended GAMES camps chose to pursue engineering careers, many of them at Illinois, "and we think that's wonderful," she admits.

So what do she and the others involved with G-BAM get out of it?

"It's a lot of work," Ertekin admits, "but it's really nice to be able to have this chance to



A camper remote-controlling her fish robot while it swims through the obstacle course.

DURING SWE'S ROUND ROBIN, GIRLS OF ALL AGES BECOME MORE WELL-ROUNDED IN ENGINEERING DISCIPLINES

November 2, 2017

On Saturday, October 7th, about 50 girls from all over the state of Illinois converged on Loomis Lab for Engineering Round Robin. Hosted by the Society of Women Engineers (SWE), the outreach program, with its appropos Robin (and Batman) theme, was designed to expose young women to different engineering disciplines. According to Katherine Kiang, a SWE Outreach Co-coordinator, they also hoped to "provide them some perspective on what it's like to do engineering as a career." Designed for girls in grades 6 through 9, the program was primarily targeting younger girls in order to get them exposed and interested at an early age. However, older girls, such as high school students, were also welcome.

The day kicked off at 9 am with a welcome presentation immediately followed by half hour rotations throughout different classrooms, where the girls split up into groups to learn about different engineering disciplines.

The disciplines included bioengineering, chemical engineering, computer engineering/computer



A Round Robin participant doing a hands-on activity.

science, and civil and environmental engineering. The bioengineering and chemical engineering rotations also included some materials engineering in order to give the girls as much exposure as possible.

The afternoon consisted of a student panel where Illinois students answered questions from the girls or their parents about anything, followed by the Rube Goldberg Challenge.

Two students participating in a chemical engineering activity.



The Batman-and-Robin-themed challenge was designed to mostly emphasize mechanical engineering: students were to create a Rube Goldberg machine that set off a buzzer, which served as the bat signal. (Rube Goldberg was a famous cartoonist known for his depictions of complicated inventions that accomplish a simple task). A Rube Goldberg machine usually uses a chain reaction to accomplish a task, and in this case, the girls were to make it primarily out of simple machines and any other materials they could find. Once all the teams were finished with their machines, the event concluded with

an informal walk-around where the girls showed off their inventions to the outreach leadership, parents, and other visitors, then ended at 3pm.

Kiang explains why they chose the Rube Goldberg challenge for the girls. She calls it:

"a really good way to utilize a lot of different skills. It's a good way to build teamwork and collaboration, and we also think it's really fun."

Waking up early to spend an entire Saturday doing something centered around academics might not initially sound the most appealing to young girls. For example, Ella Wolters, a local high school freshman admits that she only came initially because her mom told her, "Ella, you have to go to this," then acknowledges, "My mom is Angie Wolters. That's kind of why I'm here." (Angie Wolters is currently the Director of Women in Engineering at Illinois, and over the years, has been involved in a number of engineering programs and outreach events, including GAMES camp.)

During the event, though, Ella's eyes were opened and she was glad she had participated:



SWE Outreach Leaders look on as participants record a successful iteration of their completed project.

"So, yea, she wanted me to come, she confesses. "At first, I was kind of opposed, but now I'm like, 'This is cool!'"

While she has never officially attended GAMES camp, Ella has come with her mom on occasion, and says, "It kind of got me interested a little bit." And like all kids who have pushed back against the career their parents are encouraging, she admits to doing so too.



A team of Round Robin participants pose behind their completed project .

"Like I said, I was kind of against it because she pushes it so hard. But I understand why now,"

she admits, proving that mom is always right. However, while mom Angie majored in Civil Engineering, Ella's little rebellion is that she's most interested in Bioengineering at present.

But not all girls have parents like Ella who understand the importance of exposing their daughters to STEM fields early.



Participants teamed up to make the strongest bridge.

That's why, for the first time, the small parent session SWE hosted at the end of the day was divided into two sessions: one for parents of high school girls, which was pre-college oriented; another, for the parents of the younger girls, was to show them how they can support and encourage their daughters to beat the stereotypes against women in STEM fields. Kiang explains why this is so important.

"They [parents] might not know about the bigger picture skills emphasized at our events, like teamwork and problem-solving skills. I think that's what makes someone more of an engineer than just being good at math and science... An engineering mindset is unique, but it can be difficult for parents to understand if they don't already have that background."

Kiang is incredibly passionate about doing these events, and hopes the girls can take away a lot in order to make changes in the STEM fields for women: "I think it's really important to encourage girls to consider math, science, engineering, because it's very true that we have an innate bias against it in society. It's getting better, but it's not a problem that's going to be fixed overnight."

Kiang reports that she also does the event because she enjoys teaching. "It's a lot of fun for me as well. I almost became an education major, so I really enjoy working with younger kids and teaching

them whatever it is, and seeing that progression at different ages."

She also finds it rewarding to run into students she's worked with who end up at Illinois. "Sometimes we have some girls that come to our high school event, and a year or two later they'll be here at U of I, maybe even in SWE. Seeing that impact is really rewarding. It kind of reminds you of why you do engineering."

She also says it's fun to ditch studies for a bit.

"It's a good way to take your mind off of school for that one afternoon, even if for a couple hours. Especially for the younger girls, who might just realize something and think that it's so cool."



SWE Round Robin participants in the Civil Engineering rotation test the strength of their bridge made of candy, straws, and toothpicks.



A Round Robin participant does a chemical engineering hands-on activity.

A perfect example of the impact of outreach programs like Round Robin was Joy Chen, an Illinois freshman in bioengineering. From the local area, Chen went to many of the events hosted by SWE when she was in middle school and high school, and acknowledges that those events are what originally got her interested in engineering.

“Being able to teach these girls all about engineering the way that I got interested in engineering is really amazing,” she says.

One participant for whom the day helped in her decisionmaking was Alyssa

Sinclair, a rising junior at Warren Township High School in Gurney, Illinois. Sinclair says she’s been in an engineering program at her school since her freshman year.

“I’ve been really interested, but I wasn’t sure what field I wanted to specifically go into, so I figured this camp would be good to see all the different types of engineering.

Sinclair reports that in the Materials Science workshop, she learned how different materials are used to create many different objects, and how different materials can have different properties that would be best suited to different types of products. She reports that she likes industrial “because “I really enjoy computer-aided design, and there’s a lot of that in that specific field.”

Natalie Alvarado, a senior at Wood Park High School, reports, “I’m really interested in engineering, but I kind of want to figure out what type I’m interested in, so I want to get more information on the different types that there are.” Regarding the electrical engineering activity, she reports, “I like it! It’s cool.”

Also pretty much sold on engineering was Simone Gilbert, a 7th grader at Urbana Middle School. Gilbert, who has done two other SWE activities, came to Round Robin “to learn more about engineering.” The seventh grader thought the activities were fun and has decided that she wants to be an engineer, preferably in civil engineering.

Written by: Patrick Pavilonis



Leaders of the SWE Round Robin outreach event.

GIRLS EXPLORE ELECTRICAL AND COMPUTER ENGINEERING DURING GLEE GAMES CAMP

October 20, 2017

At the 2017 G.A.M.E.S. (Girls' Adventures in Mathematics, Engineering, and Science) camp during the week of June 18–24, 14 students attended the GLEE (Girls Learning Electrical Engineering) portion of the camp. These 14 girls included 7 from the suburbs of Chicago, 4 from out of state, and even one international student from Turkey. GLEE allowed girls to get their hands on electrical engineering components in a week-long adventure in circuitry and solar power.

GLEE has been run by ECE (Electrical and Computer Engineering) professor Lynford Goddard for the past eight years. This year, his 14 students undertook a couple of projects to get them familiar with the core concepts of circuitry and electrical engineering.

The first project relates to something no high schooler could ever be without: their cell phones. The girls learn how to make a radio phone (an FM transmitter circuit), which works in a very similar fashion to a walkie talkie. The circuit transmits voice patterns into a voltage signal, amplifies the signal, and then radiates it out through the attached antenna. Anyone tuned into the right frequency can then use their own circuit to decode the signal back into a voice pattern, which can be played out through speakers.

The girls also attended various classes covering a broad range of topics including solar power, algorithms, nanotech, and optics. They also got to tour a few university labs and buildings related to ECE. This year, they were generously invited into Professor Grace Gao's lab to explore GPS and the robotics involved in unmanned aircraft. Goddard explains, "In past years we used to go to the solar house, but that has moved. Instead we will be seeing Grace Gao's lab. She does GPS, robotics. Her main appointment is with aerospace, but she is affiliated with ECE so she teaches some ECE courses, so they'll go see her research lab."

Another project that the girls at GLEE got to explore was solar cells and the circuitry that goes



A GLEE camper works to solder her radio phone circuit.

into turning solar power into electricity. When asked about some of the changes he has made to the project, Goddard comments, "We are always reinventing the solar selectivity. The very first couple of years, we did experiments using a Tollens reagent to make a metal insulator, semiconductor solar cell. It didn't produce great results, so we are trying to do something different this year – a PIN solar cell." A PIN solar cell is another name for a thin-film solar cell, which are fairly easy to make and often perform more reliably than other solar cells on the market.

When asked why he has continued to head up the GLEE G.A.M.E.S. camp for an impressive eight years, Goddard replies,

“It’s a great opportunity to interact with the next generation of students. They are very motivated and excited to be here. It’s a lot of fun to work with them and to see the excitement that they have when they go through the activities.

He adds that he also enjoys working with the Illinois students who are helping with instruction:

“It’s very rewarding. It’s two-fold. One, I get to interact with high school students and motivate and inspire them. The second part is that the graduate and undergraduate students that serve as coordinators and assistants, I get to work with them. It’s really good to work with my students and meet new students participating as lab assistants.”

Over the past eight years, Goddard has taught around 150 girls the basics of ECE. About 30 of those girls have enrolled at the University of Illinois for engineering, with eight or nine staying with ECE as their major.

When asked about how he plans to grow GLEE in the next couple of years, Goddard responds, “We don’t really have a strong method of recruiting underrepresented students. We are working at trying to recruit students.” He especially wants to rely less on word of mouth for the camp to get out and instead use more social media outreach to get prospective campers interested.

Goddard concludes, “We are thankful for funding and donors. Past year, we started an individual donation from Gell Eleblossom and from Rockwell Collins scholarship. Those have helped three of the students attend this year, so that’s a good sign that our message is getting out and people are willing to contribute.”

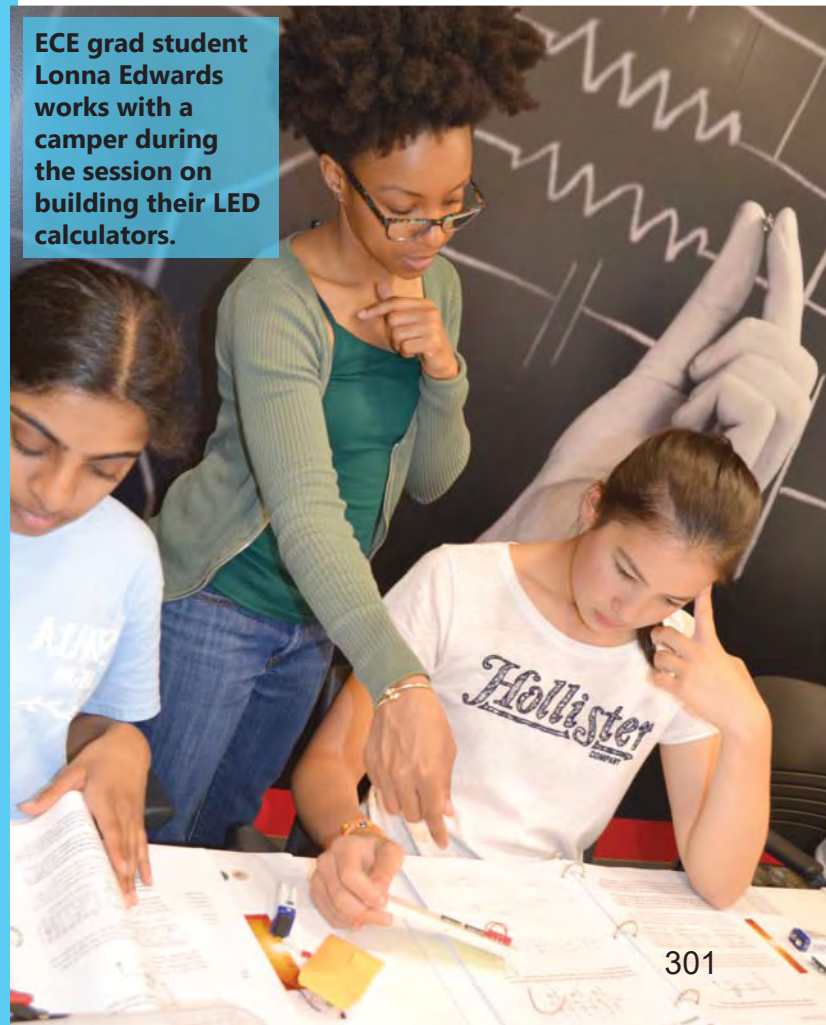


A GLEE camper works in the Optical Lithography Cleanroom.

The GLEE portion of the G.A.M.E.S. camp looks to be moving in a good direction, and at the end of the week-long camp, the girls were extremely satisfied with what they had learned and the projects they had completed. This reporter hopes that they use their radio phones to keep in touch!

Written by: Nick O'Connell

ECE grad student Lonna Edwards works with a camper during the session on building their LED calculators.



MOANA-THEMED MOMMY, ME, AND SWE MAKES A SPLASH WITH YOUNG GIRLS (AND THEIR MOMS), AS THEY LEARN ABOUT ENGINEERING

November 14, 2017

From building a boat (then watching it sink), to building a house (then watching as it was demolished during a hurricane)—all scenarios Moana might have experienced—fourteen 4th–6th grade girls gathered at the John Deere Pavilion on Saturday, November 4, to participate in Mommy, Me, and SWE and learn a bit about engineering. While the main goal for this engineering outreach event hosted by Illinois' chapter of Society of Women Engineers (SWE) was to educate girls about different engineering disciplines, they didn't do it all alone. In a special twist, the girls' moms were in attendance, too, participating in the activities right alongside the girls! The SWE members who participated hoped that this event might help the girls become interested in engineering, and that their mothers could learn more about it as well, in order to encourage them towards it.

For instance, SWE's co-chair of the event and sophomore in Civil Engineering, Kylie Burkett, hoped to get as many girls there as possible, in order to tell them:

"Hey, you can be in STEM! You can do science! You can do math! You can be anything you want to be; you just have to follow your heart!"

And that was the exact reason that Ashantie Files, mother of local 5th grader Camille, brought her daughter to the event:

"I thought it would be good for her to see that this is a field she can get into," Files admits, "a field that she'll have a lot of support in. And just kind of see what they have available."

To make the day a bit more fun and exciting for the girls, the theme of the whole event was about Moana, a recent popular Disney movie about a young Polynesian princess. The girls participated in a total of seven activities, each of which introduced

HOW FAR WILL YOU ENGINEER TODAY

SWE Outreach Leaders (clockwise from the top left: Kylie Burkett, Courtney Duncan, Katherine Kiang, Katherine Bohorquez, Megan Fox).



the girls to a different engineering discipline and incorporated Moana in some way or another. For example, in the civil engineering activity, the girls had to build a house out of Play-Doh,



Elly Peirson and her daughters, Soraya and Leila.

“They like to cook; they like to code; they like to mix properties, make potions. And so I wanted to let them understand all of the different types of engineering that there are so they can look at different career options that are non-traditional for girls.”

The day even included a quiz for the girls to take that asked them questions in order to determine their personality, then matched them up with what type of engineer they should be in the future! (Lest the reader question the effectiveness of the tool, many Illinois Engineering students who participate in SWE also took the quiz, and nearly all of them were matched with the major they currently are in.)

Katherine Kiang, one of SWE’s outreach co-directors, was very excited about having girls in grades 4–6 at the event. “A unique thing with 4th–6th graders is they’re kind of in a transition period right before middle school, where they might not necessarily have quite the same enthusiasm a little kid has about things that are flashy-sciency, though we want to maintain that enthusiasm that might have been sparked.” Kiang says.

“Something interesting with this group,” she adds. “They do have excitement, more so than middle schoolers. But they understand more than younger kids. So that’s always a really exciting age group to see how that works together.”

popsicle sticks, and paper. When each girl was done creating her house, it then had to withstand hurricane-like conditions like those Moana might have encountered (meaning it was blown with a hair dryer then splashed with water).

For the industrial engineering activity, girls used aluminum foil, toothpicks, and pipe cleaners to build a boat (Moana was in boats a lot), which was then tested by being placed in a bin of water and loaded down with coins, to see how much weight it could hold, thus proving how sturdy it was. Another activity they did involved “the claw,” which was a mechanical engineering activity that used hydraulics and syringes. For a bioengineering activity, the girls were taught about genetics and Punnett squares, and how engineering can be applied to genetics to improve the lives of patients with certain diseases. Each activity was run by one or more SWE students from the activity’s engineering major, if possible, who would be able to tell the girls (and their moms) more about each discipline.

One local mother, Sarah McCormick, who actually brought both of her daughters to the event, hoped that her girls would be able to find which specific disciplines relate to their interests the most:



Miranda Burgos tests to see if her house made out of Play-Doh, popsicle sticks, and paper can withstand hurricane-like conditions (blown with a hair dryer then splashed with water).

Kiang, a senior in Bioengineering, has been involved with SWE's outreach committee since her freshman year and even almost became an education major.

"I've always been passionate about teaching children and inspiring the next generation of engineers," she acknowledges.

Kiang is on a mission to create events for SWE that are self-sustaining, so she can have a lasting impact even after she graduates. SWE Next is one program she's working on, which focuses on girls in grades K–12. It's designed to inform girls about local STEM activities and help them create a STEM club for girls at their schools.

The other SWE outreach co-director who helped plan the event is environmental engineering major Megan Fox. Fox has been involved in SWE's outreach committee for the past two years, and has loved every bit of it:

"It's been the joy of every Saturday, and getting to see the kids learn about engineering, it kind of takes you back to when you were a kid and seeing what STEM did for you and how you got to where you are now. It definitely makes you a lot happier, and all the hard work of engineering a little more worth it."



A Mommy, Me, and SWE participant and her mom.

Other members of SWE heard about the event through the "SWEekly," a weekly newsletter published by SWE that informs members of events in which they can participate. Gwen Kramer, a freshman in civil engineering, who is also a swim instructor, says she loves hanging out with kids. She indicates that it "looked like an awesome event," so she decided to attend. Debbie Wiegand, a sophomore in aerospace engineering, worked at a day care throughout high school. Her experiences there actually inspired her to join the SWE outreach committee, which has allowed her to do something she loves: "working with kids and introducing them to engineering."

The event even included students from schools other than University of Illinois. Sarah Lehman is a freshman in mechanical engineering at Olivet Nazarene University (ONU). ONU partnered with Illinois' SWE program for the event, and sent Sarah, along with a few others, to participate. Sarah loved the experience, especially "working with the kids and seeing how creative they get."

Written by: Patrick Pavilonis



Sarah McCormick and her two daughters: Ella and Ali McCormick.



STEM STUDENT SPOTLIGHT



STUDENT SPOTLIGHT: HANI AWNI—ENGINEERING FOR SOCIAL JUSTICE SCHOLAR

January 20, 2017

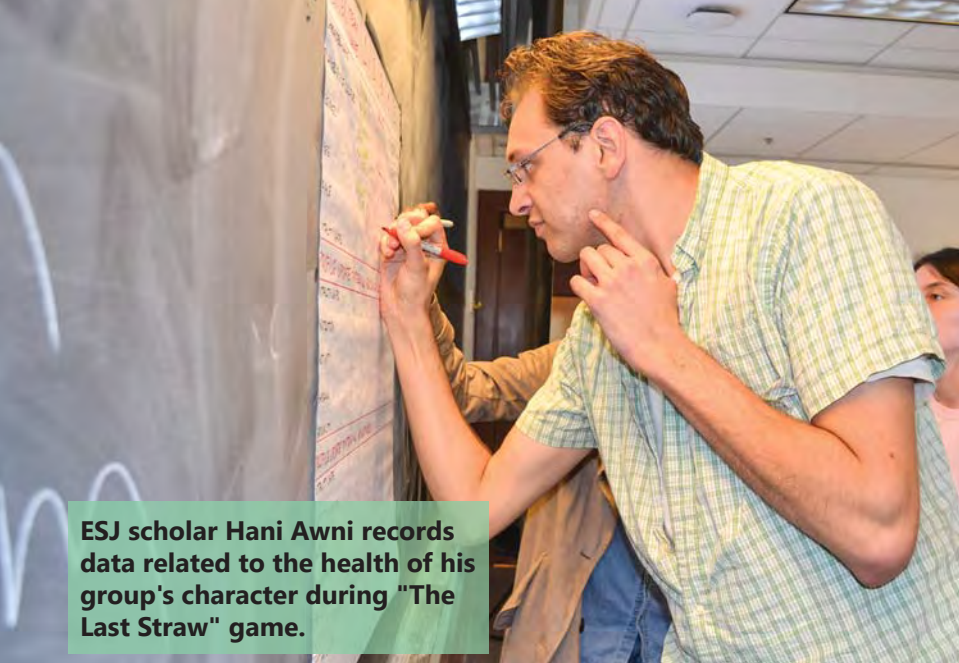
Hani Awni was not always interested in the role engineering should play in regards to social justice, but after venturing into the real world, he realized there was more.

Hani is an engineering student who studied what he found “technically interesting” during his undergraduate years, but following two years working in Silicon Valley, he was left looking for more. Hani feels his undergraduate degree left him without a major theoretical component, the connection between engineering and social justice, which he is now gaining in the Engineering for Social Justice Scholars (ESJ) program at the University of Illinois at Urbana-Champaign. This program is designed with two goals, first to encourage engineering students to “rethink the role that engineers play in social justice” and second, to give students an opportunity to participate in outreach programs that get CPS students involved in STEM.

Hani had an interest in STEM from a very young age. As a child, he wanted to be an “inventor doctor,” which later changed to engineer. His creativity and passion for STEM continued throughout his life as he fondly remembers middle school activities where he worked in groups on challenging projects where he was required to problem-solve. Flash forward a number of years, and Hani is now helping other students create their own fond STEM memories in middle school. Hani shares:



Illinois Engineering for Social Justice Scholar, Hani Awni



ESJ scholar Hani Awni records data related to the health of his group's character during "The Last Straw" game.

"When I was with the eighth grade group, I was working with four kids, and I was very impressed with how they took to it really quickly. I realized they wanted to explore."

Participating in the ESJ program has not only broadened his awareness of the influence engineering can have on social justice, but it also allows him to help younger students gain an interest in STEM. Students in the Engineering for Social Justice Scholars Program participate in outreach events on Saturdays for several consecutive weekends during the school year, where they engage with CPS middle school students on a number of fun STEM activities. During one activity that Hani particularly enjoyed, he showed students a programming language called Net Logo, which allows students to create a simulation of ant colonies using simple algorithms. Students were excited to be able to program these interesting simulations, and he remembers one student specifically being interested in the intersection of programming and biology that this activity demonstrated.

When asked about his own role in social justice, Hani says:

"I really think I need to do more service time. More service projects... I'm an upper-class white male, and there are ways I am more privileged... It's one thing to recognize that conceptually, it's another thing to know that there are literally problems I am blind to."

In engineering education, he found that there's a big focus to teach "design thinking" and a belief that there's isn't much of a connection between STEM and the humanities. Hani shared, "If we're not also teaching students these models that come from critical theory, then they'll be using design thinking, but they'll just be more effective at doing the wrong thing."

Engineering for Social Justice Scholars was created with the intent to get engineering students both involved and interested in the role they play as engineers when it comes to social justice. Students like Hani are a perfect example of how STEM and the humanities can intersect, and have a positive impact on the community around them.

Written by: Ericka Hamm



Hani Awni presents a spoken word during the final session of the class called STEMposium, a collection of skits and spoken words related to engineering social justice which was presented at the Illini Union courtyard café.

**Carlos Renteria
(center) works with
BioEngineering
GAMES camp
participants during
one of the sessions
he taught.**



BIOE'S CARLOS RENTERIA: PASSIONATE ABOUT EDUCATION, CURING ALZHEIMER'S, AND OUTREACH—PARTICULARLY INTRODUCING HISPANICS TO STEM

The more you learn, the more you can do. — Carlos Renteria

October 26, 2017

This was the attitude Carlos Renteria's dad instilled into him growing up. And it appears to have worked. Currently a PhD student in Bioengineering (BioE) and conducting research in Professor Stephen Boppart's Biophotonics Imaging Lab, Renteria dreams of becoming a university professor to both teach and do research. And while he's worked hard to get to where he is today—going for a Ph.D. at a top Engineering school—Renteria says he owes a lot of it to his dad.

"My dad was a very strong influence in terms of instilling education values in me. He really emphasized doing well in school and getting involved. The more you learn, the more you can do," he emphasizes.

Born and raised in Phoenix, Arizona, Renteria was a first-generation 4-year college graduate. His dad had gotten a community college degree, but wasn't able to get a Bachelor's in Architecture like he'd hoped. "I was the first to get a bachelor's degree," Renteria explains.

While he thought science was cool growing up, Renteria had actually hoped to fulfill his dad's dream: "I wouldn't say it [science] was something I was super invested in as a little kid. I actually wanted to be an architect growing up."

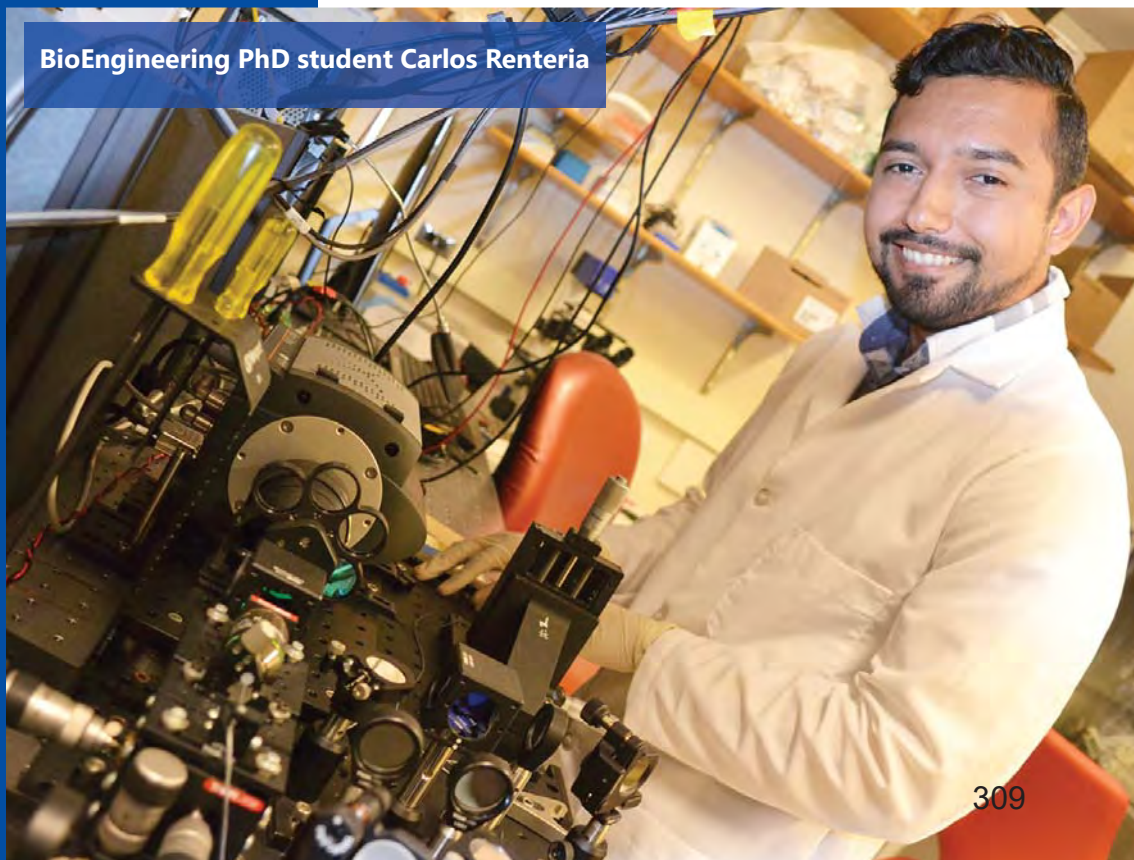
It wasn't until his sophomore year of high school, during a biology class, that the light

bulb went off. "I learned to love biology," he reports. So during his junior and senior year, he was part of the IB (International Baccalaureate) program. Similar to AP courses, it also includes creativity, action, and service portions that encourage involvement and leadership; plus students who score high enough on specific courses can receive college credit for those.

Other role models who impacted him significantly, in addition to his dad, were his teachers; he had really great biology and math teachers who encouraged him towards STEM.

"I feel like they really had a passion for what they were teaching, and that kind of made me realize some of my strengths as well. I realized that I really enjoyed mathematics, and I felt like it was important for me to join a field that was pretty math intensive. So I kind of discovered biomedical engineering."

Renteria reports that he had been interested in imaging at the time. Imaging was the one thing that



BioEngineering PhD student Carlos Renteria

he had been most interested in when he found out about biomedical engineering. After learning about all the sub disciplines, he settled on bioengineering.

“I thought that imaging was a very cool aspect of it that incorporated my desire to apply engineering principals and fundamentals via imaging to study and understand certain biological phenomena.”

And one of the biological phenomena he's interested in? Alzheimer's.

His father had it when Renteria was growing up, and he'd like to find a cure for it. So one of his research interests is neurodegenerative diseases. He admits that he'd like to cure some:

“Finding ways to alleviate those symptoms and potentially work your way to a cure, is what I would ideally like to do. There are a lot of neurodegenerative diseases, and there's a lot of neurodegeneration that occurs as people get older. Studying things like that can be very beneficial for learning what we can do about them.”

While he's never taken any coursework about the brain, he has done a lot of independent research about the brain and neuroscience. “As I do more and more research, I'm learning more and more



Carlos Renteria in front of Beckman Institute.

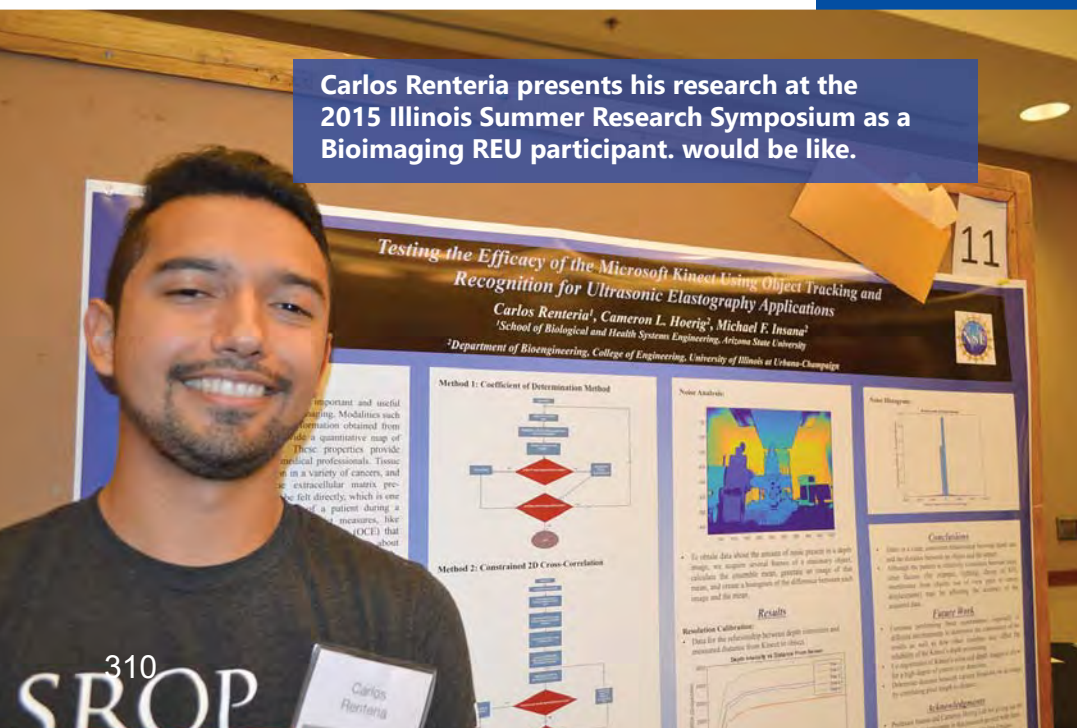
about the specific things that I'm looking into as I'm reading these papers.”

And while he plans to take a course in neuroscience, he also hopes to use engineering to help him learn more about the disease. “I felt like establishing the engineering fundamentals is very important, so that you develop the technologies and technique to study the specific thing you may

be looking at. I feel like that's a good foundation to have in order to study specific things.” Once he learns more about those, he hopes to have “a better appreciation for the field.”

So it was his dream of curing Alzheimer's that has primarily set his trajectory over the last several years. Deciding that the MRI could help solve Alzheimer's, as an undergrad in Arizona, he worked in the Prognostic Bioengineering Lab, which was involved in imaging research. There he developed an algorithm to co-

Carlos Renteria presents his research at the 2015 Illinois Summer Research Symposium as a Bioimaging REU participant. would be like.



register animo-histone chemically stained images with anatomical MR images. While the research at the lab was cancer focused. He felt the image processing fundamentals and skills sets would apply to other imaging techniques.

And they have. The image processing learning he gained from his initial undergraduate research opportunity gave him a solid fundamental understanding of a lot of the underlying math. Plus, it led him to participate in Illinois' 10-week Bioimaging REU. During the REU, he not only got to focus solely on research for the whole ten weeks, but it also gave him insight into what graduate school would be like. While he had done research at Arizona State, he had primarily been focused on doing course work with a little bit of research. The REU was his first glimpse into what it would be like to mostly focus of research, which, he says, "was a lot different than what I had at first anticipated it would be." He calls it "still busy, but...a different kind of busy." Even now, though he's taking course work in graduate school, he reports that he's mostly reading papers or analyzing data.

Plus, the Bioimaging REU not only further cemented Renteria's love of imaging; it also set his course for the next six or so years of his life:

seeking a PhD in Bioengineering at Illinois while conducting research in Stephen Boppart's lab.

While he's still doing his independent Alzheimer's research (readings he's done whenever he gets the chance), he says it's changed since coming to Illinois. Before, he had done a generic overview of it and the behavioral outcomes of the disease. This past year, however, he actually started focusing on what was actually going on with the disease. He wrote a paper on Alzheimer's for a class last semester, and while reading "discovered some underlying molecular issues and proteins associated with the disease, and how the neurodegeneration starts. It wasn't until then that I had a better idea for what was going on."

The project helped him understand mechanisms behind the disease, which he believes will be helpful as he pursues his scientific career.

Has Renteria pretty much determined that he will research Alzheimer's for his dissertation?

"No. Yes and no," he prevaricates. Intrigued by the idea of studying the retina and photoreceptors too, he may combine them with his earlier passion—the best of both worlds: "There are some things you can study in the retina that are also related to Alzheimer's and other neurodegenerative diseases."

Carlos Renteria at work in Professor Stephen Boppart's lab.



Renteria believes that the imaging research that he's currently conducting in Boppart's lab will help elucidate information about the brain, and the retina, and he hopes to use them as techniques to study the mechanisms of Alzheimer's and other neurodegenerative diseases as he progresses through his career.

Along with research, Renteria also wants to teach. He served as a TA last year for the first time, and learned a lot from that experience. "I realized how difficult it is, but it is also very rewarding. And after that, I realized I did want to teach a little more, because I think education is one of the most valuable things that we can have. That was a value that I got from my dad."

He would specifically like to teach people about signal imaging and processing. "I really think that having a good educator is very valuable," he admits. "I feel like being able to get my skill set in teaching better, I could potentially make an impact on someone's life."

When Renteria was in high school, did he ever think he would be where he is today?

"No, I didn't," he admits. "I didn't want to be a professor in high school. I didn't want to teach. I didn't want to do research. I just eventually got here." Over the past several years, he's gradually sharpened his focus; he's considered doing clinical research with an industrial focus rather than an institutional focus, and at one point was thinking about making medical devices. "So I was all over the place where my career interests were, and I eventually found myself here. And I like where I am."

"I am really happy that I ended here," Renteria adds. "I owe a lot to everyone who has taught me and educated me. I am very grateful and thankful."

Along with curing Alzheimer's and researching the Retina, another passion of Renteria's is outreach. For instance, this past summer, he did the BioE GAMES camp, BioE's Exploring Your Options in Engineering camp, and another. He says he got involved in outreach as a TA last year:

"I decided that this sounds really fun," he admits, "and this is something I was

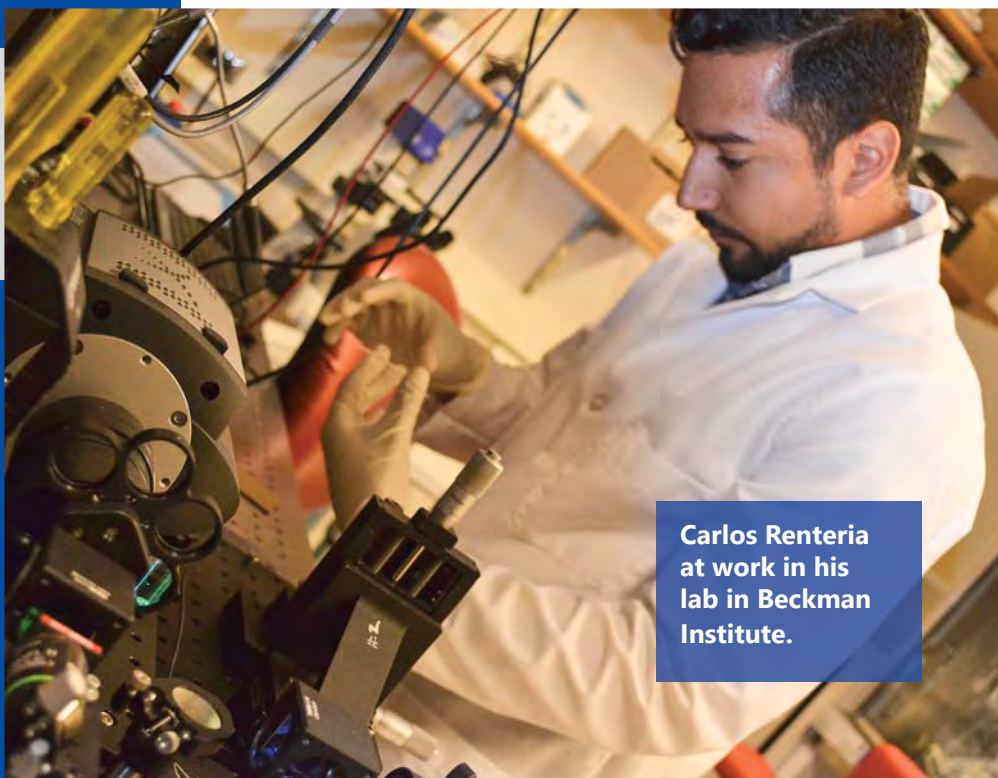
to do." So he got involved in hopes of giving back to the community.

"I feel like it's important as an academic to give back in whatever way you can. Education is something I really value," he acknowledges "I would like to not just teach and do research, but being able to reach out to groups of people or students and get them interested in science and engineering is a key core of what I want to do in the future."

Coming from a Hispanic background, he also hopes to impact the number of Hispanics in STEM. He reports that the percentage of Hispanics enrolled in college is smaller than other demographics, and the higher one goes, the larger the discrepancies.

"Being able to make those discrepancies smaller is near and dear to my heart." So he hopes that outreach activities that target those specific demographics, such as Hispanics, might help to make those discrepancies smaller.

"That way there's a lot more diversity in the STEM fields," he concludes. "Doing research and teaching is cool and great, but at the end day you want others to get interested after you're gone. Outreach is getting people interested."



**Carlos Renteria
at work in his
lab in Beckman
Institute.**

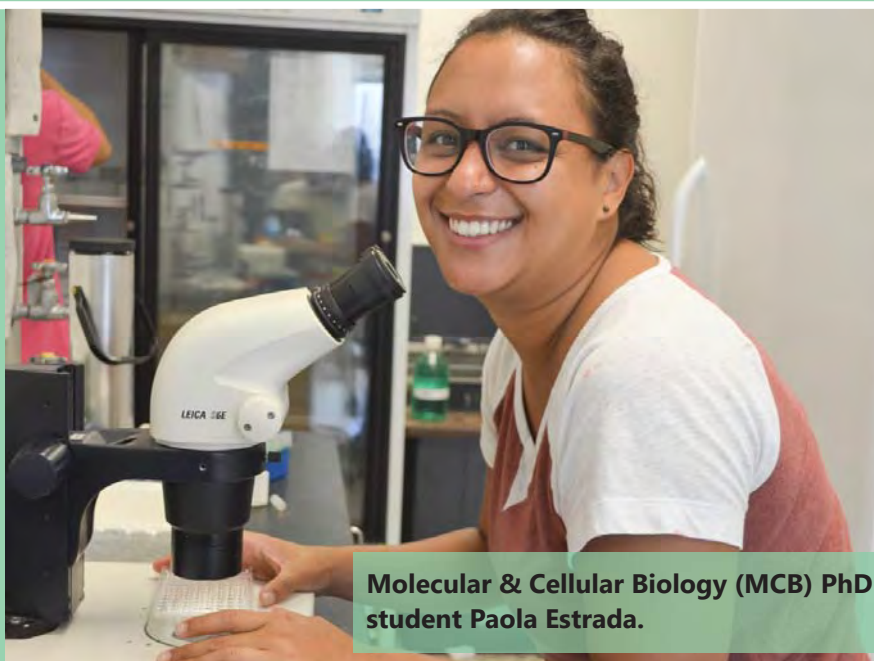
MCB'S PAOLA ESTRADA—PASSIONATE ABOUT RESEARCH & GETTING STUDENTS EXCITED ABOUT SCIENCE

November 9th, 2017

PhD students, as a general rule, have very little free time—most of their waking hours are spent holed up in some lab doing research. The precious little free time they do get, most choose to use it getting caught up on sleep or on food—or to socialize. Not Paola Estrada, however. This summer, the MCB PhD student took a break from her research to try to get 27 Urbana High School (UHS) students interested in science and engineering. Involved in MCB Day, the first day of I-STEM's summer camp this past August, Estrada helped to expose the high schoolers to some of the basics of microbiology. Ironically, it involved forensics: the MCBees used a classic detective game of "Whodunit?" in which students used science to solve the murder of a grad student, and forensics is what brought Estrada to the US and set her on her journey as a researcher.

Born in the U.S., Paola Estrada grew up in Colombia, South America. She didn't originally have her sights set on being a researcher in Biochemistry; her favorite subjects in school were actually history and economics! However, because she anticipated going into a criminal justice field, when the time came for her to attend college, she moved to New York to live with her aunt so she could go to school in the U.S.

Moving back to the States to undertake her education wasn't problem free, though. One big

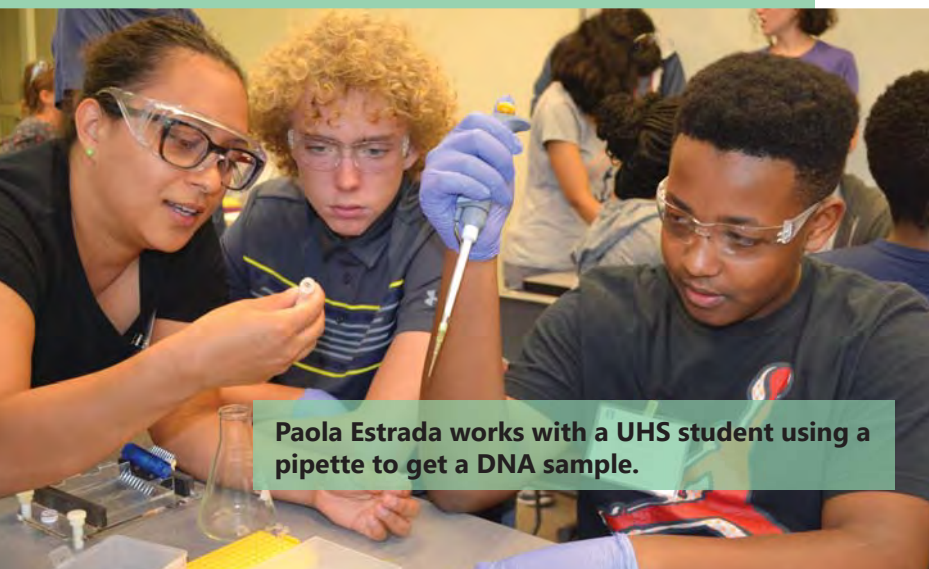


Molecular & Cellular Biology (MCB) PhD student Paola Estrada.

challenge she had to overcome first involved the language barrier. Because moving to an entirely new country was already an enormous transition, Estrada felt that throwing in college classes taught in a different language would be too much of a strain. So she chose to take ESL classes for a year and a half at a local community college until she was able to speak English more fluently. However, due to New York's large international population, she had few opportunities to practice outside of class. For instance, with her family and her community, she was able to get away with just speaking Spanish. Thus, Estrada eventually decided to jump straight into the deep end and enroll in college classes, where she'd be able to practice it full time.

So Estrada applied to and was accepted to the John Jay College of Criminal Justice CUNY, where she intended on majoring in criminalistics.

Estrada admits that overcoming the language barrier wasn't easy and took several years. For example, she recalls that for the first two years, she didn't socialize with anyone in her classes—not because, like most of the stereotypes about researchers, she was shy or anti-social—but because she quite literally couldn't speak to anyone! However, Estrada eventually became comfortable enough with the language to even consider



Paola Estrada works with a UHS student using a pipette to get a DNA sample.



Paola Estrada presents a stockpile containing all her past completed work.

teaching science to other students, which is how she began her volunteer work.

Once in college, intending a career in forensics, Estrada quickly figured out that she enjoyed the science behind forensics rather than forensics itself.

“I didn’t realize how much science it was going to be actually,” Estrada comments regarding her chosen major. “I thought it was going to be a little science, but mostly maybe a law type thing. Once I started doing it, turns out that it’s a lot of science; it was all science pretty much.”

Something else she discovered? That she enjoyed getting her hands dirty in the lab much more than sitting in class learning all the theory. So in her junior year, Estrada began an undergraduate research program with the organic chemistry professor and soon discovered her niche; she quickly learned to love all that research had to offer.

Estrada is currently researching protein crystallography, which, in her words, involves “biosynthesis of natural products, possibly antibiotics and things like that.” She and her fellow researchers at the Nair Laboratory hope to understand how these proteins make such complex compounds. Her research is focused on classifying these bacterial proteins as well as looking for analogues in the human genome to help explain how similar human proteins work.

And her research is going well. For instance, Estrada is first author on a paper entitled “Structure and Function of the Pimeloyl-CoA Synthetase BioW Defines a New Fold for Adenylate-Forming Enzymes.”

In the future, Estrada definitely sees herself still in academia; her career goals involve higher education; she hopes to teach at a small inner city college, and also do research.

“So far, I think I like teaching. I would like to stay in academia, but in a small, inner city school and not necessarily a big school like this one. I do want to continue research but probably maybe like mentoring undergrads to kind of push them into science,” Estrada explains.

And getting to push kids into science was one reason why Estrada loved mentoring high schoolers at the I-STEM camp this year. When asked how she believed the students did, Estrada replied,

“I think they did really well. Even though some of them were trying to pretend they didn’t care, you could see that they were a little impressed by some of the science things. They seemed really excited when they learned to pipette or when they were understanding this is actually stuff that scientists use in the real world and in real science.”

The “Whodunit?” game is often the closest that many people get to being a detective. The I-STEM graduate students in the MCB department took it a step farther by teaching 27 UHS students all about the science behind many forensic procedures. Paola Estrada was extremely excited to teach students about her field and looks forward to seeing as many students in the sciences as possible because of the great experience she has had with it.



Estrada speaks with Lauryn Cross, an Urbana High School student-athlete, during the I-STEM Camp’s MCB Day.

**Paola Estrada
teaches UHS
students
about her
research
during the
I-STEM
Summer
Camp MCB
Day.**





I-STEM Education Initiative

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