

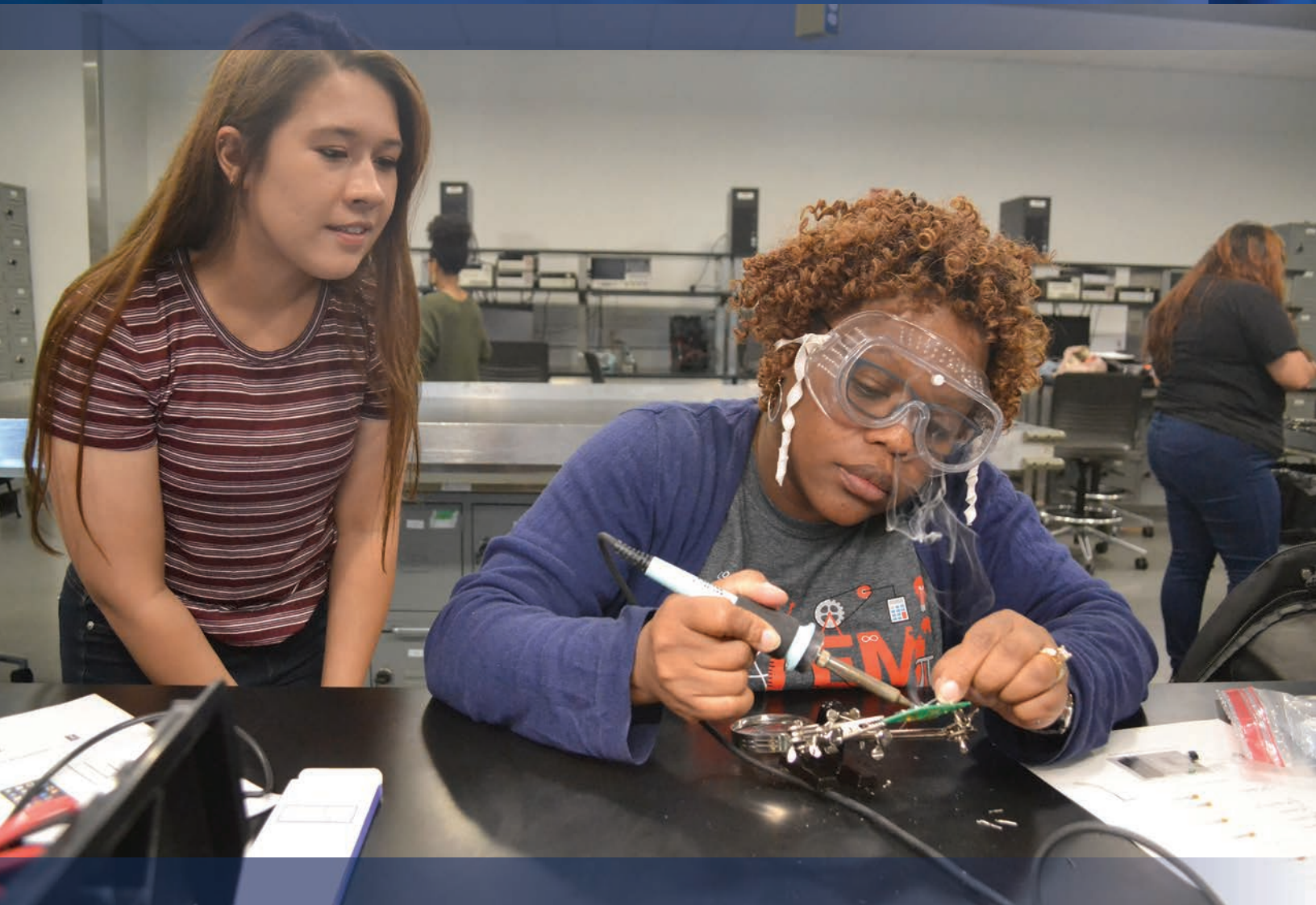
# I-STEM

EDUCATION INITIATIVE

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

## I-STEM EDUCATION INITIATIVE ANNUAL REPORT

### January–December, 2019



## From the Desk of the I-STEM Director:

In 2019, 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 2019 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 2020!



**Luisa-Maria Rosu**  
I-STEM Director



Front cover: During CISTEME365's summer 2019 institute, ECE student Kiran Murphy interacts with Anita Alicea, a STEM integration specialist at Sarah E. Goode STEM Academy, while she solders her circuit.

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

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# I-STEM COLLABORATORS

## 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
- Carle Illinois 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 COLLABORATORS

- 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 COLLABORATORS (CONT.)

- 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 COLLABORATORS

- 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.**

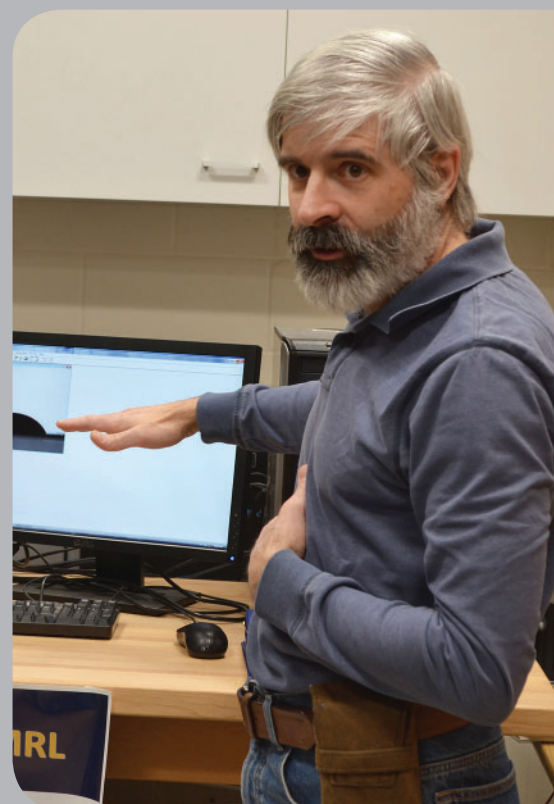
# I-STEM's Mission and Goals

**I-STEM** (the *Illinois* Science, Technology, Engineering, and Mathematics Education Initiative) will complete its eleventh full year of operation in January 2020. 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 to and 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 INNOVATIVE 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. In addition, the character of STEM education "has been evolving from a set of overlapping disciplines into a more integrated and interdisciplinary approach to learning and skill development" (2018, Committee on STEM Education of the National Science & Technology Council). 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 interdisciplinary, innovative 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 and 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 Innovation; 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: Senior research scientist Julio Soares demonstrates to Franklin STEAM Academy eighth graders how the contact angle goniometer analyzes the shape of drops of liquid

Opposite on page vi: Franklin eighth graders try out cutting-edge research equipment during a tour of MRL.

***I-STEM seeks to improve the access to and 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](http://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 produces an annual magazine, a compilation of all of the 2019 web articles, *STEM Education at Illinois in 2019*, which will be released early in 2020 both in hard copy as well as online (url: [istem.illinois.edu/resources/resources.html#2019magazine](http://istem.illinois.edu/resources/resources.html#2019magazine)). I-STEM is also producing a magazine highlighting the CISTEME365 Workshop as well as I-MRSEC outreach activities which will be available both online as well as in a limited number of hard copies. (CISTEME365url: <http://istem.illinois.edu/resources/resources.html#cisteme365>; I-MRSEC url: <http://istem.illinois.edu/resources/resources.html#imrsec>)

## OVERVIEW OF I-STEM ACTIVITIES

During its eleventh 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 2019 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, helped to develop evaluation/education 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 on pages 17–23 of 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 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 2019. For instance, I-STEM serves as a liaison to connect schools or other groups or institutions with STEM education groups or units on campus. Also, I-STEM partnered with the Clinton County's 4H Extension to set up a campus visit for ten junior high and high school students, members of its 4-H Federation leadership group, exposing students to several STEM disciplines via STEM hands-on activities and brief tours (see pages 24–29.)



## 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 the Clinton 4H group's campus visit.
- ★ **Funding Opportunities.** I-STEM's website offers resources regarding upcoming STEM education funding opportunities involving our target groups: Upcoming Funding Deadlines<sup>1</sup> lists impending deadlines by date; STEM Education Funding Opportunities<sup>2</sup> 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.

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

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



Above: I-MRSEC REU participant Lucas Komara shows the results of his work in Arend van der Zande's lab.

### Glossary of Terms

- CPS: Chicago Public Schools
- IGL: Illinois Geometry Lab
- NIH: National Institutes of Health
- NCSA: National Center for Supercomputing Applications
- NSF: National Science Foundation
- PD: Professional Development
- RET: Research Experiences for Teachers
- REU: Research Experience for Undergraduates
- RSO: Registered Student Organization
- STEM: Science, Technology, Engineering and Mathematics
- URM: Underrepresented minorities



**I-STEM seeks to foster STEM citizenship by promoting STEM education outreach both on and off campus.**

# Goal 1: Foster STEM Citizenship and Public Engagement; Advocate for STEM Education

## FOSTER STEM CITIZENSHIP AND PUBLIC ENGAGEMENT

### ◆ Increase engagement with STEM 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 (see programs I-STEM evaluates, pages 13–21, and I-STEM's Clinton 4H outreach (pages 22–29).

### ◆ Identify/support 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 section 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).

### ◆ Evaluate STEM outreach activities.

To improve the impact of Illinois' STEM outreach activities, I-STEM assesses programs by systematically collecting data on participant and school demographics, satisfaction, and impact on STEM interest and content knowledge. These data also report on the degree to which these 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 to the right shows the STEM education programs I-STEM evaluated in 2019.)

## ADVOCATE FOR STEM EDUCATION & DISSEMINATE EVALUATION FINDINGS

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

In 2019, 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.

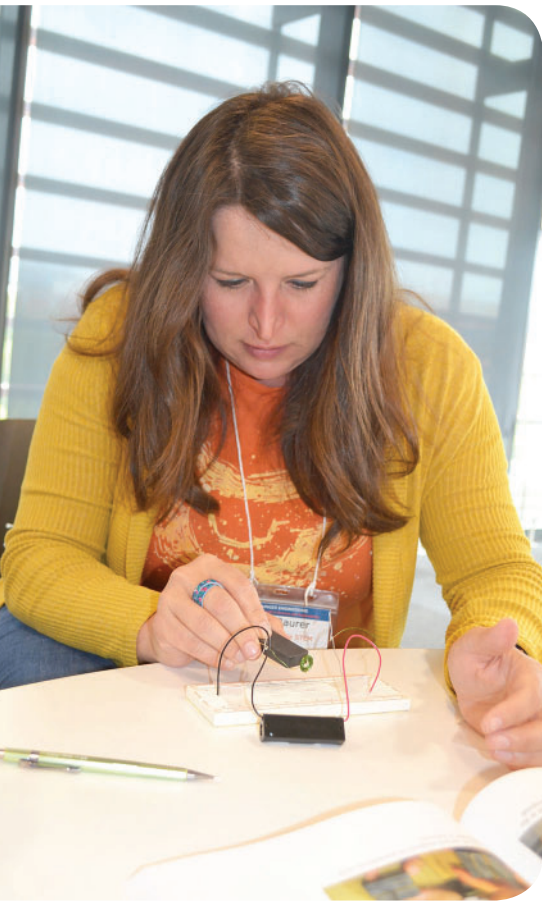


Above: Biomedical Engineering REU participant during a weekly meeting.

Opposite on page 4: I-MRSEC REU participant Michael Glasper presents his research about spin-polarized tips.

**Table 1: Outreach Programs I-STEM Evaluated in 2019**

Program	PI/CoPI/ Program Director(s)
Frontiers in Biomedical Imaging REU	Marina Marjanovic Andrew Smith
CISTEME365	Lynford Goddard
Cyberinfrastructure Program	Daniel LaPine
I-MRSEC	Nadya Mason
Inclusion REU	Daniel Katz
Mathways	Jeremy Tyson
SING	Ripan Malhi
T35 SRTP	Lois Hoyer
WE CAN REU	Paul Davidson Michelle Green



Above: Irica Baurer, an arts instructor at Sarah E. Goode STEM Acadelemy, works on the CISTEME365 breadboard hands-on activity

Bottom right: Two Franklin STEAM Academy eighth graders record the rap they wrote about magnetism as part of I-MRSEC's Musical Magnetism curriculum.

- On the state, national, and international 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 and its outreach activities.

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

To meet the challenges our society faces today, it is critical that the diversity of STEM creativity be fostered by engaging diverse citizens who are well-informed, 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 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. One way I-STEM addresses this emphasis is through its evaluation of STEM education programs with similar goals. For example, the CISTEME365 program (see pages 13–15) for which I-STEM'S Director, Dr. Luisa-Maria Rosu is co-PI, focuses on schools with high populations of students underrepresented in

STEM. Plus, I-MRSEC (see pages 16–19) has outreaches to local schools with high populations of underserved students. Another program I-STEM evaluated in 2019, Mathways, seeks to ensure retention of underrepresented students in math.

***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.***



# 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 2019, I-STEM conducted evaluations of several of these, including several REUs.

**Research Experiences for Undergraduates (REUs).** REUs have been found to increase the number of students choosing STEM careers. I-STEM evaluated four summer research experience programs for undergraduate students in 2019. Two were official REU sites funded through the National Science Foundation’s REU program and engaged a number of students in research. These included the Biomedical Imaging REU and NCSA’s Inclusion REU (see pages 13 and 20, respectively). I-STEM also evaluated a USDA-funded ELI REEU: WE CAN. In addition, I-STEM evaluated the I-MRSEC REU as part of its evaluation of its STEM Education components (see pages 19, 20, respectively).

### ◆ 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 2019, I-STEM apprised faculty of relevant funding sources 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).



I-MRSEC undergrad Carmen Paquette by one of the instruments she used in her research.

**Table 2: Selected Undergraduate/Graduate STEM Education Programs I-STEM Evaluated in 2019**

Project (Funder)	PIs
Frontiers in Biomedical Imaging REU (NSF)	Marina Marjanovic Andrew Smith
I-MRSEC REU (NSF)	Nadya Mason
Inclusion REU (NSF)	Daniel Katz
T-35 Summer Research Training Program (SRTP [NIH])	Lois Hoyer
WE CAN REU (USDA ELI REEU)	Paul Davidson



**Outreach activities by Illinois students and faculty, such as at I-STEM's first-ever Clinton County Extension 4H students' campus visit, seek to foster interest in STEM among P-20 students in the community, state, and nation.**

# Goal 3: Promote K–12-University STEM Partnerships

## STEM COMMUNICATION AND PUBLIC OUTREACH

Following are the types of STEM communication and public outreach activities I-STEM was involved with in 2019. Partners/projects that I-STEM staff collaborated with, evaluated, or disseminated information about are included in the listing that begins on page 13.

### ◆ Disseminate information about campus STEM education outreach activities.

*Illinois* colleges, units, faculty, and student organizations hosted numerous STEM Education outreach activities in 2019. I-STEM prominently displayed information about many of these via its website, listserv, and in printed or electronic materials, including this annual report and I-STEM's annual magazine, *STEM Education at Illinois in 2019*, 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 Stories<sup>3</sup> and Archives.<sup>4</sup> Information for those seeking to participate in outreach activities is organized by stakeholder groups: *P–20 teachers*<sup>5</sup> who seek professional development or to reinforce classroom instruction with additional activities, and parents and/or students seeking STEM education opportunities via *summer camps*<sup>6</sup> or *academic year activities*.<sup>7</sup> I-STEM continued to develop its STEM Education Outreach Groups webpage<sup>8</sup> that lists outstanding STEM education outreach groups/programs, many of which I-STEM evaluated, collaborated with, and/or featured on its website in 2019.

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

I-STEM works with campus STEM Education sites to promote STEM outreach activities, both campus visits and/or off-site activities that span all age ranges (elementary, middle, and secondary school students) and demographic groups. I-STEM staff often serve as a liaison between campus groups, schools, and other organizations, to increase recruitment of students not engaged with STEM outreach and to boost outreach activities, especially for primary and middle school students. For example, I-STEM partnered with the Clinton County 4-H Federation leadership group to arrange a STEM-related campus visit for ten middle and high school students (see pages 24–31 for a detailed description of the activities).

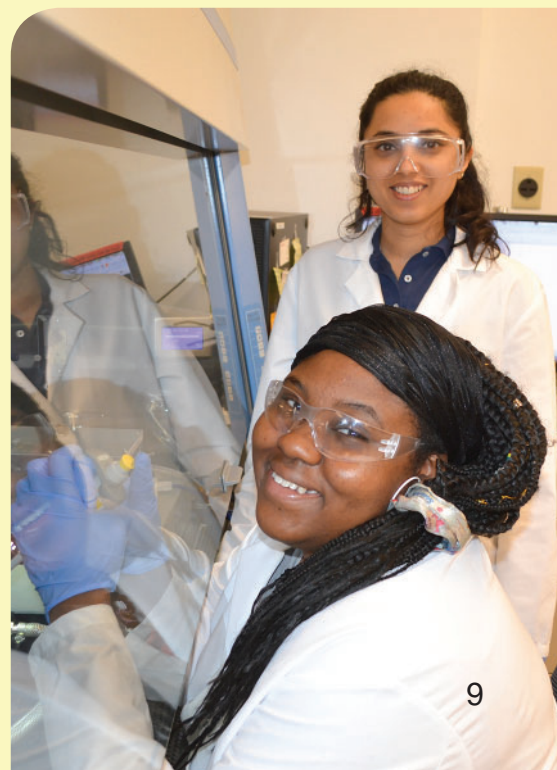
- In 2019, I-STEM continued to develop a list of campus outreach groups, including *Illinois* projects, faculty/researchers and their labs, and student organizations that conduct outreach activities, with the goal of creating a list that both university and off-campus groups can access to engage groups to perform STEM outreach

### I-STEM Website STEM Education Resources

- **STEM Education Top Stories**  
<sup>3</sup><http://www.istem.illinois.edu/news/topstories.html>
- **STEM Education Story Archives**  
<sup>4</sup><http://www.istem.illinois.edu/news/archives.html>
- **Resources for P-20 Teachers**  
<sup>5</sup><http://www.istem.illinois.edu/resources/goal2resources.html#teacherdevelop>
- **Resources for P-20 Students**  
<sup>6</sup><http://www.istem.illinois.edu/resources/goal1resources.2.html#summercamps>  
<sup>7</sup><http://www.istem.illinois.edu/resources/goal1resources.2.html#acadyear>
- **STEM Ed Outreach Groups**  
<sup>8</sup><http://www.istem.illinois.edu/resources/stem-ed-outreach2.html>

Opposite on page 8: A Clinton 4H member holds Cecelia the Tarantula.

Below: I-MRSEC undergrad Angela Johnson (bottom) conducts her research in the Diao Lab, mentored by PhD student, Prapti Kafle.





Above: An officer from the Illinois Space Society (ISS), one of the student organizations I-STEM collaborates with on outreach activities, interacts with the group of 4H middle and high school students from Clinton during the campus visit I-STEM set up.



Above: Chemistry lecturer Tina Huang (right) leads the Holiday Magic Show audience in “Hail to the Orange, hail to the Blue,” while the chemical reaction changes from orange to blue...and back. The magic show was a public outreach held by the Chemistry Department in December 2019 which I-STEM informed the public about via its list-serv and then reported on in the news section of its website.

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 and/or other organizations seeking outreach or other service opportunities.

***I-STEM works with campus groups seeking to engage in STEM education outreach activities, serving as an informal liaison to apprise them of outreach opportunities and approaching many directly to help with I-STEM campus visits by various groups.***



## STEM TEACHER TRAINING, RESEARCH, AND PROFESSIONAL DEVELOPMENT IMPROVEMENT

### ◆ Increase external funding for teacher preparation and professional development.

In 2019, 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.

### ◆ Evaluate STEM teacher training and professional development projects.

In 2019, I-STEM evaluated the CISTEME365 institute which trained K-12 educators in how to promote equity among students (see pages 13–15). I-STEM also evaluated I-MRSEC workshops aimed at improving scientific communication among professors, researchers, and students.. I-STEM supported these activities by providing on-campus evaluation services via 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.

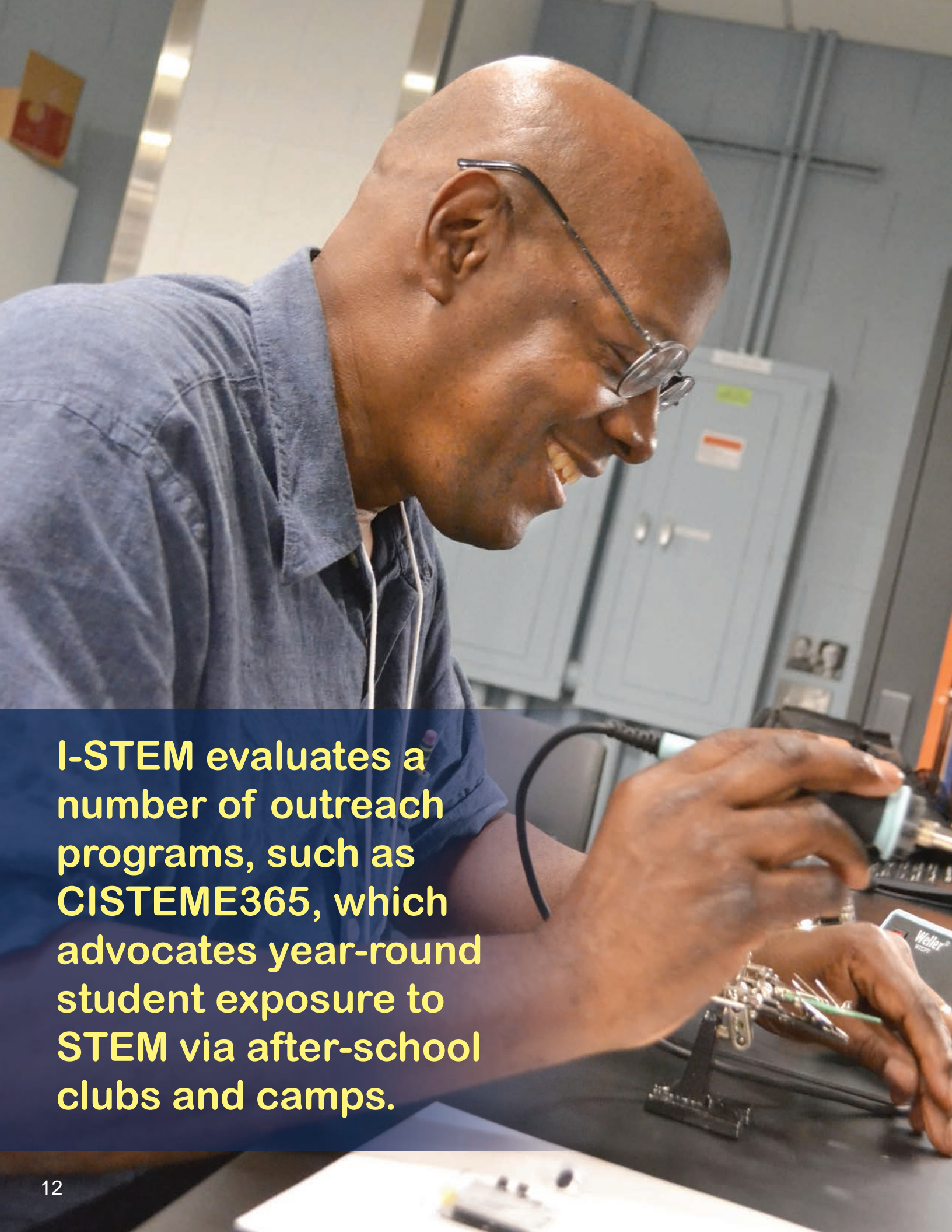
I-STEM posts web articles reporting on these programs' activities in its STEM Education News section; for STEM educators seeking these types of activities, I-STEM posts information about upcoming STEM teacher PD and research experience opportunities in its resources section. Information about I-STEM 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: At I-MRSEC's Principiae Workshop, which I-STEM evaluated, researchers appreciate Jean-luc Doumont's presentation style.

Below: A young visitor shows off the egg-drop contrivance she and her dad designed at the Dads 4 Daughters outreach in November 2019. The event was hosted by SWE (the Illinois chapter of the Society of Women in Engineering), one of the outreach groups I-STEM networks with, and an article covering this event was posted on I-STEM's website.





**I-STEM evaluates a number of outreach programs, such as CISTEME365, which advocates year-round student exposure to STEM via after-school clubs and camps.**

# STEM Education Programs/Initiatives I-STEM Evaluates

Following are the individual projects for which I-STEM performed evaluations in 2019, as well the national center, I-MRSEC, for whom we evaluated several components.

- ★ **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.
- ★ **CISTEME365.** Catalyzing Inclusive STEM Experiences All Year Round (CISTEME365) hypothesizes that experiences with cutting-edge technology must exist all year-round to effect significant improvement in students' grasp of STEM. Thus, the goal of this 3-year NSF grant is to provide year-round opportunities via STEM clubs and university-hosted summer camps that enable middle and high school students, especially those underrepresented in STEM, such as females, underrepresented minorities (URMs), and/or low-income students, to participate in sustained, intensive, hands-on STEM learning experiences in order to build technical knowledge and ability and to offer insights into different STEM careers. To accomplish this,

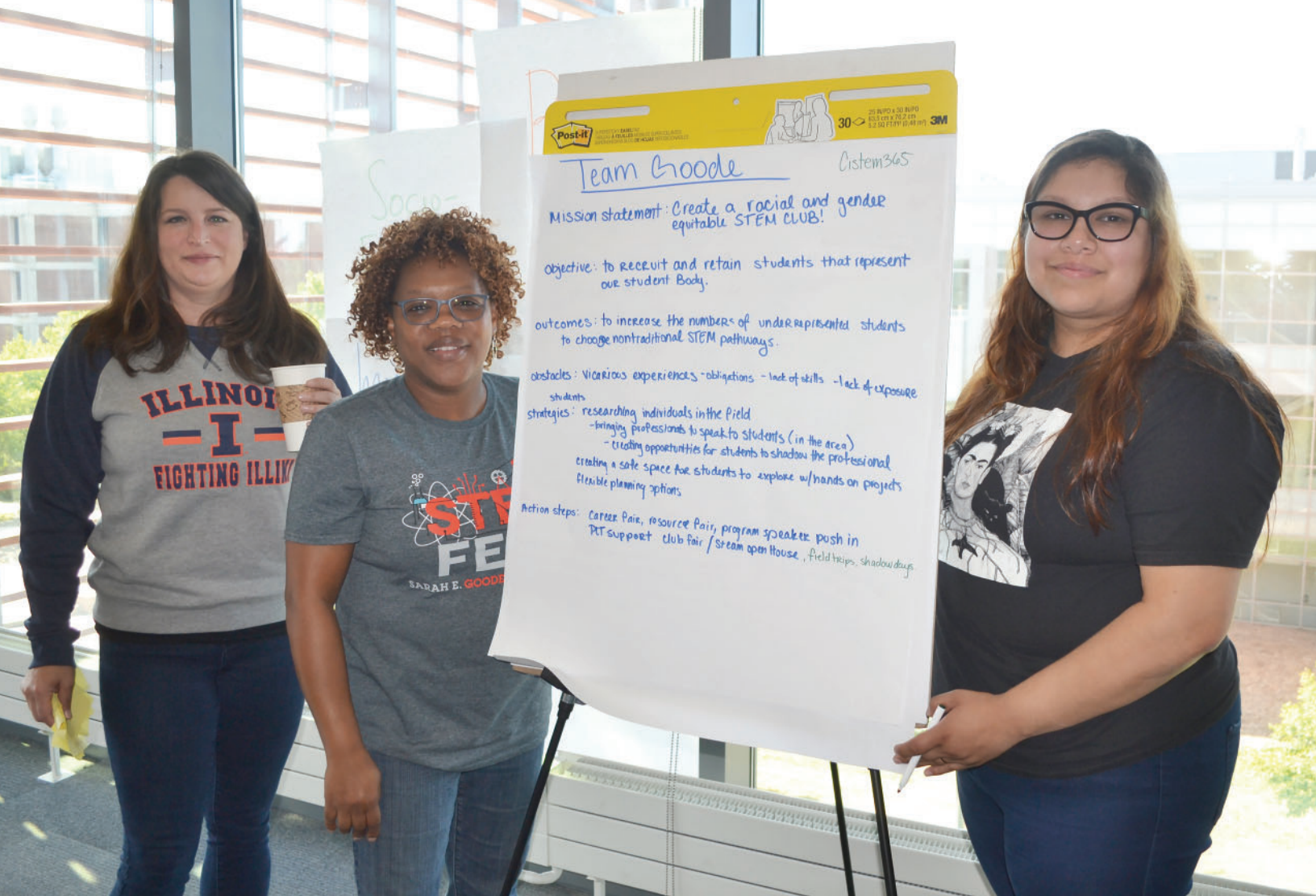


Above: Biomedical Imaging REU undergraduate student Disha Patel presents her research during the Illinois Summer Research Symposium

Below and bottom left: Biomedical Engineering REU participants.

Opposite on page 16: Donnel White, a science teacher at John M. Smyth IB World School in Chicago, solders a circuit he's building.





Above: The IDEA Team from Sarah E. Goode STEM Academy in Chicago by the Action Plan they developed.

Below: Chicago Vocational Career Academy's instructional technology teacher solders the circuit she's making.



the project provided resources to teachers via a summer learning institute combined with a school-year networked improvement community (NIC) for school counselors and teachers.

The main objective of CISTEME365 is for educators from partnering schools to begin after-school STEM clubs. So, as part of the program, for two weeks this past summer, from July 22–August 3, 2019, five schools sent IDEA (Inclusion, Diversity, Equity, and Access) Teams to campus for the first CISTEME365 Institute. There, the educators learned how to foster equity and inclusion, tried out hands-on activities that would expose students in their clubs to STEM, and networked with other educators excited about STEM.

Participating in the Institute and also as part of the 2019–2020 CISTEME365 cohort were educators from five schools. Three Chicago Public Schools were involved: John M. Smyth IB World School, a middle school, plus two high schools: the Chicago Vocational Career Academy and the Sarah E. Goode STEM Academy. Two local schools also participated: Urbana High School and Mahomet-Seymour High School. Each school's team was comprised of three members: a teacher, a counselor, and a third person (another teacher or counselor, STEM specialist, vice principal, or even interested parent).

Because CISTEME365 is targeting students often underserved in STEM, including women and minorities, the first week's emphasis

was equity training taught by Meagan Pollock of the National Alliance for Partnerships in Equity (NAPE). The message of the week-long institute was simple: reach and teach every student.

The second week, PI Lynford Goddard and his team, many of whom have taught in his “Girls Learn Electrical Engineering” (GLEE) camp over the years, introduced the GLEE curriculum, which emphasizes electrical engineering via cutting-edge-yet-fun hands-on activities. The idea was that the teachers and counselors would take the curriculum back to their schools and launch stem clubs.

Similar to GLEE, the week’s activities were a mix: brief trainings introducing electrical engineering topics were followed by related hands-on activities about breadboarding, motors, optics/imaging, how to design an experiment, algorithms, and how to solder safely. Plus, by the end of the week, each participant had completed several larger projects, building a circuit, LED calculator, and radio phone.

In addition, the educators also experienced tours, demonstrations, even a panel with members of industry: Imad Rahman of Henneman Engineering and Paul Wever of PWCE (Paul Wever Construction Equipment). Some tours/special activities dealt with imaging, bionanotechnology, antennas, and virtual reality. A special power and energy session taught by ECE faculty Subhonmesh Bose and Arijit Banerjee addressed a history of power systems, the physics behind electromechanical energy conversion, and research frontiers in power and energy. In addition, IDEA Teams also were given time to meet to work on Action Plans for their school’s club.

I-STEM’s role in CISTEME365 is to evaluate the program, with the goal of promoting the design and implementation of innovative STEM curriculum and instruction and to involve school policy leaders in enhancing the learning experiences for URM students.



Above: An ECE student helps the Sarah E. Goode STEM Academy STEM integration specialist with her breadboard.

Below: Sarah E. Goode STEM Academy’s arts instructor gets all but the final bulb to light up when doing the stationary bike demo.

Bottom left: A team of educators discuss student perceptions of STEM.





Above: I-MRSEC REU participant Carmen Paquette presents her research at the REU's end-of-the-summer poster session.

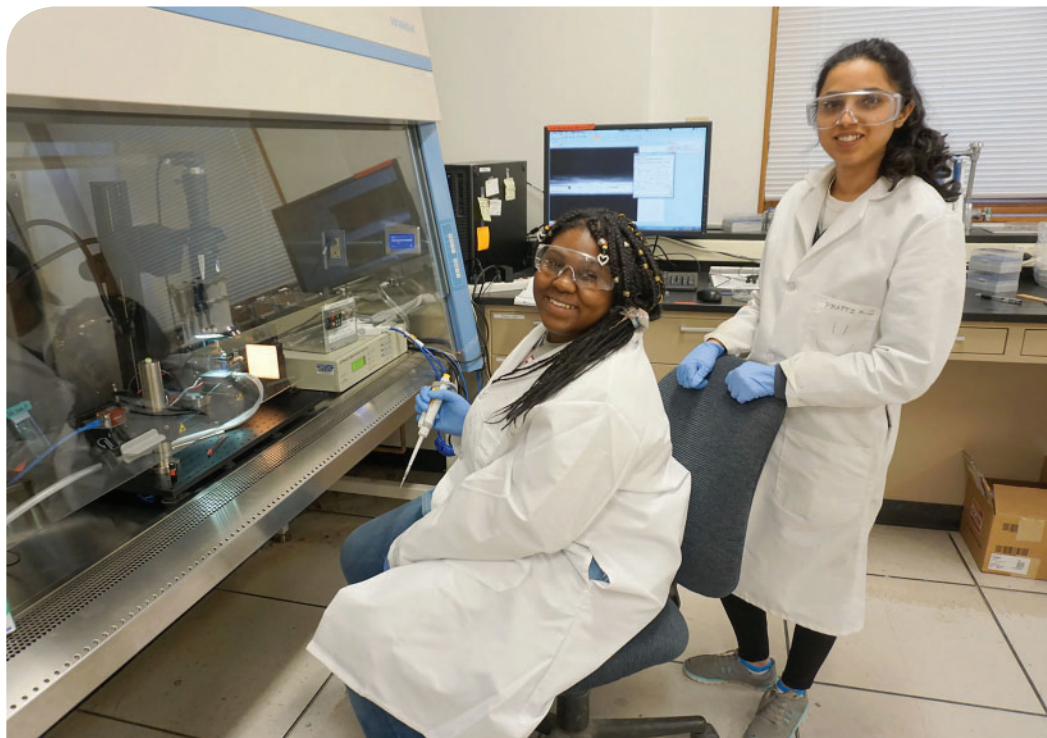
Bottom right: I-MRSEC REU undergrad Angela Johnson conducts her research in the Diao Lab, mentored by PhD student, Prapti Kafle.

Below: A Franklin eighth grader experiences virtual reality during a tour of MRL as part of I-MRSEC's Musical Magnetism Curriculum implemented at Franklin STEAM Academy.



★ **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.

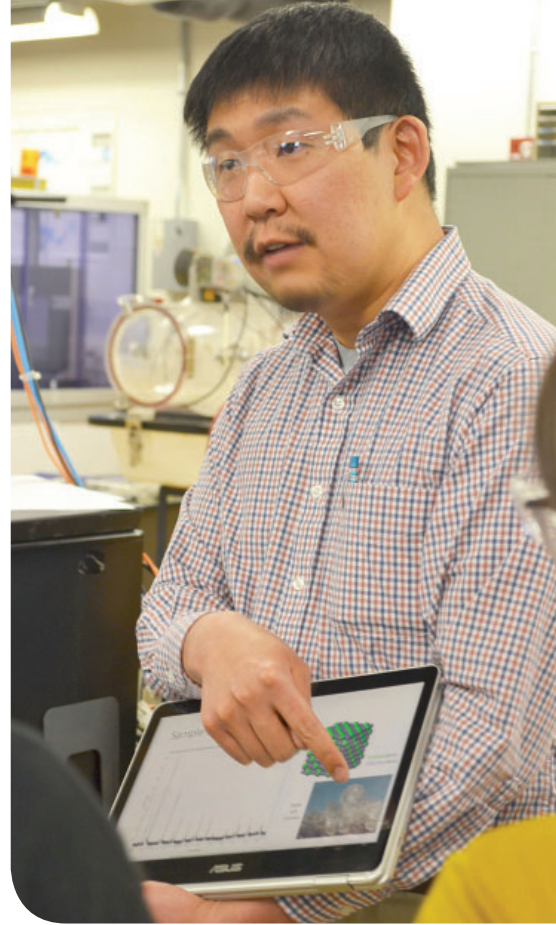
★ **Illinois Materials Research Science and Engineering Center (I-MRSEC).** I-MRSEC's mission is to perform fundamental, innovative research on understanding the dynamic properties of materials, with applications to societal needs, and to support interdisciplinary education and training of students in 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 is being 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 provides opportunities for teachers and students in rural and underserved schools to participate in materials science research and to 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 seeks 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 seeks to 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 work with I-MRSEC EHRD programs involves two thrusts: evaluation of EHRD activities includes 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. Our second thrust involves dissemination of information about the Center's various programs via the website and printed materials. Following are the EHRD activities I-STEM evaluated/reported on in 2019.

- **I-MRSEC's Cena Y Ciencias.** I-MRSEC staff, faculty, and students were involved with the Cena y Ciencias (Spanish for "Supper and Science") program at Dr. Preston Williams Elementary School in Urbana. Held the first Monday of every month, the school-year program (October 2018 through May 2019) exposed mostly Hispanic K-5 students and their families to hands-on science activities led completely in Spanish.



Above: MRL Postdoc James Lee presents an X-ray diffraction activity during Franklin STEAM Studio's visit to MRL.

Below: A Cena y Ciencias participant shows the balloon that he completely put a stick through.

Bottom left: A young Cena y Ciencias visitor has magnets attached to her paperclip chain during a hands-on activity about polymers.



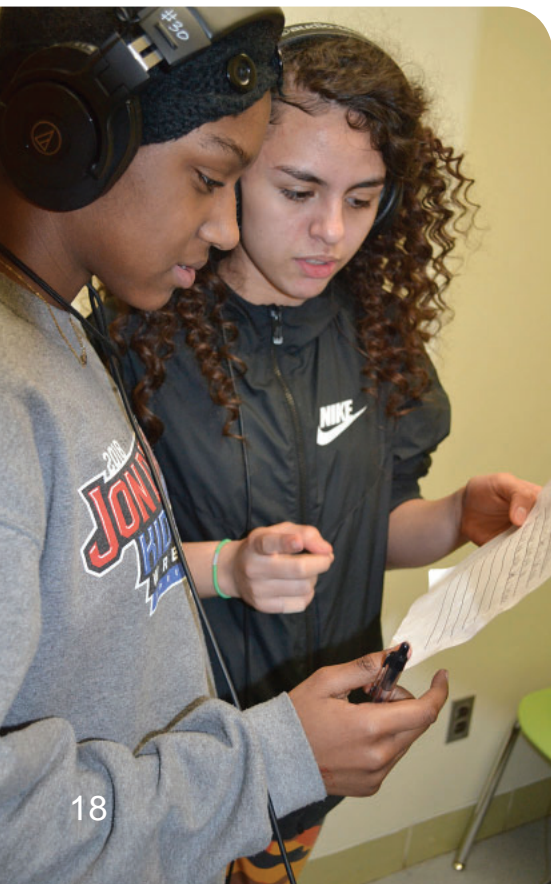


Above: Directors and actors of Magnetic Fields participate in a panel discussion after the screening.

Top right: As a part of I-MRSEC's Musical Magnetism Curriculum, Assistant Professor Pishane Huang discusses the impact of extreme cold on materials, as a Franklin eighth grader dunks a rose into liquid nitrogen.

Below: Two Franklin students prepare to record their rap as part of the Musical Magnetism Curriculum.

- **I-MRSEC Magnetic Fields Web Series.** I-MRSEC produced this 4-part web series about magnetism using a fun plot and a cast of young actors the targeted audience of middle to high school students could identify with. Intended to be a resource for teachers, the web series was directed by John Isberg, with creative and scientific input from I-MRSEC's PI, Nadya Mason, and Outreach Coordinator, Pamela Pena Martin.
- **I-MRSEC Musical Magnetism Curriculum.** The goal of I-MRSEC's "Musical Magnetism" curriculum was to expose Franklin STEAM Academy eighth graders to materials science and magnetism, but also to another of the center's main emphases: scientific communication. Lesson plans embraced a medium today's kids probably like: hip hop or rap. So, after Illinois researchers, students, and staff had exposed the students to multidisciplinary lessons in several related areas, the kids teamed up to create then present raps about specific areas of magnetism.







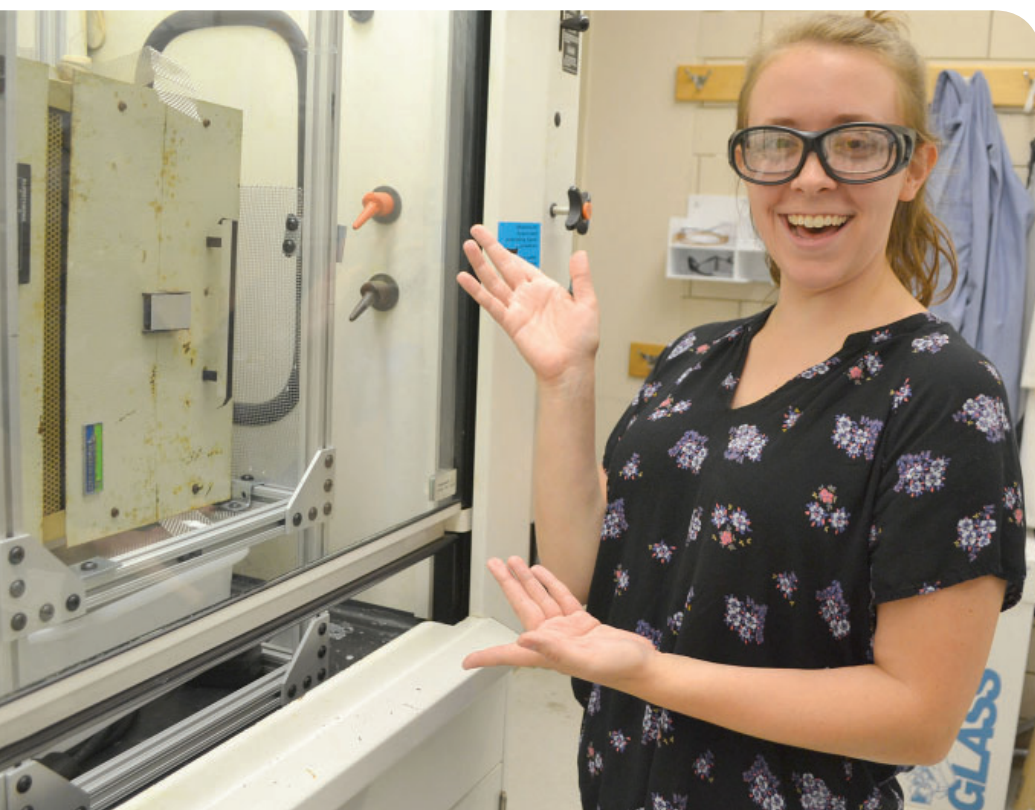
- **I-MRSEC Principiae Workshop.** As part of I-MRSEC’s scientific communication mandate, on October 10, 2019, I-MRSEC held a workshop entitled “Making the Most of Your Presentation.” Presented by Principiae’s Jean-luc Doumont, the workshop focused on training researchers to better communicate their science. One recommendation several participants intended to implement was to capture the audience’s attention by starting their presentation with humor, a story, a demonstration with an object, a question, a quote, or even a shocking statement.
- **I-MRSEC REU Program.** I-STEM’s 2019 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.

Top left: David Cahill, Jean-luc Doumont, Nadya Mason, and Daniel Shoemaker following the Principiae Workshop.

Above: I-MRSEC REU participant Hannah Gilbonio presents her research during the REU’s final presentation event.

Below: Jean-luc Doumont discusses making presentations during the Principiae Workshop.

Bottom left: I-MRSEC undergrad Carmen Paquette shows off the furnace she revamped while researching the synthesis of an antiferromagnetic material this past summer in Daniel Shoemaker’s lab.

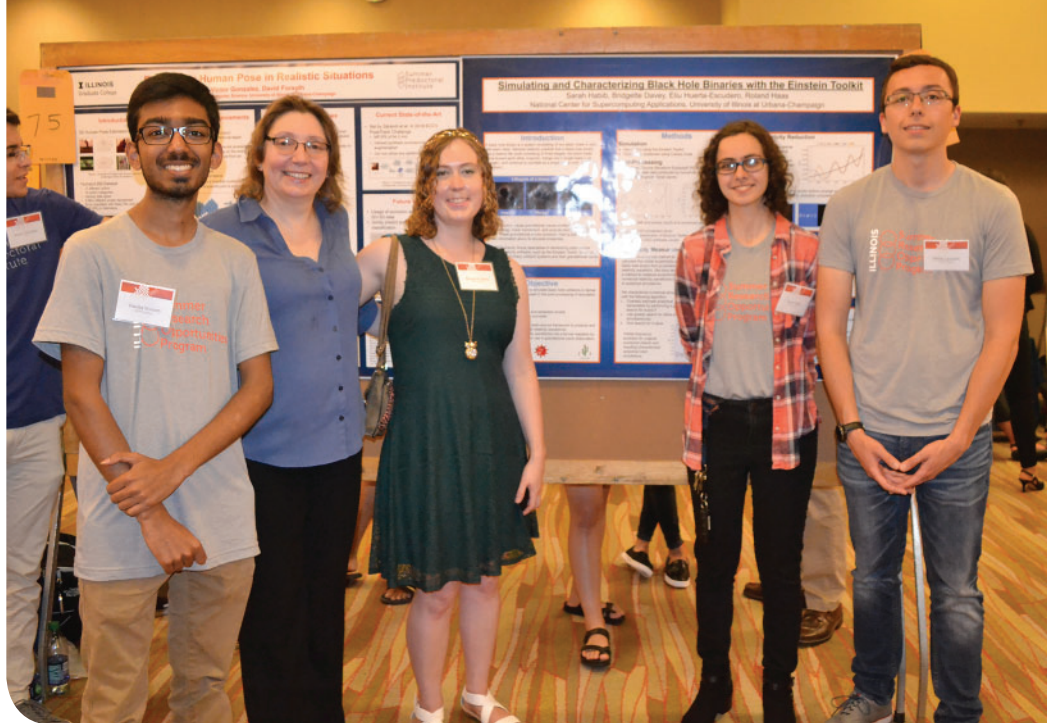




Above: Inclusion REU undergrad Bomsaerah Seong shares the insights that she gained through her research.

Top right: Olena Kindratenko (second from the left) and some of the INCLUSION REU participants at the 2019 Illinois Summer Research Symposium.

Below: Sarah Habib proudly stands in front of her research project on Black Hole Binaries



★ **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.

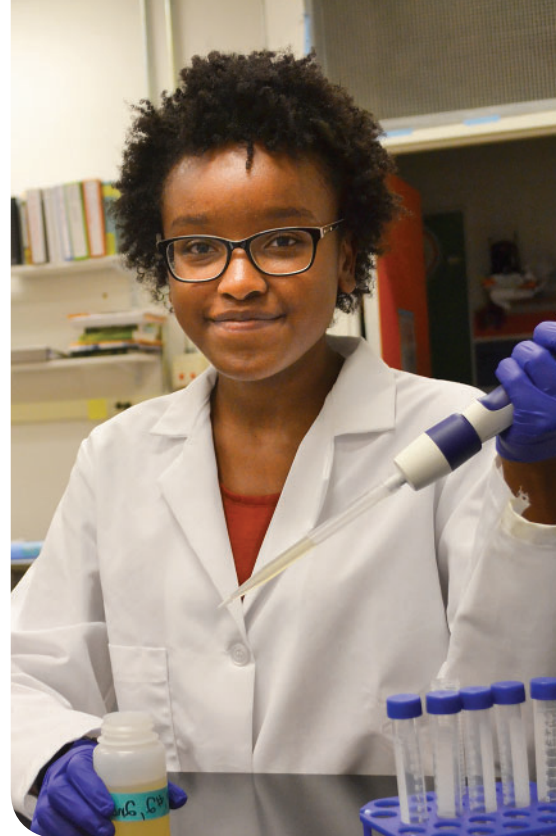
★ **Summer Internship for Native Americans in Genomics (SING).** The NIH-funded SING program is a one-week workshop about the uses, misuses, and limitations of genomics as a tool for Native American communities; it also trains Native Americans in the concepts and methods currently used in genomics. I-STEM's 2019 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.

★ **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.

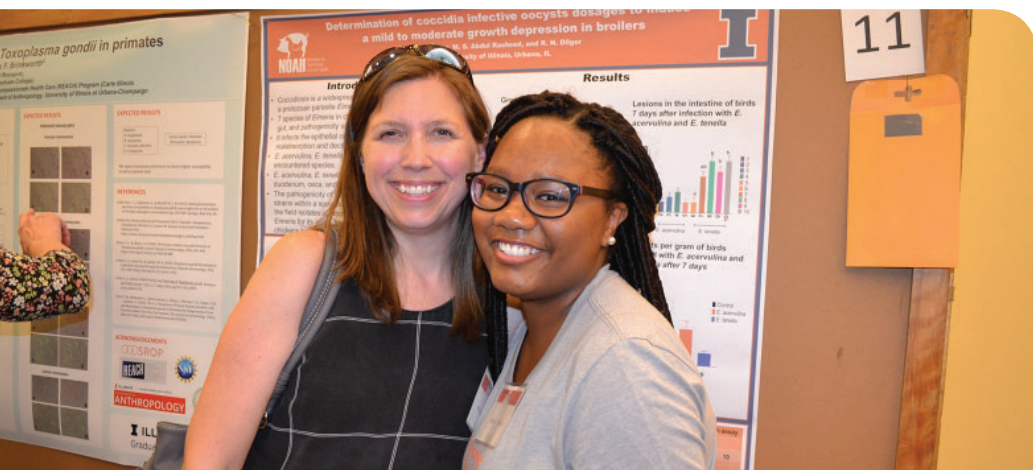
Although Year 2 data are still being collected, according to Year 1 evaluation findings, participants found the program organization and structure to be effective; however, some were dissatisfied with receiving their first stipend late. Participant satisfaction with the assigned research projects was 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.

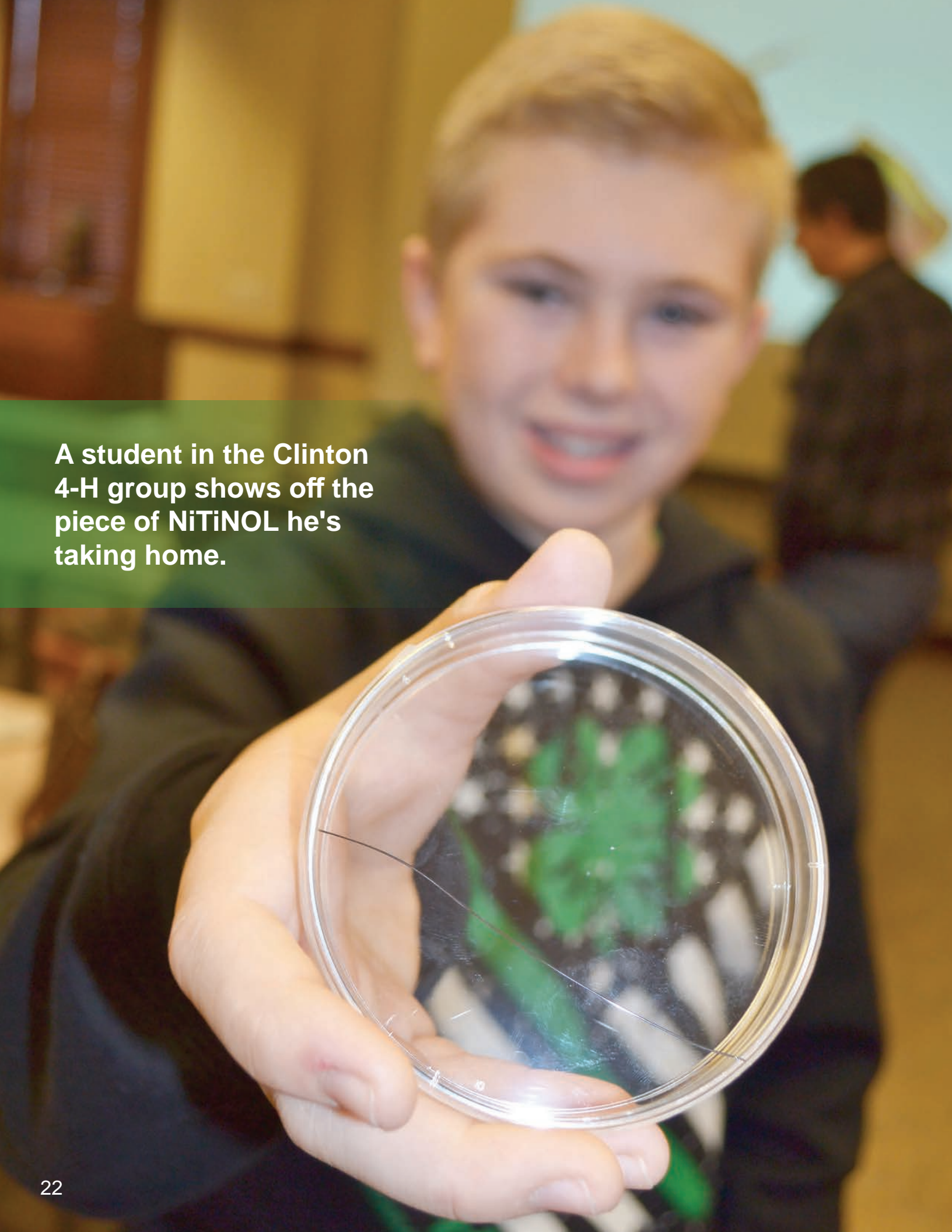


Above: A WE CAN REU undergrad conducts research on water quality.

Below: Alondra Estrana shows off the 3-D printed "turtle" she used in her research as part of the WE CAN REU.

BOTTOM RIGHT: WE CAN REU Co-PI Michelle Green (left) and AREU undergraduate student at the Illinois Summer Undergraduate Research Symposium.



A young boy with short blonde hair, wearing a dark blue jacket, is smiling and holding a clear petri dish. Inside the dish, a small green plant specimen is visible, resting on a dark, perforated surface. The background is slightly blurred, showing other people in a well-lit indoor setting.

**A student in the Clinton 4-H group shows off the piece of NiTiNOL he's taking home.**

# I-STEM Outreach Program: Clinton 4H Group Visits Campus, Experiences STEM at Illinois

On March 4th, ten junior high and high school students, members of Clinton County's 4-H Federation leadership group, traveled up from southern Illinois to spend the day on the Illinois campus. During their visit, they participated in STEM hands-on activities and briefly toured a number of campus buildings, including the IGB. While here, they were exposed to several STEM disciplines, dabbling a bit in Mechanical Engineering, Math, Aerospace Engineering, Molecular and Cellular Biology, and Entomology. Plus, they got to interact with a number of Illinois students to find out what being a student at Illinois might be like, as well as some possible career options.

The group's first activity of the day was a visit to the Mechanical Engineering Lab to participate in several fun hands-on activities with Joe Muskin, Mechanical Science and Engineering's Education Coordinator. Muskin sought to pique the visitors' interest in engineering through several fun activities, but also appealed to their practical side by showing them a list of the highest paid starting salaries nationwide, most of which were in engineering.

Before beginning his first activity, Muskin attempted to help the young people grasp nanotechnology and exactly how small a nanometer is (one-billionth of a meter). So he did a demonstration where students made a wide circle with a rope, which was to represent the diameter of a human hair. The tiny speck he held between his fingers represented the size of a nanometer in relation to the "hair."

The first activity Muskin led them in was extracting gold nanoparticles by adding sodium citrate to hydrogen tetrachloroaurate ( $\text{HAuCl}_4$ ), which



Above: Joe Muskin illustrates the size of a "nanometer" compared to the diameter of a "human hair," which is the inside of the rope circle.

Below: Clinton 4H members make gold nanoparticles.

Bottom left: A 4H member uses an eyedropper to get sodium citrate to add to her tube of hydrogen tetrachloroaurate which she will use to create gold nanoparticles.





Above: A student makes gold nanoparticles.

Top right: A student uses a magnet to move iron ferrite shavings around in a test tube.

Bottom right: Students complete a math work-sheet about Automata.

Below: A participant retrieves her NiTiNOL wire, which has reverted to its original shape



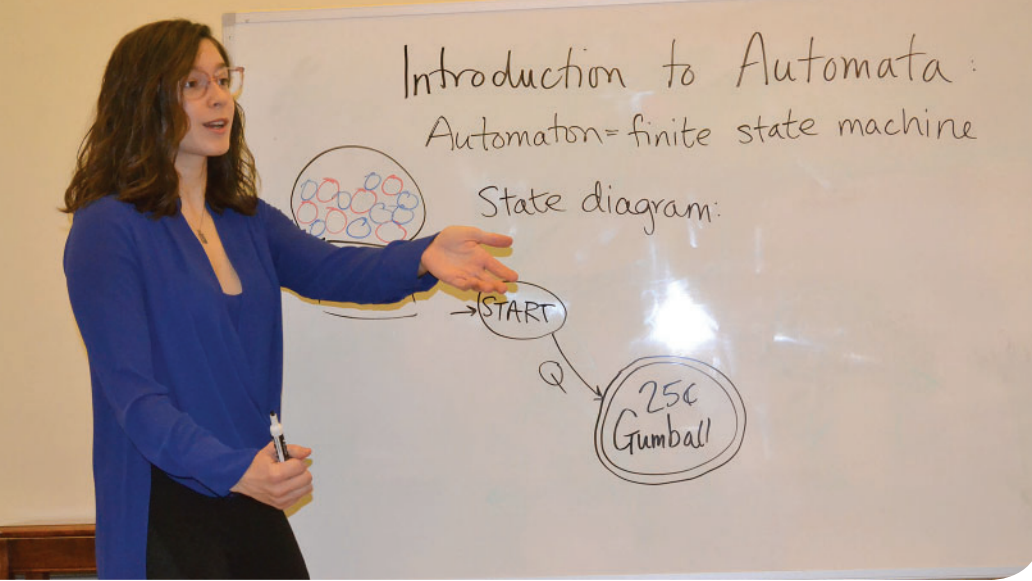
they then heated in a boiling water bath until gold nanoparticles formed. The students were excited that they were allowed to take home the gold nanoparticles they'd made, and also to discover that they were actually worth 50¢ should they want to sell them on the internet!

In another activity, Muskin illustrated some principles to explain how a toy works that they probably played with as kids—a Magnadoodle or an Etch-A-Sketch. The students were given test tubes filled with water and iron ferrite shavings plus magnets, which they used to move the shavings around to create various designs.

In Muskin's final activity, he introduced the students to NiTiNOL, a compound comprised of Nickel and Titanium made at the Naval Ordnance Laboratory, commonly known as memory metal. They received a small wire, which they were instructed to twist into a shape. Once they placed it in a beaker of hot water, however, they discovered that it reverted to its original shape. The students were also allowed to take the NiTiNOL home to play with.

Next, several members of the IGL (Illinois Geometry Lab) led the students in some fun activities about mathematics regarding Automata, or

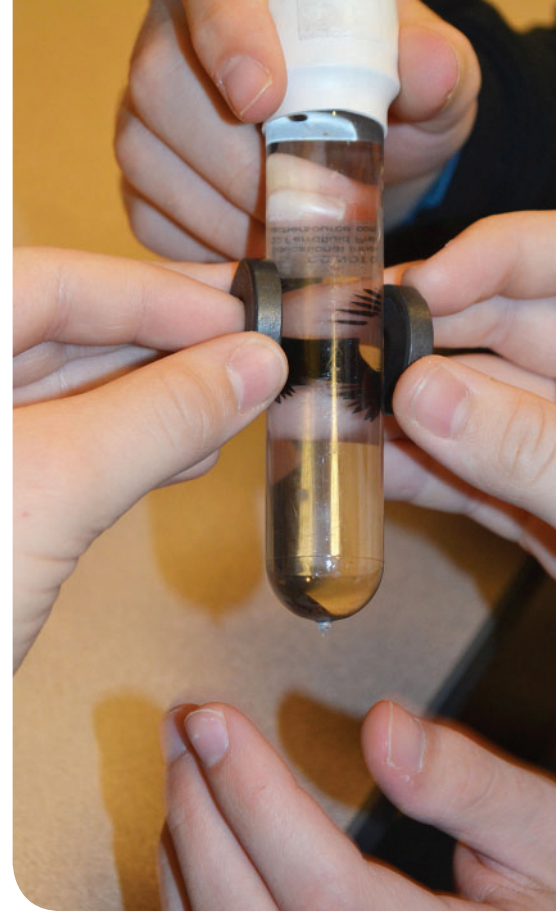




finite state machines. An automaton performs a function according to a range of predetermined programmed responses to different circumstances. To introduce the students to the mathematical idea, Alexi Block Gorman drew a state diagram of a gumball machine, to have them help figure out a number of scenarios where if the gumball costs 25¢, what are the various combinations of coins that one can use to purchase it (such as a dime, a dime, and a nickel). Her second example was using binary code (a string of 0s and 1s) to print something on a printer that will not print when a 0 is sent but will only print when it receives a 1. Students were then given some worksheets to complete related to those principles.

For lunch, the group got to experience the food court in the basement of the Illini Union. There, in addition to getting lunch, they got to feel what it might be like to be a college student as they were surrounded by a bunch of Illinois students who were eating, studying, or just hanging out.

Following lunch, the group took a brief detour to snap some obligatory photos at Alma Mater, then on to their next stop, a visit to Talbot Lab and Aerospace Engineering hosted by the Illinois Space Society (ISS), arranged by its Outreach Coordinator, Shivani Ganesh.



Top left: Alexi Block Gorman explains the Automata principle using a buying-a-gumball illustration.

Above: Students use magnets to play with the iron ferrite shavings in the test tube.

Below: During the Talbot Lab tour, ISS Outreach Coordinator, Shivani Ganesh shows off some of the group's rockets.

Bottom left: The Clinton 4-H group stops by Alma Mater for a photo.

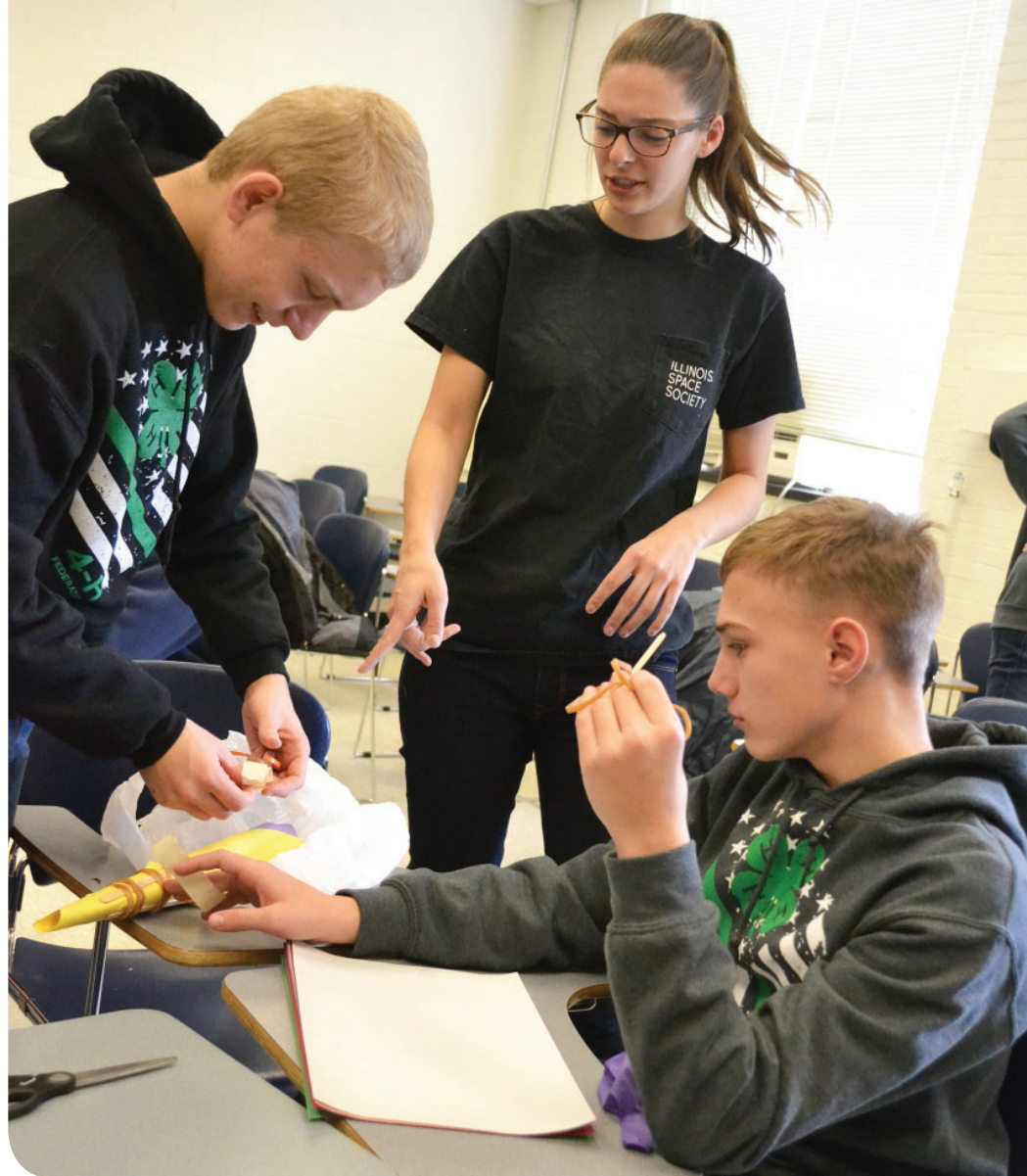




Above: Participants watch a live video chat with an Illinois Aerospace senior and ISS member, Ryan Noe, a NASSA intern.

Top right: Christine Mehr (center) gives some advice to a couple of students building their egg-drop apparatus.

Below: During the tour of Talbot Lab, participants got to see the Rolls Royce engine.



First the students had a brief tour of some of Talbot's student work spaces, where they saw some of the many rockets ISS members had built for various competitions. Plus got to see one of the landmarks of the Talbot basement tour, the Rolls Royce rocket engine.

Following the tour, the group broke into teams to complete a fun aerospace-related hands-on activity, an Egg Drop competition. The idea was to use a number of materials, such as balloons, plastic grocery bags, cotton balls, etc., to build a contrivance similar to a parachute that would protect an egg during a fall...from a second story window in Talbot. Students came up with a variety of designs and learned some things about not just engineering but teamwork during the process. A few teams even successfully protected their eggs!

ISS's final activity was a live video chat with an Illinois Aerospace senior and ISS member, Ryan Noe who is currently interning at NASA Johnson Spaceflight Center under the Pathways program. This opportunity brings in students for multiple rounds during the fall, spring, and summer sessions, and typically hires them for full time work right after graduation. Noe has one semester left and will be completing that this fall. During the chat, the younger students and leaders were able to ask him what his internship has been like and things he did while at Illinois to prepare for a career, possibly at NASA.





The next discipline students explored was Molecular and Cellular Biology (MCB), as Max Baymiller, an MCB PhD student and Outreach Coordinator of MCB's graduate student organization, the MCBees, introduced participants to the Tree of Life and Carl Woese's proposal that the taxonomy used to classify all life include three domains: Archaea, Bacteria, and Eukarya as the highest level, rather than two kingdoms (animal and plant.) Following his discussion, students were given cards depicting various life forms and asked to classify them according to either Haeckel's Tree of Life model proposed in 1879, or Woese's 1990 scheme.

Following this introduction to Woese, students took a tour of Illinois' Carl E Woese Institute of Genomic Biology (IGB), led by Courtney Cox Fenlon, the IGB Outreach Activities Manager. There they learned about research done at the IGB, and also got to see several labs, including a clean room, along with some art developed from IGB research

The group's final activity of the day was a trip to Morrill Hall to interact with Ed Hsieh and Scott Clem, the two Outreach Coordinators of the Entomology Graduate Student Association (EGSA). In addition to viewing the EGSA's insect collection and learning a lot about various insects, the more intrepid students (and leaders), were able to touch or hold different insects from Entomology's Petting Zoo, including Cecelia, the Tarantula.

Cheryl Timmerman, 4-H coordinator for Clinton County, shares why she arranged for the group of students to do a campus visit.

**“Because one,” she says, “we want them all to come to the U of I. We want them to understand the opportunities that are here, and the best way to experience that is through the on-campus visits.”**

Above: Shivani Ganesh (left) and Colby Litteken prepare to drop his egg apparatus from a Talbot lab 2nd story window.

Below: The MCBees' Max Baymiller introduces the students to the Tree of Life and Carl Woese.





Above: EGSA Outreach Coordinator Ed Hsieh prepares to hand Cecelia the Tarantula to a student.

Top right: During the tour of IGB, Courtney Fenion (left) and two students look at an art exhibit featuring reprints of research done in IGB.



Timmerman adds that in the past, a few of the students have attended the 4-H Illinois Summer Academies, one-week camps in a number of different disciplines.

Timmerman also wanted the students to be able to check out the engineering school as well as the College of ACES. She mentioned that when ACES's Dean Kidwell had visited, some kids had expressed an interest in engineering and Kidwell had suggested that they could also get a similar degree through ACES. "She talked about the crossover and exploring all your options," she recalls.

Timmerman's take on the visit? "It's been great," she reports. "STEM is obviously a focus everywhere, especially in the schools. The morning session and all the hands-on activities were great, making your own gold is pretty exciting, and then following it up with the math was an awesome experience for them."

Timmerman believes her students were most engaged during Joe Muskin's hands-on activities, the ISS students' aerospace activities, and IGSA's petting zoo.

Shivani Ganesh, ISS's Outreach Coordinator, explains why she believes it's important to bring youth onto campus for visits:

**"Oftentimes, younger kids can get intimidated by the scope of engineering; I know I definitely have been! Bringing younger students to campus—specifically, the aerospace engineering community—epitomizes the fact that we're all just students pursuing what we're passionate about. Hence, we do our best to lead by example."**

Christine Mehr, ISS's Assistant Director in charge of Professional Development, shares why she and her fellow ISS members were excited about doing activities with the southern Illinois group.



**“We were all at that age where we didn't know what we wanted to do. So it's really exciting being able to show people that this is what you can do from engineering and help talk them through what it's really like, not only going to college but working in that field.”**

She adds that the younger students weren't the only ones to benefit, but that she and her fellow Aerospace students had also found the outreach to be rewarding.

**“Seeing their excitement reinvigorates your own passion, because sometimes you forget what it's really like to be passionate when you're so busy with your studies.”**

One of the 4-H youth, Colby Litteken, a junior at Mater Dei Catholic High School in Breese, Illinois, shares why he wanted to come on the campus visit.

**“I've been to U of I multiple times, and every time I've been here, I've fallen in love with this campus more and more. I've wanted to be an engineer since as far as I could remember, and I know they've got really good programs for that.”**

Litteken says he's narrowed the field he intends to go into down to two, and he'll probably choose between mechanical and electrical engineering.



Above: Christine Mehr (center) gives some advice to a couple of students building their egg-drop apparatus.

Below: A member of the ISS chats with the 4H members about a Mars rover they designed.

Bottom left: Colby Litteken shows off the egg-drop contrivance he and his teammate built during an Aerospace Engineering hands-on activity.





# 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 Director. Projects: PIRE, R25, Mathways
- Molly Dawn Galloway, Graduate Research Assistant. Project: Mathways, SRTP.
- Elizabeth Innes, Communications Specialist. Projects: I-STEM website, I-STEM Magazine, I-STEM Annual Report; edit, format, and publish evaluation reports if needed.
- Katelyn Liss, Graduate Research Assistant. Projects: NCSA Cyberinfrastructure; T35 SRTP
- Joe Cross, Post Doctoral Researcher. Projects: I-MRSEC.
- Marlon Mitchell, Graduate Research Assistant. Projects: WE CAN REU, Biomedical Imaging REU
- Maggie Phan, Graduate Research Assistant. Projects: Cottrell Scholar Midwest Regional Meeting, GLAM, I-MRSEC, NCSA Inclusion REU, SRTP

## 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 2019). A senior in Anthropology with a concentration in Human Evolutionary Biology and a minor in Integrative Biology, Kristina received her Bachelor's Degree in May 2019. Her plans for the future involve getting a Master's degree in nursing
- Ashley Chung (spring 2019). A May 2019 graduate, Ashley majored in Economics. She is currently a technology consultant.
- Joshua Chung (summer and fall 2019). A junior, Joshua is majoring in Architecture with a minor in Business and expects to graduate in May 2021. His career goal is to work in a firm working for a non profit organization.
- Ryan Kim (summer 2019).
- Nick O'Connell (spring 2019). A senior 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.
- Sooah Park (summer and fall 2019). A junior majoring in Accountancy, she hopes to graduate in 2021, with a career goal of being an accountant.
- Yuna Park (summer and fall 2019). Majoring in Community Health, Yuna is on the Pre-Health Administration track. Currently a sophomore, she plans to graduate in 2022. After graduation, she hopes to go to graduate school then find a job in hospital administration.



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..

### 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 2019; some were funded externally, such as by NSF and NIH, which requires evaluations for its projects.



Real Time with

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Learning with Purpose



Label-free Identification  
using

Analysis of Demyelination  
Confocal Microscopy

by Maldonado<sup>3,4</sup>, and Catherine B...  
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Abstract

Translocation experiment

To verify the effectivity of fabricated growth factors, experiments were conducted. Translocation of RelA was induced by treating cells with 1,500 ng/mL TNF $\alpha$  within a 1-hour period. This caused movement of RelA from the cytoplasm to the nucleus.



Conclusion

RelA translocation to the nucleus was observed in cells treated with 1,500 ng/mL TNF $\alpha$  within a 1-hour period. This indicates that the fabricated growth factors are effective in inducing RelA translocation.

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