

I-STEM

EDUCATION INITIATIVE

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

I-STEM EDUCATION INITIATIVE ANNUAL REPORT

January–December, 2018



From the Desk of the I-STEM Director:

In 2018, the participation of I-STEM in the development of multiple STEM programs, units, and research efforts at Illinois continued to be essential for their success. I-STEM has also played a critical role in the achievement of numerous STEM-related activities across Illinois, including numerous grant applications that require an independent evaluation of STEM-related research and education programs.

The 2018 annual report highlights I-STEM involvement in the following activities:

- Fostering and participating in dialogue among key campus and external stakeholders;
- Working with campus units to plan, develop, and submit external funding proposals for STEM education;
- Helping to improve campus STEM education programs by performing summative and formative evaluations;
- Enabling networking among STEM educators about effective pedagogy and program components;
- Disseminating information about campus STEM education programs and funding opportunities;
- Promoting university K–12 Outreach Activities.

I-STEM aims to play a more central role in multiple aspects of STEM education at Illinois and to be better known across campus and serve as a locus of activity and as a clearinghouse in the following years for all STEM education research and evaluation, as well as a valuable source of information regarding STEM Education outreach activities both on campus and in the community. In particular, for a larger impact, I-STEM is also reconfiguring many of the existent collaborations in a stronger partnership among the involved stakeholders in STEM education: local schools and communities; the Chancellor's Office; the Colleges of ACES (Agricultural, Consumer, and Environmental Sciences), Engineering, Education, LAS (Liberal Arts and Sciences), and Veterinary Medicine; and industry partners, corporations and foundations.

We hope you will recognize the benefits of the powerful STEM initiatives in this report and of the increased collaboration and entrepreneurship in STEM education on our campus. We are hopeful that the energy and impact of these STEM initiatives will continue to grow in 2019!



Luisa-Maria Rosu
I-STEM Director



Front cover: At I-MRSEC's Cena y Ciencias Program, Polímeros!, a young visitor examines the polymer DNA strand he made out of red licorice, gummy bears, and toothpicks.

Back cover: A WE CAN REU participant conducts research in Paul Richardson's lab on water quality.

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I-STEM PARTNERS



COLLEGES AND SCHOOLS

- College of Agricultural, Consumer, & Environmental Sciences
- College of Applied Health Sciences
- College of Business
- College of Education
- College of Engineering
- College of Fine and Applied Arts
- Division of General Studies
- Graduate College
- School of Labor and Employment Relations
- College of Law
- College of Liberal Arts and Sciences
- Graduate School of Library and Information Sciences
- College of Media
- College of Medicine
- School of Social Work
- College of Veterinary Medicine

CAMPUS UNITS

- Beckman Institute for Advanced Science & Technology
- Center for Education in Small Urban Communities
- Division of Biomedical Sciences
- Institute for Genomic Biology
- National Center for Super-Computing Applications (NCSA)
- Office for Mathematics, Science, & Technology Ed. (MSTE)
- Osher Lifelong Learning Institute (OLLI)
- University of Illinois Extension-4H

EXTERNAL PARTNERS

- American Chemical Society
- American Physical Society
- American Society of Materials
- American Association of Universities (AAU)
- Association of Public Land-Grant Universities (APLU)
- Caterpillar Foundation



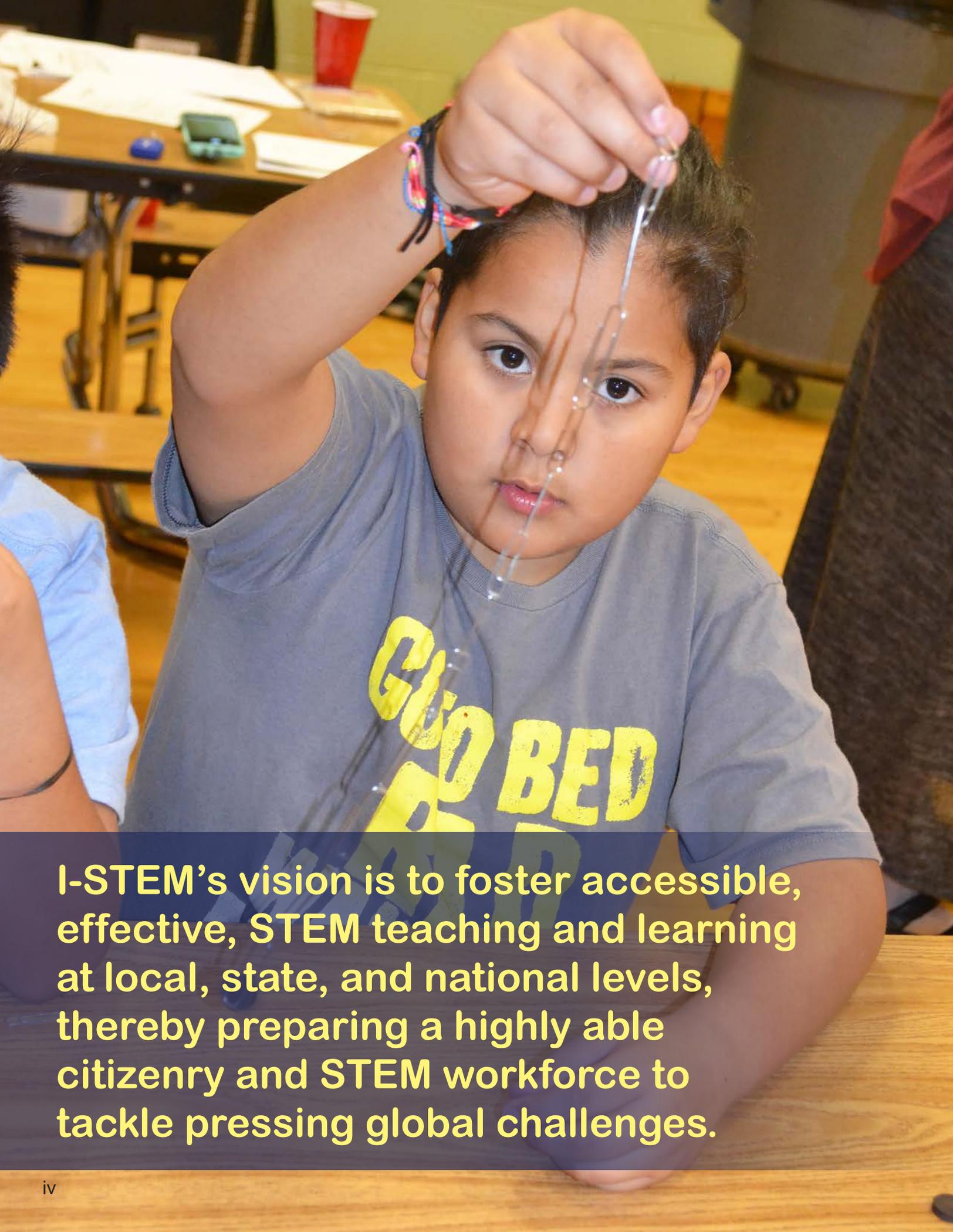
EXTERNAL PARTNERS (CONTINUED)

- Chicago Community Trust (CCT)
- Chicago Public Schools (CPS)
- Department of Commerce & Economic Opportunity (DCEO)
- DREAM-Up
- FIRST/FIRST Lego League
- Illinois Biotechnology Industry Organization (iBIO)
- Illinois Business Roundtable (IBRT)
- Illinois Math and Science Academy (IMSA)
- Illinois Science Olympiad
- Illinois Science Teachers Association (ISTA)
- Illinois State Board of Education (ISBE)
- John Deere Foundation
- Museum of Science and Industry
- National Center for Women in Information Technology
- Office of the Governor, State of Illinois
- O'Donnell Wicklund Pigozzi & Peterson, Inc. (OWP/P)
- Physics Teacher Education Coalition
- Saint Louis Science Center
- Urban Schools Initiative
- University of Illinois at Chicago

LOCAL PARTNERS

- Booker T. Washington STEM Academy
- Campus Middle School for Girls
- Champaign Unit 4 School District
- Champaign-Urbana Community Fab Lab
- Champaign-Urbana Schools Foundation
- Don Moyer Boys and Girls Club
- Next Generation School
- University Laboratory High School
- University Primary School
- Urbana School District 116





I-STEM's vision is to foster accessible, effective, STEM teaching and learning at local, state, and national levels, thereby preparing a highly able citizenry and STEM workforce to tackle pressing global challenges.

I-STEM's Mission and Goals

I-STEM (the *Illinois* Science, Technology, Engineering, and Mathematics Education Initiative) will complete its tenth full year of operation in January 2019. I-STEM partners with STEM (science, technology, engineering, and mathematics) academic, research, and outreach units at the University of Illinois at Urbana-Champaign (*Illinois*), as well as a number of partners locally and across the state and nation. I-STEM seeks to improve the access, quality, and efficiency of STEM education activities at *Illinois* and in the state and the nation, serving as a model for other universities seeking to improve the number and quality of their own STEM education programs.

WHY FOCUS ON STEM EDUCATION?

Our world increasingly relies on science and technology to solve some of today's most intractable problems. As noted in the National Science and Technology Council report, *Federal Science, Technology, Engineering, and Mathematics (STEM) Education Strategic Plan (2013)*, improving STEM education will continue to be a high priority. However, U.S. student interest and performance in STEM fields is in decline. Perhaps at no time in our nation's history has a strong, comprehensive system of education been so essential. As challenges mount in such areas as national defense, climate change, health, energy, economic growth, food safety and accessibility, and environmental protection, so does the demand for highly able scientists, engineers, and health professionals. As one of the nation's premier land-grant research universities, *Illinois* is committed to improving STEM education at all levels.

I-STEM's activities are organized around three primary goals:

- **Goal 1: Foster STEM Citizenship Through STEM Communication & Public Engagement.** Cultivate sustained, coordinated partnerships to engage the public in STEM experiences early and consistently, involving university faculty and students to help meet STEM education challenges. 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. Disseminate information about STEM Education Initiatives.
- **Goal 2: Foster Undergraduate & Graduate STEM Education Reform.** Stimulate accessible, engaging, undergraduate and graduate STEM programs and research experiences to promote interest and success in STEM fields, including teaching, for diverse students.
- **Goal 3: Advocate for STEM Education; Disseminate Evaluation Information.** Serve as advocates for STEM education in the state and the nation, such as at national conferences. Disseminate results regarding STEM Education evaluations.



Above: During I-MRSEC's *Cena y Ciencias* outreach, an Illinois PhD student and SACNAS member interacts with a student using toothpicks and various candies to build a "polymer DNA strand."

Opposite on page vi: A Dr. Preston Williams Elementary School student uses paperclips and magnets to make a "polymer chain" during I-MRSEC's *Cena y Ciencias* outreach.

I-STEM seeks to improve the access, quality, and efficiency of STEM education activities at Illinois and in the state and the nation.

Communication Resources

- **I-STEM Website**
url: istem.illinois.edu/index.html.
- **Top Stories:** Web articles are organized in descending order, chronologically.
url: <http://www.istem.illinois.edu/news/topstories.html>
- **STEM Education News Story Archives:** Web articles are organized by category.
url: <http://www.istem.illinois.edu/news/archives.html>
- **Directory of Externally Funded STEM Education Projects:** This directory is organized by target audience.
url: <http://www.istem.illinois.edu/stemed/stemed.html>
- **STEM Education External Funding Opportunities, by Funder:** url: <http://www.istem.illinois.edu/funding/fundingopps.html>
- **STEM Education External Funding Opportunities, by Upcoming Deadlines (by Month):** url: <http://www.istem.illinois.edu/funding/upcomingdeadlines.html>;
- **I-STEM-News Listserv.** url: <https://lists.illinois.edu/lists/info/i-stem-news>
- **I-STEM Print/Electronic Resources.** In addition to this Annual Report, I-STEM is producing its annual magazine, a compilation of all of the 2018 web articles, *STEM Education at Illinois in 2018*, which will be released early in 2019 both in hard copy as well as online (url: istem.illinois.edu/resources/resources.html#2018magazine). I-STEM also produced a magazine commemorating its recent summer camp: the I-STEM 2017 Summer Camp magazine, which is currently available both in hard copy as well as online (url: <http://istem.illinois.edu/resources/resources.html#summercampmag>).

OVERVIEW OF I-STEM ACTIVITIES

During its tenth year of operation, I-STEM performed a variety of activities, both to serve as a resource to improve/increase STEM education on campus and to foster it locally, in the state, and the nation. Major I-STEM activities in 2018 included:

1. **Fostering and participating in dialogue among key campus and external stakeholders.** Key stakeholders discussed ways to improve STEM education on campus, in the state, and throughout the nation (see pages ii–iii for lists of I-STEM partners).
2. **Working with campus units to plan, develop, and submit external funding proposals for STEM education.** I-STEM's Director, Luisa Maria Rosu, who has significant expertise in both education and evaluation of educational programs, was key in the development of evaluation components for numerous proposals. I-STEM will evaluate these projects should they receive funding.
3. **Helping to improve campus STEM education programs by performing summative and formative evaluations.** I-STEM evaluates numerous STEM education programs, which are listed and described throughout this report.
4. **Enabling discourse and networking among STEM educators about effective pedagogy and program components.** I-STEM fosters discourse via meetings, seminars, presentations, and discussion groups; interactive directories; and a listserv that serves educators on campus and beyond (see our communication resources to the left).
5. **Disseminating information about campus STEM education programs.** I-STEM's website highlights effective, on- and off-campus STEM Education outreach activities, courses, and programs, such as research opportunities for various groups. STEM Education news stories are organized chronologically in descending order on the HomePage and in Top Stories, while the News Story Archives organizes them by category, including by various age groups, by discipline, by year, etc. The ISTEM-News Listserv informs its members about current STEM-education news and upcoming events.
6. **Disseminating information about campus and external funding opportunities.** The website also reports on upcoming funding opportunities that promote, foster, and improve STEM education for I-STEM's target groups, organized both by funder and by month. I-STEM's Listserv also informs members about upcoming funding opportunities (see communication resources to the left).
7. **Promoting/Organizing K–12 Outreach Activities.** I-STEM has developed an extensive network of STEM outreach projects and organizations and helped to recruit volunteers for several K–12 outreach activities during 2018. For instance, I-STEM serves as a liaison to connect schools or other groups or institutions with STEM education groups or organizations on campus. Also, I-STEM partnered with Illinois' College of Applied Health Sciences for I-STEM's first-ever AHS Day. This outreach event targeted scholar-athletes from Urbana High School.

I-STEM'S ROLE: FOSTER STEM EDUCATION

I-STEM's involvement in facilitating STEM education targets four audiences on campus and throughout the state of Illinois and the nation:

1) **P–20 students**, 2) **STEM educators**, 3) **undergraduate/graduate students**, and 4) **STEM education decision makers**. To accomplish our goals, I-STEM seeks to 1) foster communication and collaboration via networking and/or partnering; 2) provide funding opportunity information and assist with grant writing; 3) provide expertise on evaluation and/or education; and 4) disseminate information about campus STEM education programs and outreach.

- ★ **Foster Communication/Collaboration.** I-STEM meets regularly with campus STEM researchers and STEM education coordinators regarding education, outreach, or evaluation components in their projects. The I-STEM-News listserv facilitates communications about STEM education news plus upcoming opportunities and events. I-STEM also connects the general public with university groups/projects who perform outreach activities and helps organize outreach events, such as I-STEM's AHS Day.
- ★ **Funding Opportunities.** I-STEM's website offers resources regarding upcoming STEM education funding opportunities involving our target groups: Upcoming Funding Deadlines¹ lists impending deadlines by date; STEM Education Funding Opportunities² organizes data by funder. The I-STEM-News listserv apprises subscribers of upcoming funding opportunities. I-STEM staff routinely research funding sites and perform maintenance of I-STEM's resources to catalog and make available current information.
- ★ **Provide Education/Evaluation Expertise.** I-STEM serves in an advisory capacity to faculty, researchers, or units, and assists in writing education, outreach, and/or evaluation components for their proposals and/or research grants/projects. I-STEM evaluates the impact of various programs' outreach activities, teacher development, undergraduate/graduate program reform efforts, or advocacy, both to improve STEM education in a variety of settings and to improve recruitment to *Illinois*. In these roles, I-STEM gathers information about its target groups and the impact of programming on instruction, student achievement, and recruitment into STEM fields.
- ★ **Disseminate STEM Education Program Information.** While I-STEM disseminates information to stakeholders in a variety of ways, it is primarily through the website, where new STEM education articles related to I-STEM's three goals and their target audiences (see above), and/or newly awarded funding with STEM education components are posted regularly. Routine maintenance of external funding resources involves on-going research to both post information, organized by funder and upcoming deadlines, and to send it electronically via email and the I-STEM-News listserv. Most of I-STEM's evaluation reports, annual reports, magazines, STEM education outreach flyer, and posters are available electronically, while some are also available in printed form.

¹<http://www.istem.illinois.edu/funding/upcomingdeadlines.html>

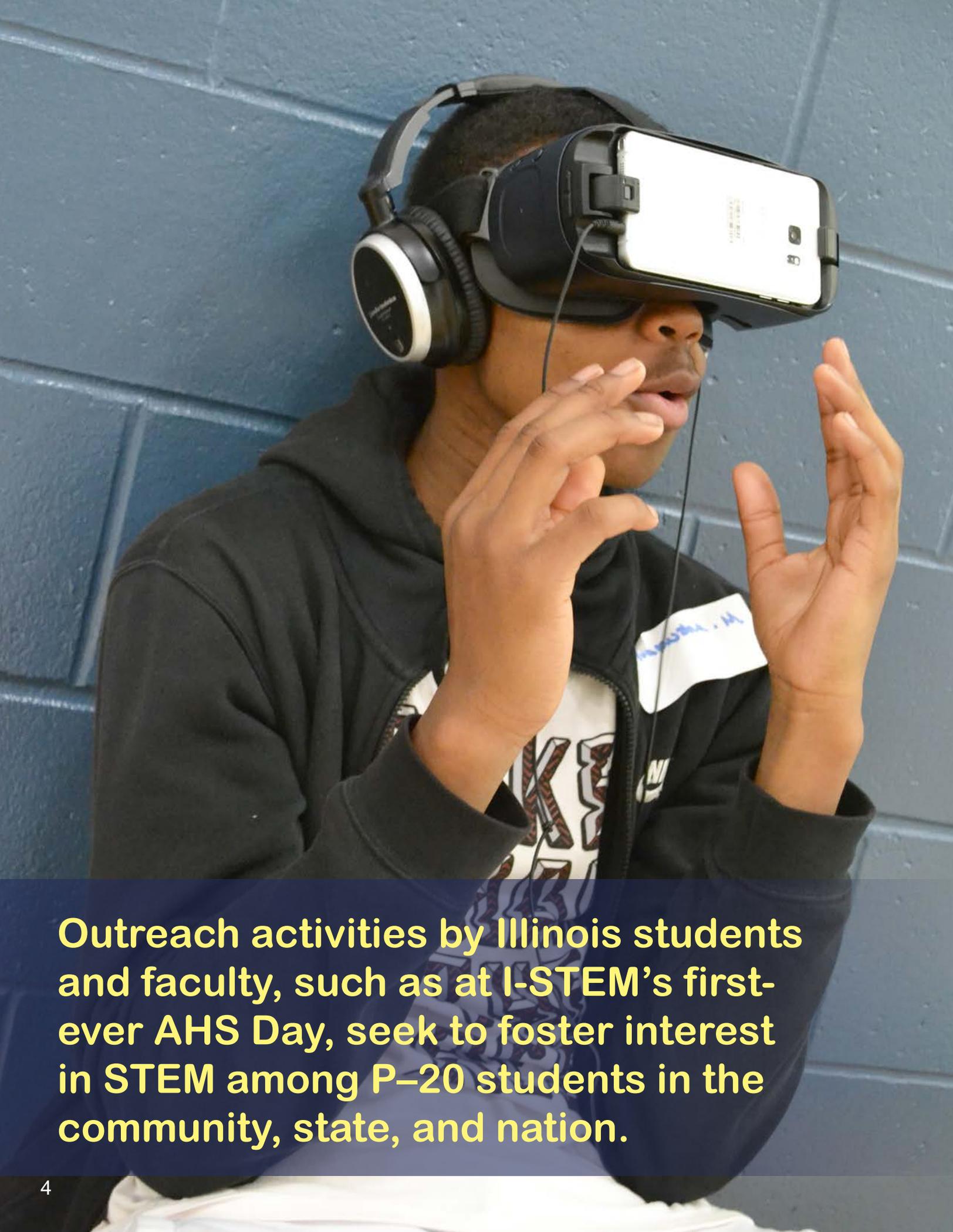
²<http://www.istem.illinois.edu/funding/fundingopps.html>



Above: During I-MRSEC's *Cena y Ciencias* outreach, a Dr. Preston Williams Elementary School student uses toothpicks and various candies to build a "polymer DNA strand."

Glossary of Terms

- CPS: Chicago Public Schools
- GLAM: Girls Learn About Materials
- IGB: Institute for Genomic Biology
- IGL: Illinois Geometry Lab
- NIH: National Institutes of Health
- NCSA: National Center for Supercomputing Applications
- NSF: National Science Foundation
- PD: Professional Development
- POETS: Center for Power Optimization of Electro-Thermal Systems
- RET: Research Experiences for Teachers
- REU: Research Experience for Undergraduates
- RSO: Registered Student Organization
- STEM: Science, Technology, Engineering and Mathematics
- UHS: Urbana High School
- URM: Underrepresented minorities



Outreach activities by Illinois students and faculty, such as at I-STEM's first-ever AHS Day, seek to foster interest in STEM among P-20 students in the community, state, and nation.

Goal 1: Foster STEM Citizenship Through STEM Communication & Public Engagement

STEM COMMUNICATION AND PUBLIC OUTREACH

Following are the types of STEM communication and public outreach activities I-STEM was involved with in 2018. Partners/projects staff collaborated with, evaluated, or disseminated information about are included in the listing on page 17.

◆ Identify campus STEM education outreach activities and disseminate information about them.

Illinois colleges, units, faculty, and student organizations hosted numerous STEM Education outreach activities in 2018. I-STEM identified many of these and prominently displayed information about them via its website, listserv, and in printed or electronic materials, including this annual report and its annual magazine, *STEM Education at Illinois in 2018*, which features articles published on our website throughout the year about STEM education activities by Illinois researchers, staff, and students. Website news articles are published under Top Stories³ and Archives.⁴ Information for those seeking to participate in outreach activities is organized by stakeholder groups: *P-20 teachers*⁵ who seek professional development or to reinforce classroom instruction with additional activities, and parents and/or students seeking STEM education opportunities via *summer camps*⁶ or *academic year activities*.⁷ In 2018, I-STEM continued to develop its webpage listing outstanding STEM education outreach groups/programs,⁸ many of which I-STEM evaluated, collaborated with, and/or featured on its website in 2018.

◆ Partner with state and national organizations.

To ensure that Illinois is strategically positioned to promote collaboration and leverage resources to improve P-20 STEM education experiences for students, especially those from underrepresented groups, I-STEM partnered with state and national STEM P-20 organizations/initiatives, such as IMSA (the Illinois Mathematics and Science Academy [see page 19]) and the AAPA American Association of Physical Anthropologists (see page 13).

◆ Evaluate STEM outreach activities.

To improve the impact of Illinois' STEM outreach activities, I-STEM assesses programs to systematically collect data on participant and school demographics, satisfaction, and impact on STEM interest and content knowledge. Aggregated, these data represent campus-level impact and the degree to which STEM outreach activities are easily accessed by families and educators, extend across grade levels, align with school needs, and attract demographically diverse participants. (Table 1 shows STEM outreach programs I-STEM evaluated in 2018.)



Above: PhD student, Kisung Kang, learns about using social media to communicate science during I-MRSEC's Twitter Workshop.

Opposite on page 4: A UHS student experiences virtual reality during I-STEM's first-ever AHS Day.

I-STEM Website's STEM Education Resources

- **STEM Education Top Stories**
³<http://www.istem.illinois.edu/news/topstories.html>
- **STEM Education Story Archives**
⁴<http://www.istem.illinois.edu/news/archives.html>
- **Resources for P-20 Teachers**
⁵<http://www.istem.illinois.edu/resources/goal2resources.html#teacherdevelop>
- **Resources for P-20 Students**
⁶<http://www.istem.illinois.edu/resources/goal1resources.2.html#summercamps>
⁷<http://www.istem.illinois.edu/resources/goal1resources.2.html#acadyear>
- **STEM Ed Outreach Groups**
⁸<http://www.istem.illinois.edu/resources/stem-ed-outreach.html>



Above: Kinesiology Professor Steven Petruzzello shares about his research during I-STEM's AHS Day.

Below: Urbana High School senior, Lauren Cross, waits to ask a question during the AHS Day Kinesiology session.



Table 1: Selected Outreach Programs I-STEM Evaluated in 2018

Program	PI/CoPI/Program Director(s)
GLAM	Jessica Krogstad, PI, MatSE Professor
I-MRSEC	Nadya Mason, PI, Physics Professor
Mathways	Jeremy Tyson, Head, Mathematics Department
POETS Young Scholars Program	Andrew Alleyne, PI, MechSE Professor

◆ **Work with campus STEM Education sites/outreach groups.**

I-STEM works with campus STEM Education sites to ensure that STEM outreach activities, both campus visits and/or off-site activities, span all age ranges (elementary, middle, and secondary school students) and demographic groups. I-STEM works with campus groups and local schools, often serving as a liaison, to increase recruitment of schools not engaged with STEM outreach and to boost outreach activities, especially for primary and middle school students. For example, I-STEM partnered with the Urbana School District's Urbana High School in 2018 to expose its students to STEM education activities through I-STEM's first-ever AHS Day.

- In 2018, I-STEM continued to develop a list of campus outreach groups, including *Illinois* projects, faculty/researchers and their labs, and student organizations that conduct outreach activities, with the goal of creating a list that both university and off-campus groups can access to engage groups to perform STEM outreach activities. Many of these occur on campus, while some feature *Illinois* personnel volunteering in schools and at other informal educational settings. Types of outreach events employed include: after-school programs, Saturday events, mentoring, one-day or weekend campus visits, summer camps, research experiences, and internships. While this database is by no means comprehensive, I-STEM staff regularly add groups to the database, which contains the group's name (and acronym), website url, contact information, targeted age groups, plus outreach programs/activities each performs/sponsors. I-STEM's Education Outreach webpages include an alphabetical list of campus outreach groups, located at: <http://www.istem.illinois.edu/resources/stem-ed-outreach2.html>, plus a more comprehensive database located at <http://www.istem.illinois.edu/resources/stem-ed-outreach.html>.
- I-STEM worked directly with campus groups seeking to engage in STEM education outreach activities. I-STEM served as an informal liaison to apprise them of outreach opportunities via email and its list-serv, calling upon many of these to help with campus visits by various groups. *Illinois* personnel and student groups I-STEM staff regularly recruited for outreach events include Joe Muskin, Mechanical Science and Engineering's Educational Outreach Coordinator; the MCBees, an MCB graduate student

organization; Chemistry's REACT; the Illinois Space Society; the Illinois Geometry Lab (IGL); and the EGSA (Engomology Graduate Student Association), to name a few. I-STEM will continue to partner with these groups and others in 2019 to link them with schools seeking outreach or other service opportunities.

◆ **Increase the number of underrepresented students who enter the STEM pipeline/graduate from *Illinois* in STEM.**

I-STEM underscores that in order to meet the challenges facing our society day, it is critical that we maintain the diversity of STEM creativity by engaging diverse citizens who are well-informed and active participants in society. Thus, implicit in I-STEM's vision of preparing a diverse STEM workforce is an emphasis which has increasingly gained importance over the last several years—that the university safeguard the multiplicity of perspectives and thinking in classroom, laboratories, workspaces by increasing the number of students from underrepresented groups who enter the STEM pipeline. One way this may be accomplished is via outreach activities that specifically target K-12 underrepresented population groups, including minorities and women.

Thus, I-STEM collaborates with both campus and other, off-campus programs, which specifically seek to engage talented P–20 students in order to increase the number of underrepresented students who both enter the STEM pipeline and eventually graduate from *Illinois* in STEM fields. These groups target schools (both local and throughout the state, including Chicago Public Schools) as well as other STEM education organizations. In addition, in an effort to engage underrepresented population groups locally, I-STEM has specifically been targeting mostly minority Urbana High School student athletes, such as for its May 4, 2018 AHS Day

I-STEM also obliquely addresses this emphasis through its evaluation of a number of STEM education programs with similar goals. For example, one program I-STEM evaluated in 2018 was the GLAM GAMES camp, which targets high school young women, who are underrepresented in STEM fields, along with Mathways, which seeks to ensure retention of underrepresented students in math.



Above: During I-STEM's Spring 2018 AHS Day, an Urbana High School student navigates an obstacle course based on input from her teammates.

Bottom left: A UHS student interacts with an *Illinois* faculty member during the spring 2018 AHS Day.



I-STEM collaborates with both campus and other, off-campus programs which specifically seek to engage talented P–20 students in order to increase the number of underrepresented students who both enter the STEM pipeline and eventually graduate from *Illinois* in STEM fields.

STEM TEACHER TRAINING, RESEARCH, AND PROFESSIONAL DEVELOPMENT IMPROVEMENT

◆ Increase external funding for teacher preparation and professional development.

In 2018, I-STEM worked with several units who were submitting STEM teacher development proposals to funding agencies. I-STEM encourages faculty writing proposals to incorporate existing campus teacher development programs into them as a way to sustain and institutionalize these teacher preparation and professional development programs. I-STEM also encourages K–12 school districts to take advantage of campus professional development (PD) resources. In addition, I-STEM recommends that projects/labs offer Research Experiences for Teachers.

◆ Evaluate STEM teacher training, research, and professional development projects.

In 2018, I-STEM evaluated an NSF-funded Research Experience for Teachers projects operating at *Illinois*, the POETS RET, as well as an evaluation of the Cottrell Scholar Midwest Regional Meeting. I-STEM also evaluated the FUSION teacher professional development program at the Illinois Math and Science Academy (IMSA). In addition, I-STEM also evaluated the I-MRSEC workshops aimed at improving scientific communications. I-STEM supported these activities by providing on-campus evaluation services, ensuring important continuity and cross-fertilization opportunities among the initiatives, as well as the engagement of state-of-the art STEM program evaluation models, both on campus and in coordination with external evaluators.

◆ Disseminate information about STEM teacher professional development and research experiences.

I-STEM works to disseminate information about current campus STEM teacher professional development programs that offer workshops and training and work to improve STEM teacher retention, reduce out-of-field teaching, and increase student performance. These programs provide a variety of resources, including induction and mentoring; graduate disciplinary coursework and degree options; leadership development; and research experiences.

I-STEM posts web articles reporting on these programs' activities in its STEM Education News section; for STEM educators seeking these types of activities, I-STEM posts information about upcoming STEM teacher PD and research experience opportunities in its resources section. Information about I-STEM web articles plus upcoming PD and research opportunities are also sent to interested stakeholders via I-STEM's listserv. (See page 2 for communication resources.)



Above: As part of a POETS RET-developed solar car curriculum, Uni High students test components they're creating under a bright light that is simulating the sun.

I-STEM encourages K–12 school districts to take advantage of campus professional development (PD) and Research Experiences for Teachers that projects and labs offer.



Above: A Next Generation School eighth-grade student works on building a solar car as part of a POETS-RET-developed curriculum.

Below: Two Next Generation School eighth graders work on their team's solar car.

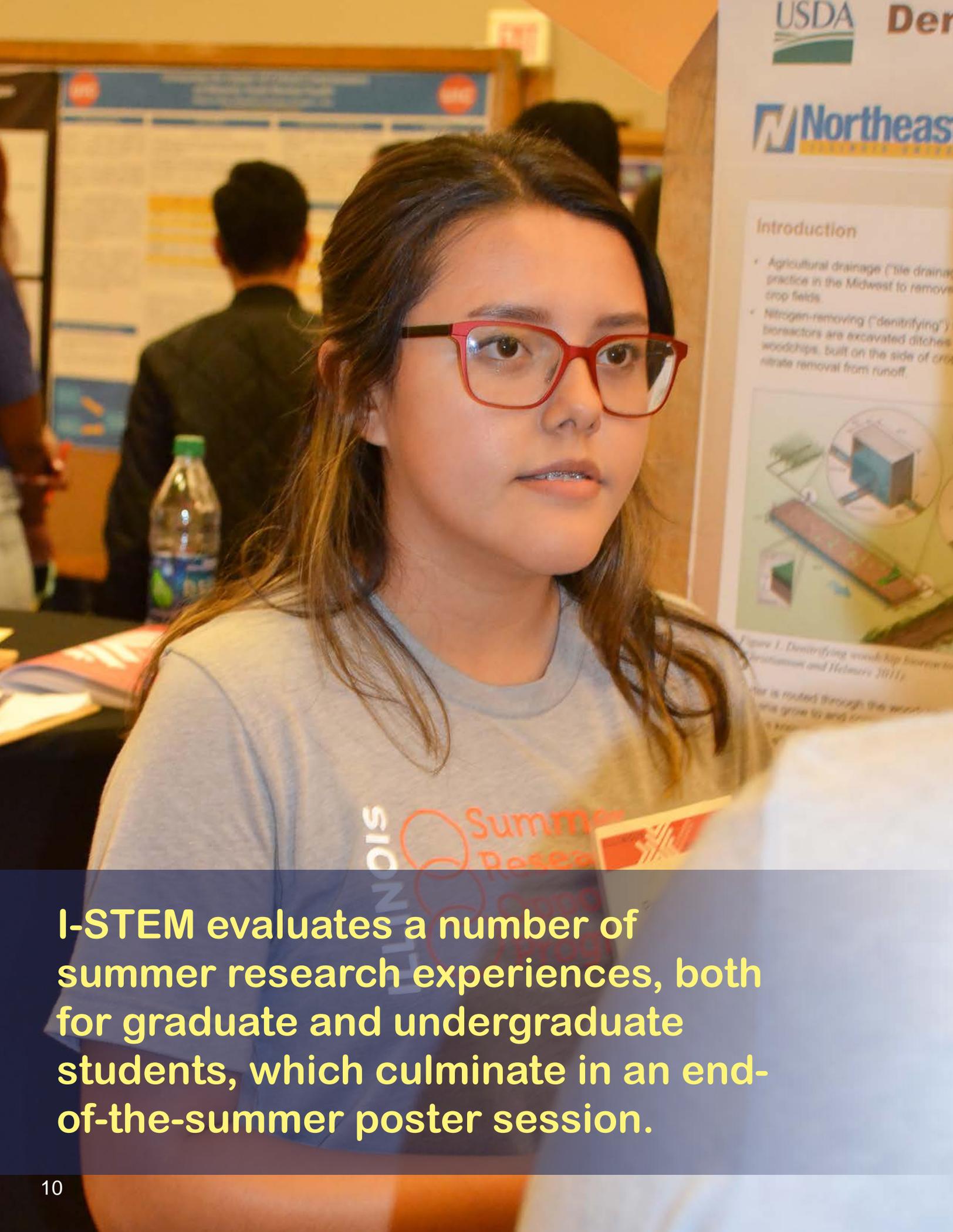
Bottom right: Uni High science teacher Sharlene Denos helps her students build a solar car as a part of the curriculum she helped develop for POETS' RET.



Above: A Uni High student tests the solar battery she's working on for her team's solar car model.

Directly below: Next Generation School science teacher Bryant Fritz helps his eighth grade students test their solar car under a light as a part of the solar car curriculum he helped develop for POETS' RET.





I-STEM evaluates a number of summer research experiences, both for graduate and undergraduate students, which culminate in an end-of-the-summer poster session.

Goal 2: Foster Undergraduate and Graduate STEM Education Reform

UNDERGRADUATE/GRADUATE STEM EDUCATION REFORM ACTIVITIES

◆ Improve undergraduate STEM courses to increase accessibility, engagement, and success.

I-STEM continues to work with campus undergraduate STEM educational reform activities in order to reduce attrition and increase student performance in introductory STEM courses and to increase graduation rates for STEM majors, especially students from underrepresented groups. In meetings with faculty, I-STEM personnel address research findings, best practices, and effective pedagogy and models in STEM teaching and learning, especially around increasing diversity and performance of underrepresented groups.

◆ Evaluate and analyze undergraduate and graduate STEM education projects, such as courses and workshops.

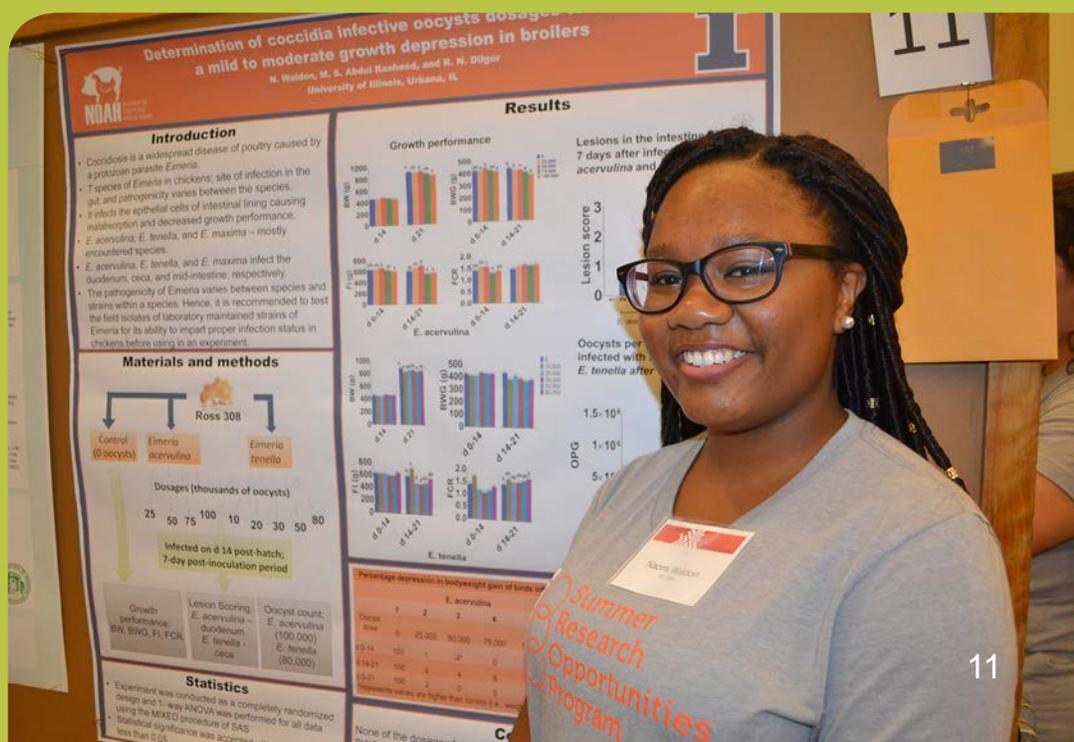
I-STEM identifies strengths and gaps in campus STEM academic programs to assist in developing effective, scalable, and sustainable STEM education models. STEM departments have implemented both campus- and externally-funded reform projects. In 2018, I-STEM conducted evaluations of several of these, including several REUs.

Research Experiences for Undergraduates. Research Experiences for Undergraduates (REUs) have been found to increase the number of students choosing STEM careers. I-STEM evaluated five summer research experience programs for undergraduate students in 2018. Two were official REU sites funded through the National Science Foundation's REU (Research Experiences for Undergraduates) program and engaged a number of students in research. These included the Biomedical Imaging REU and NCSA's Inclusion REU. I-STEM also evaluated a USDA-funded ELI REEU: WE CAN. Two centers for whom I-STEM evaluates their STEM Education components, I-MRSEC (see pages 18–19), and POETS, an Engineering Research Center (see pages 21–22), also offered REUs as one of their STEM education components.



Above: A 2018 POETS REU undergrad discusses his research with a visitor at the Illinois Summer Research Symposium.

Below and opposite on page 12: WE-CAN REU undergrads present their research at the 2018 Illinois Summer Research Symposium.





Above: WE-CAN REU participant Alondra Estrada sets up a camera out in the woods in order to study turtles. (Photograph courtesy of Alondra Estrada.)

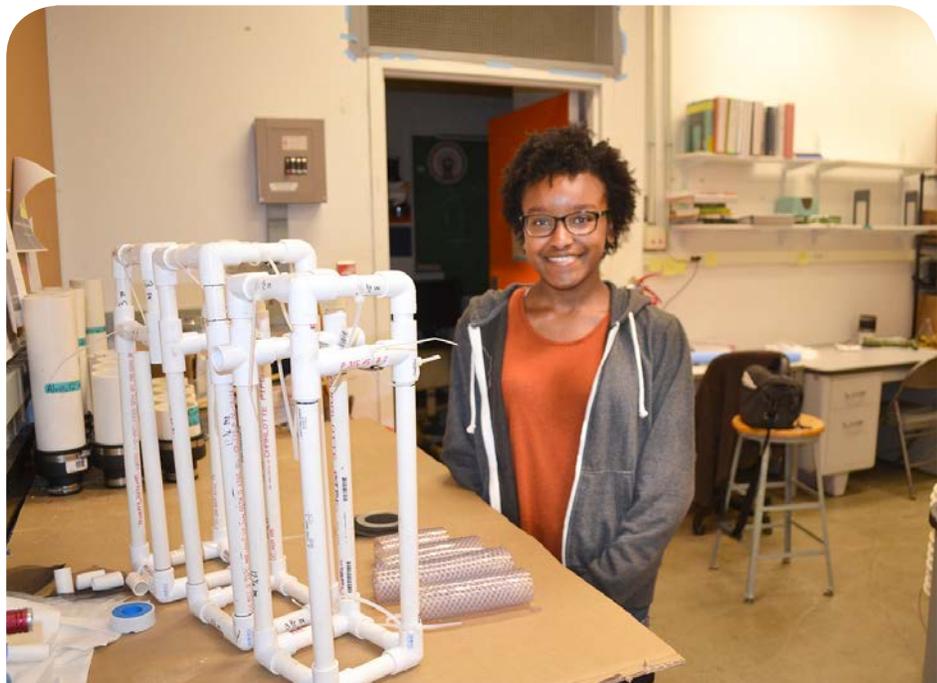
Bottom right: WE CAN REU participant, Alisha Weatherspoon, by one of the devices she used when conducting research in Paul Davidson's lab on water quality.

Table 2: Selected Undergraduate/Graduate STEM Education Programs I-STEM Evaluated in 2018

Project	PIs
Frontiers in Biomedical Imaging REU, NSF	Marina Marjanovic Andrew Smith
IDEAS, NSF	Ripan Malhi
Inclusion REU, NSF	Daniel Katz
PIRE, NSF	Narayan Aluru
POETS: Center for Power Optimization of Electro-Thermal System, REU, NSF	Andrew Alleyne
POETS: Deere Senior Design Capstone Project, NSF	Andrew Alleyne
SING, NIH	Ripan Malhi
T-35 Summer Research Training Program (SRTP), NIH	Lois Hoyer
USDA ELI REEU: WE CAN REU	Paul Davidson

◆ **Increase external funding to improve undergraduate and graduate STEM education.**

To ensure adequate funding to support undergraduate and graduate STEM education reform for consistent, sustained, high-impact programming, I-STEM encourages units to apply for educational improvement resources from major external funders. In 2018, I-STEM was involved in **several grant submissions** seeking to improve undergraduate and graduate STEM education. I-STEM also supports faculty via a variety of mechanisms, such as upcoming funding opportunities disseminated both on the I-STEM website, as well as through the I-STEM-News Listserv (see page 2).



Goal 3: Advocate for STEM Education; Disseminate Evaluation Information

ADVOCATE FOR STEM EDUCATION & DISSEMINATE EVALUATION FINDINGS

◆ Network to advocate for funding, incentives, and programmatic support for STEM education.

In 2018, I-STEM staff members continued to network at the local, state, and national levels to promote STEM education and advocate for STEM education programs and resources.

- On the local level, I-STEM staff regularly met with campus administration and researchers from various colleges or departments and presented at unit- and campus-level meetings.
- On the state and national levels, I-STEM'S Director, Dr. Luisa-Maria Rosu, presented at a number of conferences where she discussed I-STEM'S role in STEM education at the University, including the various evaluations I-STEM performs.

◆ Document trends and needs in Illinois' STEM teaching and learning, teacher preparation, workforce, and STEM pipeline and mainline.

I-STEM worked with programs designed to increase student interest in STEM careers, strengthen the state's STEM pipeline, and foster STEM workforce development. For example, I-STEM worked with the Illinois Mathematics and Science Academy, evaluating IMSA's Fusion STEM enrichment program (see page 19).

◆ Identify STEM education reform projects at Illinois.

I-STEM identifies and catalogs *Illinois'* current external funding projects, as well as potential resources. As part of this, I-STEM reports on many of these in the Current STEM Ed Highlights of I-STEM's home page, the News section, and STEM Ed Projects section of I-STEM's website (see page 2). Regarding identifying potential resources for STEM education reform, I-STEM lists potential funding resources in the Funding Opportunities section of the website, plus routinely sends out upcoming funding opportunities via I-STEM's listserv (see page 2).

STEM EDUCATION ADVOCY EVENTS

- ★ **AAPA Conference – COD-IDEAS.** In April 2018, the I-STEM Director, Dr. Luisa-Maria Rosu, participated at the AAPA (American Association of Physical Anthropologists) Conference – COD-IDEAS as the evaluator for NSF IDEAS. (See <http://physanth.org/about/committees/diversity/cod-ideas-increasing-diversity-evolutionary-anthropological-sciences/> for additional information.



Above and below: Veterinary Medicine students who participated in SRTIP in summer of 2018 present their research at its end-of-the-summer poster session.





Above: Kathleen Oolman, a Physics PhD student who is part of I-MRSEC, explains an activity to visitors at the MRL Open House.

Bottom right: I-STEM Director Luisa-Maria Rosu addresses extension officers at a November 2018 conference at the i-Hotel.

Below: State of Illinois 4H STEM Specialist Keith Jacobs who attended Rosu's presentation at the Extension conference.



★ **AERA Annual Meeting.** In April 2018, the I-STEM Director, Dr. Luisa-Maria Rosu, was a discussant for the session “STEM in and Before the Classroom” at the 2018 Annual Meeting of the AERA (American Educational Research Association).

★ **University of Illinois Extension Conference.** On November 15, 2018, the I-STEM Director, Dr. Luisa-Maria Rosu, spoke at a conference held by the University of Illinois Extension Office. In her presentation, she explained to Extension workers and 4H program coordinators from all over the state about I-STEM and its role in STEM Education, not only on campus, but throughout the state.

Rosu's session was intended to introduce members of the audience to a number of I-STEM's key emphases. For instance, she addressed its role in fostering STEM citizenship, indicating that informed citizens should have the ability to apply critical-thinking skills needed to understand complex STEM-related issues in order to develop their own views and to act accordingly.

She also addressed I-STEM's role in regards to public engagement and STEM communication, as it seeks to better serve as well as help shape the trajectory of community-wide STEM communication and public engagement efforts. She encouraged conference participants, many of whom were educational program coordinators throughout the state, to avail themselves of I-STEM's informal STEM outreach network comprised of many of the campus' key outreach groups in order to access a variety of STEM outreach activities. As a result of her presentation, an extension worker in southern Illinois networked with I-STEM, arranging to bring high school students on campus in 2019 to expose them to some activities in various STEM disciplines.

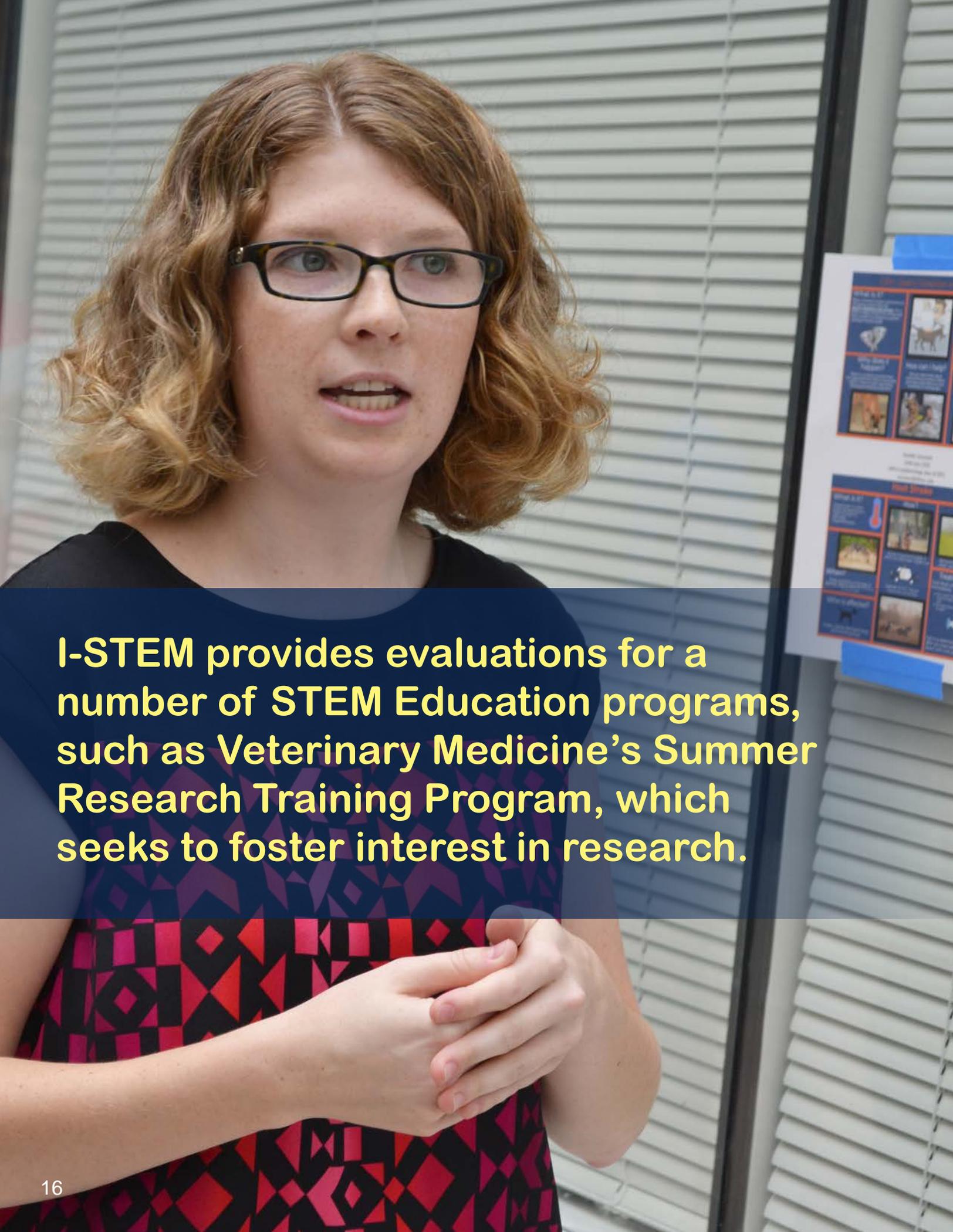
Finally, she also addressed I-STEM's advocacy for multidisciplinary and interdisciplinary collaboration to solve key issues in our society. She emphasized the need to maintain the vitality of STEM creativity by engaging diverse citizens to be well-informed and active participants in society, thus safeguarding the multiplicity of perspectives and thinking in classrooms, laboratories, and workspaces. She also sought to familiarize the audience with I-STEM's various outreach initiatives, such as its recent AHS Day, to expose underserved youth to the campus and to the career possibilities in the different STEM disciplines.



Our vision for this institution is to foster accessible STEM teaching and learning—from preschool through graduate education at local, state, and national levels, preparing a highly able citizenry and a STEM workforce to tackle pressing challenges.

ILLINOIS

I-STEM is working to stimulate partnerships in order to serve as an advocate for STEM Education and to understand the Illinois STEM pipeline and workforce development needs within the state and the nation.

A woman with shoulder-length, wavy, reddish-brown hair and black-rimmed glasses is speaking. She is wearing a dark blue top with a red and black geometric pattern. Her hands are clasped in front of her. The background consists of white horizontal blinds. To the right, a bulletin board is visible with several colorful posters pinned to it, including one with a horse and another with a dog. The text is overlaid on a dark blue semi-transparent box.

I-STEM provides evaluations for a number of STEM Education programs, such as Veterinary Medicine's Summer Research Training Program, which seeks to foster interest in research.

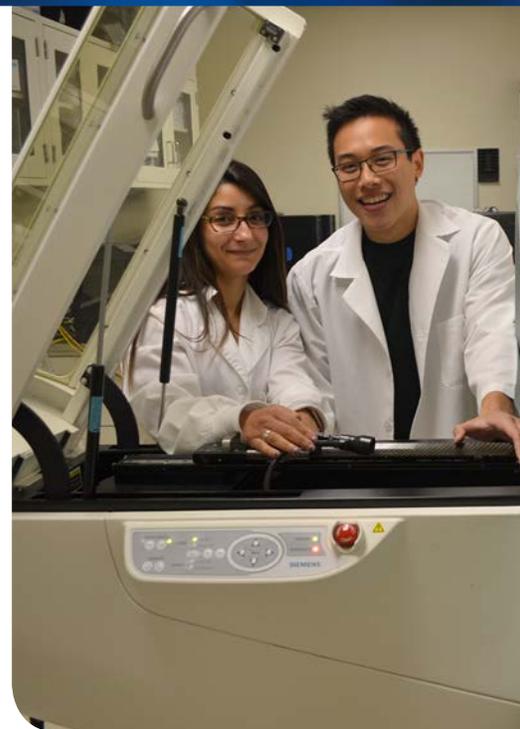
STEM Education Programs/Initiatives I-STEM Evaluates

Following are the individual projects for which I-STEM performed evaluations in 2018, as well as national centers for whom we evaluated several components.

★ **Bioimaging REU.** Discoveries in Bioimaging Research Experience for Undergraduates (REU) was a 3-year, 10-week summer program from 2015–2017 emphasizing team-based research which integrated social and professional activities to supply a multi-tiered mentoring strategy. Participants were encouraged to develop a network of role models, mentors, and peers to support and encourage their transition to graduate school. This REU's objective was to exploit the unifying link between bioscience, discovery, and bioimaging, which is an inspirational centerpiece for the *Illinois* campus. This program targeted undergraduate students from underrepresented populations. Although the grant expired in 2017, I-STEM completed a 3-year comparison of the program early in 2018. Regarding skills gained, students reported that their greatest improvements were in their ability to create a research poster; to apply to graduate school; and to write a concise abstract. Program components with which participants were most satisfied included their research projects, professional development/supplemental programs, and networking opportunities.

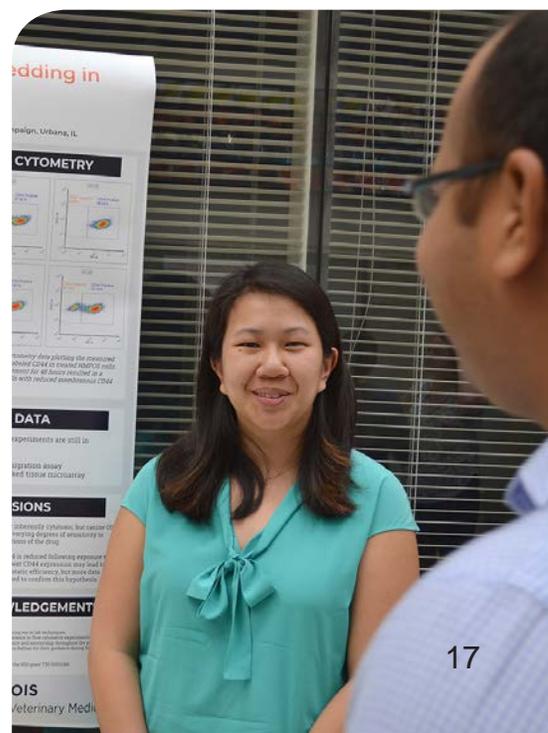
★ **Biomedical Imaging REU.** A continuation of the Bioimaging REU above, the Discoveries in Biomedical Imaging REU is a 10-week summer program of team-based research which integrates social and professional activities to supply a multi-tiered mentoring strategy. Participants are encouraged to develop a network of role models, mentors, and peers to support and encourage their transition to graduate school. This REU's objective is to exploit the unifying link between bioscience, discovery, and bioimaging, an inspirational centerpiece for the *Illinois* campus. This REU targets undergraduate students from underrepresented populations. I-STEM's 2018 evaluation found that the program components with which participants were most satisfied included their research projects, professional development/supplemental programs, and networking opportunities.

★ **Cottrell Scholar Midwest Regional Meeting Evaluation.** I-STEM evaluated the Cottrell Scholar Midwest Regional Meeting, an annual research, networking, and career development conference for members of the Cottrell Scholars program, which champions early career teacher-scholars in chemistry, physics and astronomy by providing significant discretionary awards for research. This meeting took place on Tuesday, April 17, 2018 at the Illini Union. The evaluation study, which analyzed usefulness, satisfaction, and participants' expectations of the meeting found that participants attended for career networking opportunities and to learn about teaching developments. The most highly ranked activity was the talk by Physics Professor Mats Selen.



A participant in the Bioimaging REU works with his mentor on their research project.

Below and opposite on page 16: Participants in the NIH-funded Summer Research Training Program, Summer Training in Translational Biomedical Research, explain their research to visitors at the end-of-summer poster presentation.





Above: Civil and Environmental Engineering Research Scientist Sotiria Koloutsou-Vakaki and I-MRSEC Outreach Coordinator, Pamela Pena Martin enjoy I-MRSEC's Alda Scientific Communication Workshop, Making the Choice to Connect, on May 18, 2018.



Above: Lydia Franco-Hodges, the presenter at I-MRSEC's Alda Scientific Communication Workshop, shares a communication strategy with participants.

★ **Cyberinfrastructure (CI) Program.** I-STEM evaluates NCSA's Cyberinfrastructure Internship Program, whose aim is to address the issue of the shortage of a workforce with specialized skills needed to support advanced CI operations. The goal of this program is to provide motivated individuals the opportunity to obtain real-world CI operational experience through a short, full-time program in an area already supported by NCSA for its own operations. Over the three years of this project, the program will train 30 interns to enter the workforce as CI system engineers and system administrators. In the long-term, the program will result in study materials and best practices that can be transferred to other institutions interested in establishing similar internship programs for CI professionals. This evaluation study is collecting and analyzing data and reporting to the program coordinators and NSF. We are evaluating key components of the program (interns and mentors training, seminars, visits and interactions with industry partners in the Research Park) to see if they are operating effectively and how and to what extent they may be improved. Furthermore, to explore the impact and value added of participating in the CI activities, the evaluation surveys interns after participation in the program. The 2018 study found that 85% of interns were either very satisfied or satisfied with their overall experience.

★ **Illinois Materials Research Science and Engineering Center (I-MRSEC).** I-MRSEC's mission is to perform fundamental, innovative research on understanding the dynamic properties of materials, with applications to societal needs, and to support interdisciplinary education and training of students in materials design understanding and application, particularly targeting students from underserved and underrepresented communities. The research and education goals and the associated challenges require the multidisciplinary, collaborative effort of a Center whose vision is to be a world leader in multidisciplinary materials research with broad scientific impact across many fields and to serve as a Midwestern hub of excellence in materials research, innovation, education, and outreach. I-MRSEC's science will form the basis for new technologies in electronics, information storage, photonics, and biomaterials.

- I-MRSEC's Education, Human Resource Development, and Diversity (EHRD) program will be integrated with research and partnership activities to increase interest, knowledge, and skills for students at many levels, particularly targeting students traditionally underrepresented in STEM. I-MRSEC will provide opportunities for teachers and students in rural and underserved schools to participate in materials science research and interact with Center PIs and students. I-MRSEC will include materials science activities in Science Olympiad for the first time to stimulate interest in the field among students nationwide. The REU program will seek to transition undergraduates to STEM graduate programs or high-tech industrial jobs. An annual Materials Science Boot Camp will enhance connections between academia, industry, and national labs. I-MRSEC will train graduate students and postdocs in both research and professional development to produce scientists with the skill and knowledge to push the boundaries of materials science research in industrial and academic environments.

I-STEM's evaluation of I-MRSEC's EHRD activities include evaluation planning, data collection, and analysis and seeks to provide both formative information to guide program improvement and a summative assessment of its effectiveness and impact.

- **I-MRSEC REU Program.** I-STEM's 2018 evaluation of I-MRSEC's REU program found that the program was generally well-received by participants who gained valuable laboratory skills; learned what graduate school would be like; and developed meaningful professional relationships with faculty, graduate student, and postdoctoral mentors.
- **I-MRSEC Science Communication Workshop.** I-STEM's evaluation found that 85% of workshop participants attended because they wanted to improve their science communication skills. Almost all I-MRSEC members and all non-I-MRSEC members agreed that the knowledge/skills they'd gained during the workshop would positively contribute to their science communication.

★ **Illinois Mathematics and Science Academy (IMSA)**

Fusion. I-STEM evaluates IMSA's Fusion project, a teacher professional development (PD) and student STEM enrichment program for Illinois grade 4–8 students who are talented in, interested in, and motivated by mathematics and science, particularly emphasizing students historically underrepresented in those areas. The 2018 evaluation activities consisted of a review of curriculum documentation, securing IRB approval, and observing PD at IMSA. By design, the Fusion curriculum is inquiry based, problem centered, and integrative. Learning experiences focus on helping students “learn how to learn” and emphasize logic, mathematical thinking, and experimental scientific thinking. Related to students' lives, topics are to arouse their curiosity and increase their motivation to learn in mathematics and science. Teachers from participating schools are supported with on-going PD for the delivery of the curriculum and use of appropriate pedagogy.



Above: During I-MRSEC's Cena y Ciencias Polimeros program at Dr. Preseton Williams Elementary School in Urbana, a participant demonstrates how he was able to put a stick through a balloon completely during one activity about polymers.

Bottom Left: A PhD student from the Program for Ecology, Evolution, and Conservation Biology signs up for a Twitter account during a break in I-MRSEC's workshop, Social Media for Scientists: #Tweetyourscience, designed to inform workshop participants how to use social media to communicate science.

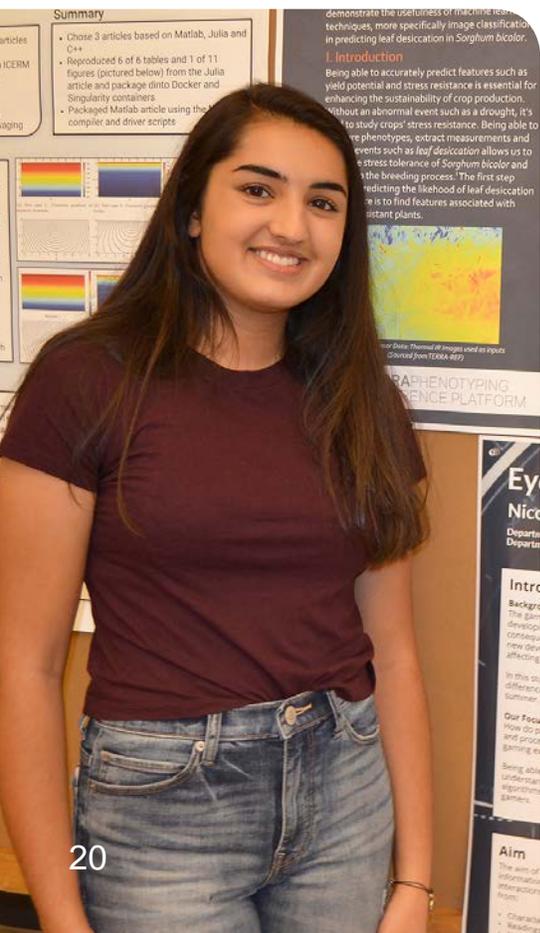
Below: A participant catches an imaginary ball during a connect-with-your-audience exercise at I-MRSEC's Alda Scientific Communication Workshop.





Above: Summer 2018 International INCLUSION REU poster undergrad Lujain Fatta presents her research about trying to reverse engineer the design of a nano crystal, during an end-of-the-summer poster session at NCSA

Below: 2018 INCLUSION REU undergrad Lisa Kanbur, a rising sophomore in Computer Science at the University of Buffalo in New York, presents her poster about her research that used eye tracking to look at race and cultural differences in video games.



This evaluation study was designed to provide Fusion program management and IMSA leadership with valid, useful information to guide improvement and assess effectiveness and impact of Fusion interventions on teachers' practices. I-STEM evaluated key program components (teacher training, interactions with professional development leaders, new curriculum activities implementation, and instructional practices) to see if they are operating effectively and how and to what extent they may be improved. Furthermore, to explore the impact and value added of participating in Fusion, the evaluation surveyed teachers, mentors, and trainers after participation in the program. The study's significance results from identifying quality teaching practices and ways teachers develop instructional activities, pedagogical strategies, and curriculum to encourage underrepresented minorities to pursue STEM careers. Overall, the evaluation will contribute to the development of quality teacher PD in STEM disciplines. During the second year of the study, I-STEM implemented a multi-case evaluation study of 6 to 10 schools/sites to describe and understand each school's essentials and, in particular, how the implementation adheres to the PD program's objectives.

★ **Increasing Diversity in Evolutionary Anthropological Sciences (IDEAS).**

The NSF-funded IDEAS project seeks to improve diversity in Anthropological Sciences through targeted mentoring and outreach to minority communities. One of the main IDEAS workshop objectives is to match undergraduate and graduate students with faculty mentors of similar interests, including professionalization modules and networking activities throughout the meeting to allow participants to meet a variety of researchers at the conference in an engaging manner. These mentoring groups serve as the formal unit of support structure for IDEAS. In 2018, all student and faculty participants said they would recommend the IDEAS workshop to other students and will remain in contact with the IDEAS community. Most said they had learned more about the diversity of research topics than they would have through a typical research community, developed a better understanding of biological anthropology, and that "speed mentoring" groups offered more opportunities to obtain responses to relevant career questions.

★ **INCLUSION REU.**

I-STEM evaluates the 3-year, NSF-funded INCLUSION (Incubating a New Community of Leaders Using Software, Inclusion, Innovation, Interdisciplinary, and Open-Science) Research Experience for Undergraduates (REU), which trains pairs of students in software skills, leveraging and building upon state-of-the-art lessons. Students work with pairs of mentors on interdisciplinary research projects that develop and use open source software across a wide variety of STEM fields. Their work can lead to research advances, and their projects contribute open source tools to the larger scientific community, leading to additional advances. INCLUSION provides interdisciplinary training for undergraduate researchers to facilitate their professional growth, and prepare them for the STEM workplace, while increasing diversity in the STEM pipeline through engagement in research. I-STEM evaluation activities included a mid-program focus, an end-of program survey, plus participant interviews to capture program activities' impact and effectiveness in creating formal and informal mentoring relationships.

★ **Mathways.** Mathways is an NSF-funded program that seeks to create a pathway to encourage underrepresented minorities (URMs) to participate in collaborative mathematics research, mentoring, and instruction. This is achieved by recruiting *Illinois* students in the Merit program, which provides supplemental services to URM students in STEM fields, to the *Illinois* Geometry Lab, a math research lab. Mathways students gain opportunities to conduct and present research, as well as attend summer camps and other outreach programs. The Mathways evaluation currently focuses on the program's implementation, effectiveness, impact, and sustainability.

★ **POETS (Power Optimization for Electro-Thermal Systems) Engineering Research Center (ERC).** The goal of this NSF-funded ERC is to increase the power density of current mobile electrified systems by 10–100 times over current, state-of-the-art systems. I-STEM evaluated several of POETS' educational programs in 2018.

ENG 198 Personal Mobility Course Comparative Study. In January of 2018, I-STEM completed an evaluation of POETS' ENG 198 Personal Mobility section, piloted in fall 2016 and designed to help freshmen discover what being an engineer is like early on. Working as part of interdisciplinary teams, they were to devise an innovation of benefit to society in the area of personal mobility. The goal was for students to learn design process, experience teamwork, and come up with an end product that let them experience having contributed to society. The 2017 POETS Personal Mobility Comparative Study was conducted to gather information about students' course experiences and satisfaction and compare student perceptions of engineering between Personal and Non-Personal Mobility project groups.

POETS-Deere Senior Design Capstone Project. I-STEM administered a post survey to participants in POETS' Interdisciplinary Senior Design Capstone Project. The survey sought to determine how satisfied students were with their experience and whether their confidence in a number of engineering practices had increased based on their involvement with the project.

Research Experience for Teachers (RET). POETS' RET program brings STEM middle school and high school teachers to POETS' partner universities to focus on either research, curriculum development, or a combination, with the goal of impacting students vicariously through their teachers. At partners where teachers focus solely on curricular development, teachers are introduced to POETS' research, then focus on developing a product. Other programs offer more traditional RETs: embedded into a research lab, teachers are trained in lab safety, do experiments, analyze data, then present a poster summarizing their research. I-STEM evaluates POETS' RET programs at participating POETS universities. In January of 2018, I-STEM completed analyzing 2017 data then submitted the report.

Research Experience for Undergraduates (REU). This 10-week summer program for undergraduate students provided team-based research and integrated social and professional activities to supply a multi-tiered mentoring strategy. Participants were encouraged to develop a network of role models, mentors, and peers to support and encourage their transition to graduate school.



Above: POETS RET participant David Bergandine by equipment his students used as part of his heat pipes lesson, along with some of the pipes they tested.

Below: POETS REU undergrad Alexandra Moore presents her research at the Illinois Summer Research Symposium.

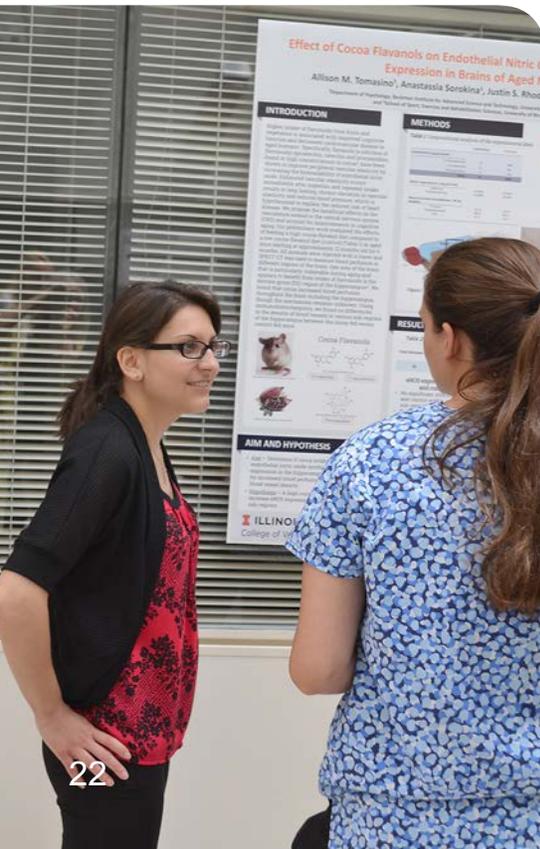




Above: Vet Med student, Mary Kate Feldner, discusses her poster during SRTP's July 31st end-of-the-summer poster session.

Below: Vet Med student, Allison Tomasino (left), explains her research to a visitor to the SRTP poster session

Bottom left: SRTP participant Jessica Kerr discusses her research with a visitor to SRTP's end-of-summer poster session.



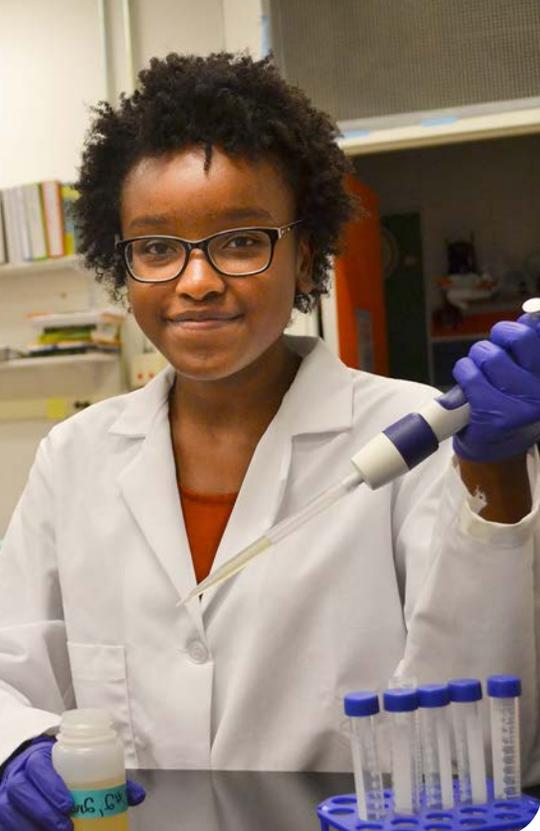
Young Scholars Program. POETS' Young Scholars Program, piloted in the summer of 2017, provides an opportunity for high school students to advance their goal of pursuing higher education. Under the mentorship of a faculty member or graduate student, the four high school participants in 2018 got to work on a team of two high school students and one high school teacher, completing an authentic research project at a world-class research university. The program aimed to make students feel comfortable in a university setting, and help them gain a science identity and confidence in attending college.

In 2018, I-STEM evaluators administered to participants pre-surveys at the beginning of the program and post-surveys at the end. The surveys consisted of questions regarding students' demographic information, motivation for participation in the Young Scholars, perception of competency and interest in engineering, confidence in research activities, satisfaction with the pre-training workshop and program experience, and tasks/activities for summer research experience. Survey results indicated that students enrolled in the program in order to learn more about STEM fields, were satisfied with the pre-training workshop, and were satisfied with their experience and the amount of guidance given.

★ **Summer Internship for Native Americans in Genomics (SING).** The NIH-funded SING program is a one-week workshop about the uses, misuses, and limitations of genomics as a tool for Native American communities; it also trains Native Americans in the concepts and methods currently used in genomics. I-STEM's 2018 evaluation included a pre- and post- questionnaire for each day of the workshop to determine the effectiveness of SING's program, as well as an end-of-program survey.

★ **T35 SRTP: Summer Training in Translational Biomedical Research:** I-STEM evaluated this 10-week, NIH-funded, Summer Research Training Program (SRTP), which seeks to foster Illinois veterinary medicine students' interest in research. Project PI Lois Hoyer matched 20 students with faculty mentors who share similar research interests. With their faculty member's help, students planned and conducted research projects and participated in weekly seminars to explore available careers and be trained in research ethics and compliance and scientific writing. Students contributed to an end-of-the-program poster session at *Illinois*; many also presented at the NIH Veterinary Scholars Symposium.





Above: WE CAN REU undergrad Alisha Weatherspoon conducts research in Paul Richardson's lab on water quality.

Below: Alondra Estrana, a rising junior in Illinois' Department of Natural Resources and Environmental Science, shows off the 3-D printed "turtle" she used in her research as part of the WE CAN REU.

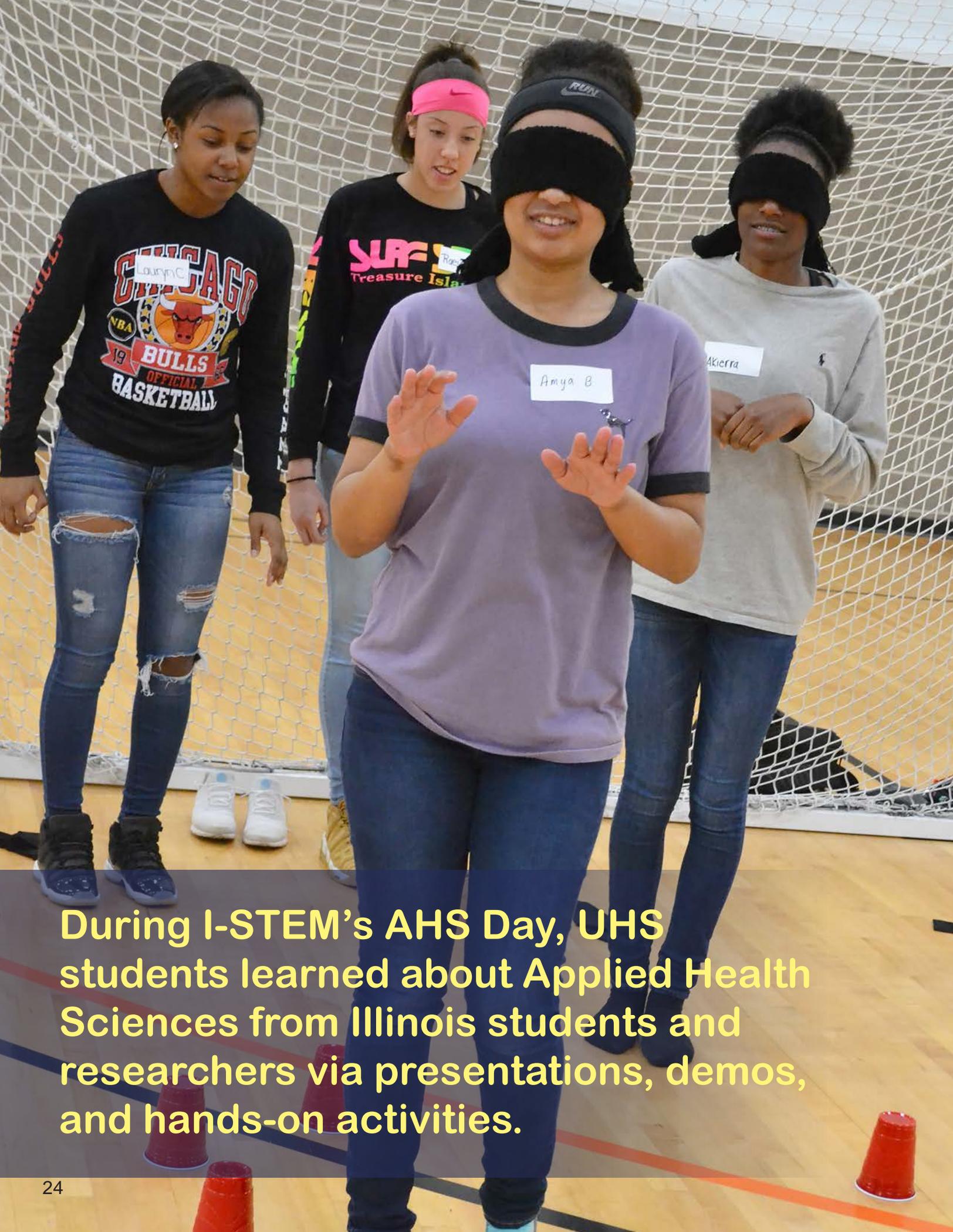


Above: WE CAN REU Co-PI Michelle Green (left) and REU undergraduate student, Naomi Waldon, with her poster at the Illinois Summer Undergraduate Research Symposium.

★ **USDA ELI RE EU: WE CAN REU.** The goal of the 3-year USDA ELI RE EU fellowship program, WE CAN REU, is to cultivate leaders in agriculture by providing undergraduate students with unique, multi-disciplinary skills bridging global food security, agri-ecosystems, and technology via an immersive, two-year experience. Scientific research often lacks interdisciplinary collaboration; engineers and biologists are typically isolated and work in “silos,” resulting in a gap. This program aims to bridge this gap and break down cross-discipline communication barriers by bringing together undergraduates from diverse backgrounds via a 2-phase internship. Summer One provides undergrads with initial exposure and training in co-management of natural resource conservation and agricultural engineering. Summer Two fellows will participate in SROP, Illinois’ Summer Research Opportunities Program, where their individual interests and skills will be channeled into independent research mentored by *Illinois* faculty, with students networking with USDA personnel through seminars.

I-STEM’s evaluation seeks to provide the grant’s PIs valid, useful information to guide improvement and assess program effectiveness and impact. Evaluators administered online pre and post student surveys, plus held focus groups for students, faculty/mentors, volunteers, and staff in order to understand baseline participation; retention rates; perceptions; and the experiences of all participants.

Although Year 2 data are still being collected, according to Year 1 evaluation findings, participants found the program organization and structure to be effective; however, some were dissatisfied with receiving their first stipend late. Participant satisfaction with the assigned research projects was mixed. Participants were highly satisfied with their interactions with their graduate mentors and faculty advisors and reported that their faculty advisors were very accessible. In addition, participants reported that the majority of the REU’s activities and presentations were useful.



During I-STEM's AHS Day, UHS students learned about Applied Health Sciences from Illinois students and researchers via presentations, demos, and hands-on activities.

I-STEM Outreach Program: AHS Day



Above: AHS Assistant Dean Gretchen Adams escorts UHS students from one session to the next.

Bottom right: A UHS student experiences a roller coaster in virtual reality at AHS day.

Below: An *Illinois* student shares what being an AHS student is like.

Opposite page: UHS students experience the Mouse Trap Obstacle Course.



On Friday, May 4th, around 20 Urbana High School athletes and their coaches visited *Illinois'* College of Applied Health Sciences (AHS) for I-STEM's first ever AHS Day. During their visit, students were introduced to folks from AHS' four different departments (Kinesiology & Community Health, Speech & Hearing Science; Recreation, Sport, & Tourism [RST], and I-Health). There, the high school students not only learned things they hadn't known before about the presenters' various research areas, but they were also introduced to college majors they've most likely never considered before. Plus, they met some AHS students, including a few athletes, to find out what it's like to be a student in AHS at *Illinois*.

AHS Assistant Dean Gretchen Adams explains why an event like AHS Day is beneficial for high schoolers: "It exposes them to the student experience at the University of Illinois and in the College of Applied Health Sciences." She also indicates that students might not be aware of the many career opportunities available in AHS:

"I consider the majors in our college to be "discovery majors," she explains, "since they are not explicitly taught as subjects in high school. Students get to learn about our majors and career opportunities in these areas, including some of the innovative research happening in our health fields."

Regarding the college's goals for the day, Patty Hudek, the AHS Undergrad Recruiter, adds that the college sought to:

"Plant the seed early on, so these young folks know what we do and what we're about...It may not even be on their radar. We want the majors in Applied Health Sciences to be on their radar before they get to college."





Above: Speech and Hearing Assistant Professors Fatima Husain and Pasquale Bottalico do a tag team presentation about their research in the field.

Below: A UHS student practices removing gloves properly in order to prevent contamination.



So to introduce UHS students to some directions they might consider when choosing their careers, a cadre of AHS administrators, professors, and students exposed the group to a myriad of possibilities, both careerwise and as college students in AHS.

For instance, a dynamic duo from AHS's Department of Speech and Hearing Science gave an educational yet entertaining presentation about their research. Assistant Professor Fatima Husain, shared about auditory, speech, and language processing in the brain using neuroimaging and computational modeling techniques, and also about a disorder she's studying—tinnitus (ringing in the ear), typically associated with hearing loss.

Assistant Professor Pasquale Bottalico also shared some aspects of his research in acoustics, particularly room and musical acoustics, including the uncertainty of measurements and statistical analysis of data, along with speech intelligibility. Having discovered that he had studied opera (along with engineering) when he was an undergrad, the high schoolers requested that he sing for them, which he agreed to do. However, when Bottalico finally made good on his promise and sang, the session was over and, sadly, most students had left the room by that point.

The high school students enjoyed the session immensely, and reported that they'd appreciated learning more about speech and hearing: "Everything's been fun because I got to learn more about my ear wax and everything," acknowledges Lauren Cross. "It's more in depth."

UHS sophomore Bryson also appreciated the first session about the ears and hearing: "I liked that because I learned a lot of stuff I didn't know," he admits.

In the session on Community Health and Health Sciences, the UHS students experienced a variety of activities. They met the Service Dogs Club members, as well as some of the service dogs in training. A Labrador, Alma, along with Berry the poodle, demonstrated some of things they've been learning in preparation for careers as service dogs themselves. The club members obtain the dogs as puppies, take turns taking care of them and training them. They even name them—hence the dogs have names only an *Illinois* student can truly appreciate: (Alma, short for Alma Mater, Berry, a derivative of Ikenberry, and Maisie, named after the crop [corn, or maize] grown in *Illinois*' historical test plots.

During the Community Health sessions, students also got to participate in some related hands-on activities: how to remove contaminated gloves without contaminating oneself; how to administer an Epi Pen, and how to bandage an injury; for instance, Sergio McClain, Jr. volunteered to have a "sprained ankle" bandaged.

The Kinesiology session taught by Associate Professor Steven Petruzzello, grad student Allyson Box, and undergrad Nicki Levar, exposed students to Petruzzello's research in exercise science and the psychology of exercise and sport. Student athletes' eyes particularly lit up when Petruzzello touched on the psychology behind a free-throw routine and its positive benefits, such as helping athletes relax and focus.



Above: UHS students listen as Associate Professor Steven Petruzzello speaks about his work in Kinesiology.

Petruzzello shares the benefit of bringing high schoolers onto campus:

“I think it’s useful for high school students to see what research is and the different forms it can take. I’m not completely certain that they have a good idea of what research really is, so I think seeing that it can take forms that may not fit with their framework is helpful to give them an idea that they might want to do something like that either in college or beyond.”

He also hopes he and his team corrected some misconceptions about who scientists are and what they do.

Levar, who just graduated with her B.S. in Kinesiology, helped to demonstrate the psychological and physiological effects of exercise on brain activity, using an ECG and a stationary bike. During the interactive presentation, as she pedaled the bike, or stopped pedaling and closed her eyes, students could see the differences between the different states of exercise or relaxation via live data on a projector. Students were also encouraged to ask questions throughout the presentation.



“I’d also like to think that we showed them that “scientists” or “researchers” are just regular people and not stuffy and boring,” he explains, then puts a plug in for research: “I hope they at least consider the thought they can get involved in research as an undergrad when they go to college, and that it’s not just playing with test tubes!” – Associate Professor Steven Petruzzello



Above: An undergraduate student shares with UHS students about what it’s like to be a student in AHS during an AHS Day student panel.

Bottom left: UHS students learn the proper technique to bandage a sprained ankle.



Above: Kinesiology Professor Steven Petruzzello shares about his research during AHS Day.

Below: During I-STEM's AHS Day, an Illini Service Dog member introduces Berry the poodle to the UHS students as an example of one AHS student organization which will allow students to give back to the community.



“I tried to share a little about my experience in the lab,” Levar reports, “so they would be aware of the awesome opportunities within reach for undergraduate students. I think they left the lab excited about what they learned. It was fun to interact with them and increase their exposure to new concepts and practices!”

One activity that particularly engaged the high schoolers was the student panel.

“For these kinds of recruitment events,” Hudek explains, “we like to have students that have experienced our majors in applied health sciences speak to what they have done in their major, and what it’s like to come in as a freshman, and how you grow as a person, and how you develop and learn.” She adds that giving the UHS visitors the opportunity to hear about AHS students’ experiences, “It really opens up—broadens the knowledge of the prospective students that are coming.”

Lauren Cross is a senior at Urbana High School who will be attending Barton College in Winston, North Carolina this fall to play basketball. She shares about the impact of AHS Day:

“Everything was good. It was just, really, really, really good, very informational, so that’s what made it good. We actually got to interact and had to do stuff that we had to be active.”

She also believes the event will impact her career-related choices next year in school. “It broadens my vision of what I can do with physical therapy or exercise science, because I didn’t know I can be an EMT, and I didn’t know all that stuff, and now I feel like I know all that.”

Cross, who is a senior and will be heading to college next year, believes much of what she experienced will be applicable to her college experience. For example, she found the student panel to be quite helpful. She learned “what to expect freshman year...how to manage time.”

“And with me going to college, I learned more about what life would be like and what classes to take and what I’m experiencing because I’m going to be studying exercise science...This really, really helped me.”

Regarding the student panel, she also felt being able to interact with college students rather than adults, whose college experiences were a long time ago, was helpful. “So I think it was good to relate to them. I’m happy they weren’t adults because they couldn’t tell me what their freshman year was like now, but now these are people that were actually in college.”

The students definitely enjoyed the session by folks in RST. For example, they played volleyball with a huge, overinflated, hot pink ball. They got to shoot some hoops (which obviously made them feel quite at home, since they're all basketball players).

One activity was a team-building exercise led by Don Hardin: the Mouse Trap Obstacle Course, which was littered with “mines” which would “explode” if one stepped on them, along with real mouse traps which were actually set. Students were then divided into two teams (girls against the boys) at each end of the course. Then one person from each team was blindfolded and traversed the obstacle course based on the shouted instructions of her/his teammates.

Regarding the last session at the ARC, UHS sophomore Bryson reports that he enjoyed all the different activities.

AHS Assistant Dean Gretchen Adams shares about one of her favorite parts of the day: “Watching the interactions between the faculty and UHS students. The faculty were very personable and really wanted to engage them,” then adds, “I am appreciative of their time and help!”

As for the students, she enjoyed: “listening to all of their questions and observing their curiosity,” adding that some students were engaged with one area, while others enjoyed other sessions.

Might some of the students end up in AHS at Illinois? Adams hopes so. In fact, that was her goal for the day: that one of the activities would:

“Engage them and help them start thinking of that field as a career possibility in the future, ideally pursuing one of our majors in the College of AHS at the University of Illinois.”



Above: UHS students play volleyball during RST activities.

“I thought it was fun. We got to do something we actually liked to play, like basketball, and then do the mouse trap sport, which he says was fun: “I mean, it was showing us teamwork and stuff. Yeah, they all taught us something.” – UHS sophomore Bryson.



Don Hardin (right) explains the rules of the Mouse Trap Obstacle Course to AHS students.



I-STEM RESOURCES

Above: I-STEM Director Luisa Rosu presents about I-STEM at an Extension Conference.

Below: I-STEM Graduate Research Assistant Molly Galloway.



I-STEM STAFF

- Luisa-Maria Rosu, I-STEM Interim Director. Projects: PIRE, IDEAS, R25, Mathways, POETS
- Molly Dawn Galloway, Graduate Research Assistant. Project: Mathways.
- Elizabeth Innes, Communications Specialist. Projects: I-STEM website, I-STEM Magazine, I-STEM Annual Report; edit, format, and publish evaluation reports if needed.
- Katherine Koch, Graduate Research Assistant. Project: NCSA Inclusion REU, Mathways.
- Katelyn Liss, Graduate Research Assistant. Project: IMSA FUSION, T35 SRTP
- Emily Loveland, Graduate Research Assistant. Project: Mathways.
- Marlon Mitchell, Graduate Research Assistant. Projects: WE CAN REU, Biomedical Imaging REU
- Youngshil Paek, Research Scientist. Projects: CPLC, POETS.
- Maggie Phan, Graduate Research Assistant. Projects: Cottrell Scholar Midwest REgional Meeting, GLAM, I-MRSEC, NCSA Inclusion REU, POETS, SRTP
- Debby Ann Reynolds, Office Support Specialist

I-STEM UNDERGRADUATE STUDENTS

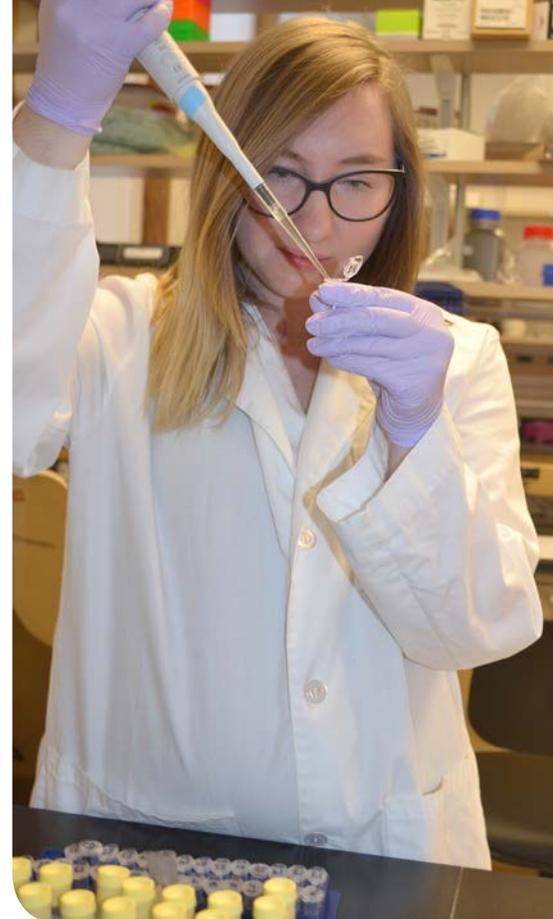
Undergraduate students assisted I-STEM staff with data entry and interview transcriptions, as well as website maintenance and publication development. Students learned professionalism in a workplace setting; new skills, such as html/CSS coding; and proficiency with new software, such as SPSS, Adobe Dreamweaver, InDesign, and/or Photoshop.

- Kristina Allen (spring, summer, and fall 2018). A senior in Anthropology with a concentration in Human Evolutionary Biology and a minor in Integrative Biology, upon graduation, Kristina plans to get a Master's degree in nursing following receiving her Bachelor's Degree in May 2019.
- Kevin Ding (summer 2018) A junior in Community Health with a minor in Informatics. Upon graduation, Kevin plans to pursue either Health Administration or Health Education.
- Payal Malik (spring 2018). A May 2018 graduate, in Economics and Finance, her career goal is to be the chief economist of some small, open economy.
- Nick O'Connell (spring and fall 2018). A junior in mechanical engineering with a minor in computer science, after Nick completes his Bachelor's degree in Spring 2019, he plans to work for in the R&D department of a big technology company.
- Patrick Pavilonis (spring and fall 2018). A senior studying Middle Grades Education with concentrations in both math and science, Patrick hopes to teach either math or science at the middle school level in the Chicagoland area following graduation.
- Brittany Rhed (summer and fall 2018). A Psychology major with a concentration in Behavioral Neuroscience and a minor in Philosophy, graduated in May of 2018 and plans to pursue a Master of Public Health degree. Brittany also plans to serve in the Peace Corps upon completing her education.
- Niharika Roychoudhury (summer 2018). An August 2018 graduate in General Psychology and Sociology with a certificate in Leadership, Niharika is currently pursuing a Master's in Clinical Psychology in the Netherlands.

I-STEM Funding

Funding for I-STEM comes from a variety of sources. Funding for the office overhead and support staff comes from state money through the Provost's Office. Funding for I-STEM's director comes from state funds, as well as through externally funded projects. Additionally, much of the director's focus is on helping faculty write proposals, which, if funded, could supply additional revenue. The communications specialist/webmaster, who is tasked with disseminating information about STEM education projects across the campus, is also funded by state funds. Many of I-STEM's evaluators and the undergraduate students are funded through the evaluation projects themselves.

This report contains a comprehensive list of evaluation projects I-STEM worked on in 2018; some were funded externally, such as by NSF and NIH, which requires evaluations for its projects. Additionally, I-STEM completed several pro bono projects in hopes that these might become a source of revenue in the future.



Above: I-STEM undergraduate student worker, Kristina Allen, at work in her research lab.

Below: I-STEM undergraduate student worker Nick O'Connell, who is majoring in mechanical engineering with a minor in computer science..





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