

2015–16 Annual Report



The Illinois Science & Technology Institute (ISTI) is proud to present its third annual report.

This report provides an overview of the 2015–16 school year, detailing growth, key metrics, successes, and learnings from the third year of implementation.

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The Problem

A disconnect exists between STEM fields and the next generation of innovators.	Traditional learning fails to engage students in authentic STEM experiences.	No easy way exists to bridge the gap between the classroom and the real world.	The cost of building one-off programs and maintaining relationships is significant.
By 2024, Illinois will demand 526,000 STEM and STEM-related jobs. ¹	Over the coming decade, STEM jobs in Illinois are projected to grow 60 percent faster than the US average. ²	Recent analysis shows that the high-tech industry in Illinois employs 534,300 directly.	Seven of the top 10 fastest-growing occupations in Illinois are STEM or STEM- related. ⁴

Illinois students are underprepared for the workforce. ISTI is preparing the next generation of problem solvers.



Students from the Downers Grove North Women in STEM team worked with Illinois State University to find smarter ways to use energy.

¹"Employment projections, 2014–2024," Illinois Department of Employment Security (IDES), accessed September 1, 2016, http://www.ides.illinois.gov/LMI/Pages/Employment_Projections.aspx.
²Ibid.

³Mark Muro, Siddharth Kulkarni, and David M. Hart, "America's advanced industries: New trends," Brookings Institution, August 4, 2016, https://www.brookings.edu/research/americas-advanced-industries-new-trends/.

⁴"Employment projections, 2014–2024," Illinois Department of Employment Security (IDES), accessed September 1, 2016, http://www.ides.illinois.gov/LMI/Pages/Employment_Projections.aspx.

Our Approach

The Illinois Science & Technology Institute (ISTI) is a STEM-focused nonprofit that provides programs and partnerships that connect companies with classrooms.

ISTI works with schools, companies, universities, and nonprofits to make a greater impact on the next generation of innovators, serving as a bridge between the classroom and real world to facilitate deeper collaboration between students and industry mentors. ISTI programs are a departure from the way students typically learn—providing authentic challenge topics and mentoring to prepare students for future STEM careers.

In just three years through the R&D STEM Learning Exchange, ISTI has reached more than 2,000 students at more than 35 high schools across the state through the STEM Challenge and Mentor Matching Engine (MME) programs. In 2015–16, more than half of students impacted by ISTI programs were from demographic groups traditionally underrepresented in STEM, such as women and people of color.



STEM Challenges



Learning Exchange

Watch a video about the

STEM Challenge

STEM Challenges are year-long, problem-based learning projects that connect high school students with top science and tech partner companies. Facilitated by motivated teachers, the program enables the students to work directly with mentors from industry, bridging classroom learning with real-world problems and making a concrete connection between high school and their future careers. These experiences promote critical thinking and research and design, raise students' awareness of careers at STEM-focused companies across the state, and contribute to building the next generation of innovators.

ARE YOU UP FOR THE CHALLENGE?

R&D STEM Challenge 2015–16 participation

19 Schools

▶ ▶| ◀) 2:07 / 2:18

800 Students 55 Teachers

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10 Challenges

"Both the Mentor Matching Engine and STEM Challenge allow students at Washington High School to make connections and have access to resources that would be difficult without the R&D Learning Exchange. Students now have access to experts in the field that they are researching, which improves the overall quality of the design and analysis of the experiment."

Jennifer Miller, Chemistry Teacher, Washington High School

2015–16 STEM Challenges and Solutions

This year, STEM Challenges addressed a range of topics, including environmental sustainability, medication adherence, aerospace and defense, Internet of Things technology, community health, and behavioral economics. Students worked in teams to generate hundreds of innovative solutions.

AbbVie Foundation



Argonne

Raxter

Participating schools: North Chicago Community High School

The Challenge: As neighbors and partners, the AbbVie Foundation would like your input into how to improve health literacy in the North Chicago community. Your Challenge is to design and recommend an innovation or system that would improve health literacy and overall wellness in the North Chicago community.

Student solution: Developed plans for an in-school clinic to serve the North Chicago Community High School (NCCHS) community, targeting needs specific to North Chicago, such as counseling and immunizations. The clinic would also provide valuable training for students in the healthcare pathway program at NCCHS.

Argonne National Laboratory

Participating schools: Evanston Township High School

The Challenge: Argonne's Cyber Operations, Analysis, and Research (COAR team) is seeking your input about teenagers' use of apps on mobile devices, knowledge and perceptions about security and permissions, and suggestions for improving security. Your challenge is to research, assess, analyze, and make recommendations to their team.

Student solution: Developed an awareness campaign, ChromeBook Takeover, for their school around understanding privacy and security connected to social media and other websites. The campaign uses shock value to disrupt the norm of "agreeing" to privacy and security.

Baxter International Inc.

Participating schools: Instituto Health Sciences Career Academy, Lindblom Math & Science Academy, Muchin College Prep

The Challenge: Your challenge is to research renal dialysis and parenteral nutrition, focusing on treatment and care that can take place in the home. What new design innovations to new or existing approaches would you suggest to Baxter in order to improve usability, accessibility, and patient healthcare outcomes?

Student solution: Researched home treatment options for renal dialysis and designed an innovative, antimicrobial tubing system coated with copper to decrease chance of infection.



Students from Oak Park & River Forest High School worked with mentors from Takeda Pharmaceuticals to address medication adherence.

Students from Lindblom Math & Science Academy present their STEM Challenge solution.

Illinois State University: Center for Renewable Energy



Microsoft

Participating schools: Downers Grove North High School, Downers Grove South High School, Washington Community High School, Williamsfield High School

The Challenge: Develop a prototype product, plan, process, or system that suggests an innovative and "smart" way to manage everyday energy use. How can we better manage and use energy for our personal, local, or community use through these smart technologies?

Student solution: Designed a "Water YOUsage" mobile app that provides home-based tools and advice to reduce water consumption. The app includes water usage tracking tools, tips on how to reduce usage, and monthly water bill comparisons.

Microsoft

Participating schools: Lake View High School

The Challenge: Microsoft is challenging students to identify a problem in the community (your school, your neighborhood, your city, and beyond) and use Internet of Things (IoT) technology to build a solution or improve upon existing technology, using tools like sensors and analytics.

Student solution: Developed an idea called the "Bully Busters" with a goal to use heat sensor technology to detect instances of bullying on school security cameras based on the body's physiological response to certain stimuli and emotions created by those actions.



Motorola Mobility

Participating schools: Gwendolyn Brooks College Preparatory Academy, Von Steuben Metropolitan Science Center

The Challenge: How might we use mobile phones to investigate and solve a current problem for people in our local or, possibly, global community? What would it take to make these new or new uses of technologies work, and what is their potential for future applications?

Student solution: Developed idea and prototype for "Smart Vest"—a vest designed for police officers to track critical information such as injury location and GPS location of an officer. The vest communicates with an accompanying mobile app to notify emergency responders.



Motorola Solutions Foundation MOTOROLA SOLUTIONS

OUNDATION

NORTHROP GRUMMAN

Takeda

Participating schools: Chicago Vocational Career Academy

The Challenge: Motorola Solutions is challenging students to investigate and recommend new mobile technology applications and tools that you might develop to help save lives and keep people safe in emergency and disaster situations. What types of critical information could be shared using technology, and how could those tools and systems be developed and validated? How can this system focus on important data and filter out noise?

Student solution: Designed a teddy bear that monitors for and recognizes signs of asthma attack, records the child's breathing, and alerts parents and paramedics of any abnormalities.

Northrop Grumman

Participating schools: New Trier High School, Oak Park and River Forest High School, Palatine High School

The Challenge: Develop a countermeasure sensor system that can detect and defeat threats. This could include a build of a functional hovercraft or prototype, which can be used with the countermeasure sensor(s) to detect hostile threats.

Student solution: Built functional hovercrafts with sensors able to detect hostile threats.

Takeda Pharmaceuticals

Participating schools: Evanston Township High School, Maine South High School, Oak Park and River Forest High School

The Challenge: Address and improve the problem of medication adherence in your chosen therapeutic area (diabetes, depression, or obesity) and develop solutions to present to Takeda Pharmaceuticals and other industry stakeholders.

Student solution: Developed the "CHANCE" campaign for the Evanston community, to encourage cultural and educational awareness when addressing depression patients and therefore improve medication adherence. The "CHANCE" campaign would be taught at local medical schools as well as the Evanston Township High School health clinic.



TGG Group

Participating schools: ITW David Speer Academy, Wheeling High School

The Challenge: Identify a way in which individuals systematically deviate from rational decision-making in a harmful way; develop a recommendation based on behavioral economics for reducing the harmful behavior; prove that your recommendation works and measure the size of its effects.

Student solution: Created a campaign based on behavioral economics to nudge student behavior to frequently and consistently throw away their trash in the school cafeteria.



Press Coverage of STEM Challenges



Local STEM students show off their dazzling inventions May 19, 2016 *Fox: Good Day Chicago*



trending with more than 200 mentions on Twitter during the STEM Challenge showcase

<u>A STEM mentorship program</u> May 17, 2016, *WILL* <u>At ISTC's STEM Challenge, teens take on IoT, renewable energy, defense tech</u> May 20, 2016, *Chicago Inno*

<u>Evanston high school student show off STEM research at Merchandise Mart</u> May 27, 2016, *Evanston Review* Bootstrapping in America—Interview with Mark Harris May 18, 2016, *Tasty Trade*

<u>Palatine High School's 'Ugly Pearl' wins hovercraft competition</u> May 7, 2016, *Daily Herald* How the Internet of Things can prevent bullying May 25, 2016, Microsoft blog post

"Most students might not associate science and fun, but this program lets us personalize our projects, collect data, and draw our own conclusions. It's encouraging that a company like Baxter recognizes that there might not be just one answer or one way to get there and welcomes our questions and ideas." JeNaye, Student, Lindblom Math & Science Academy

> "You need to have that dream and you need to dream big. These students have the opportunity to be extremely successful, and this program opens their vision to show them what they are capable of and how far they can go." Olivier Visa, Mentor, Baxter International Inc.

Mentor Matching Engine



The Mentor Matching Engine (MME) is an invitation-based platform that virtually connects Illinois high school students and their teachers to STEM professionals from industry and research institutions to support and enhance personalized, student-led research.



Watch a video about the Mentor Matching Engine

Process and Participation

To begin, students (either individually or as a team) develop a question that can be answered through an investigative research process, and they request mentors with relevant subject matter expertise. Mentors provide guidance in a discussion-based forum that can accommodate document sharing and video conferencing. These one-on-one mentorships, which facilitate quick responses to students' questions, enable the students to collect new perspectives from a STEM professional, guide their projects toward success, build relationships, and gain greater awareness about STEM careers.

Mentors from ISTI partner organizations sponsoring a STEM Challenge were assigned to their specific partner school and were able to supplement their in-person engagements with on-going communication via MME.

In 2015–16, the MME saw significant growth—both in terms of usage and satisfaction.

By the numbers: Mentor Matching Engine metrics 2015–16 Number of teachers Number of partner Number of mentors Student projects Number of students supported by mentors leading students in organizations recruited on MME on MME independent research contributing mentors +274% Growth in number of students Growth in number of teachers

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Resource Repository



Learning Exchange RESOURCE REPOSITORY

The Resource Repository is a centralized, open resource that gives teachers, students, and parents access to more than 100 high-quality STEM resources offered by more than 50 leading Illinois-based organizations, including ISTI partner companies and research institutions invested in developing Illinois' future innovators. The Resource Repository hosts curriculum, summer programs, professional development opportunities, and local events aligned to NGSS practices.

In the coming year, ISTI will make enhancements to the Repository based on the recommendations of the American Institutes for Research (AIR), which evaluated the tool as part of a report for the Illinois State Board of Education. AIR indicated that there is potential to increase the capacity of the Resource Repository by building greater buy-in from the districts who participate in the ISTI activities. If district leaders and teachers see the Resource Repository as a platform where they not only can receive materials but also use it as a place for sharing their resources and best practices with others, they may be more likely to interact with it.



Students from Instituto Health Science Academy visit the Baxter International Inc. R&D facility in Round Lake, Illinois.

Evaluation and Outcomes

ISTI collects detailed metrics on its programs to track impact and outcomes from all users, in particular students and teachers.

ISTI worked with the University of Illinois' I-STEM initiative as the external program evaluator, who focused on four key focus areas: Implementation, Effectiveness, Impact, and Sustainability.

Methods

ISTI and I-STEM employed multiple data collection methods and sources to obtain information from teachers and students to assess the impact of, effectiveness of, and satisfaction with ISTI's program. Data sources included a pre/post student survey, teacher surveys, a focus group, individual interviews, evaluation of professional development efforts, and project evaluations at the STEM Challenge Student Showcase. For the first time, in 2015–16, evaluators collected data on individual participants to contribute longitudinal data about the impact of these programs on their college and career outcomes.

Outcomes and Impact

Key findings:

- STEM Challenges and the Mentor Matching Engine offer unique, empowering learning experiences.
- The interactions with industry partners have helped students to better grasp what various careers in STEM industries involve and what industry partnerships mean for research and development.
- ISTI partnerships offer mentors the opportunity to better understand high schools' learning realities and contribute more consciously to the future workforce preparation for Illinois.

Implementation

STEM Challenges and the Mentor Matching Engine were implemented on schedule and as planned, per the project timeline.

Teachers reported that they would like more structure, deadlines, and a more detailed timeline.

Effectiveness

93 percent of teachers are satisfied with ISTI's overall programs and structure.

The data reveal how teachers, students, and mentors perceived the program in 2015–16: **Teachers** reported how the ISTI projects allow students to solve real-world problems, expose them to young professionals in STEM fields, and provide them the opportunity to make professional connections that otherwise would be difficult to reach. **Students** were also satisfied with the overall program and their Challenge. They enjoyed working in teams and gained an understanding of the value of teamwork.

Mentors saw real educational value in their involvement. They saw themselves as resources to students and were happy to be role models for students interested in STEM fields. In the future, mentors would appreciate clearer expectations of their role as mentors and more interaction with students.

Impact

Students indicated after the program that they were significantly more likely to pursue a major in a STEM-related field.

Students increased their understanding of how to formulate a research question, how scientific knowledge is built, and the nature of the job of a STEM researcher.

Students were also significantly more likely to have a desire in pursuing a career as a researcher and they possessed a greater ability after the program to overcome any barriers they might encounter.

Teachers noted that while they tried to have an investigative teaching style even before a Challenge, this experience has encouraged them to participate in other full-scale, problem-based learning experiences.

Both teachers and students saw mentors as important resources; teachers saw these mentors as possible connections for the students to build and maintain.



Students from Williamsfield High School in Central Illinois built a working prototype model of their school to showcase potential energy savings.

Students from Muchin College Prep in Chicago collaborate with their team on the Baxter STEM Challenge.

Sustainability

An overwhelming majority of teachers saw real value in exposing their students to professionals in STEM fields.

The majority of teachers would like to participate in ISTI next year, indicating a commitment to sustainability.

By the numbers: Participation in ISTI programs has grown steadily since year one



Number of student and teacher participants

STEM Challenge partner high schools



Total number of teachers who completed the professional development workshop, 2013–2016

Growth Strategy and Goals for 2016–17

In year three, ISTI plans to continue to grow its programs and expand its partnerships. To address the evaluation findings and improve program outcomes, ISTI staff will focus on these key items:

Grow in existing schools: ISTI is currently working with partner schools from 2016–17 to determine how the program can grow within their schools to train more teachers and reach more students. For some schools, it will mean bringing this opportunity from an after-school club into a classroom setting. For others, it will mean inviting teachers who have not yet participated to lead a STEM Challenge.

Grow in new partner schools: ISTI will take on new partner schools that commit to hosting a STEM Challenge in the 2016–17 school year and/or putting students on the Mentor Matching Engine who will seek mentors for independent research projects. This expansion will be customized based on capacity as well as existing partnerships, geographic diversity, and the ability to scale in future years.

Build on existing partnerships: STEM Challenges have shown to be valuable tools for building new partnerships, as well as a way to enhance existing partnerships that an industry player might already have with a school or community. As we have seen with Motorola Solutions' partnership with Chicago Vocational Career Academy (CVCA), and Microsoft's with Lake View High School, the STEM Challenge brings parameters and structure where both the students and partner have an interest.

Refine the Mentor Matching Engine: The Mentor Matching Engine platform was rebuilt during the summer of 2015 on a new back-end system with enhancements and features to allow for the growth of the programs and the continual increase of users. Over the 2014–15 academic year, ISTI collected feedback from students, teachers, and mentors on the platform and used this feedback to improve upon the previous iteration of the MME. These features included the ability to upload users in bulk onto the system, which allows teachers to copy their students' email addresses from a roster and invite them all at the same time; video conferencing so that students, teachers, and mentors can interact face to face when not able to meet in person or when the mentor relationship is virtual; and the ability for a mentor to communicate privately with the teacher before accepting a project and during the project for feedback.

Shift the STEM Challenges timeline: In response to teacher and mentor feedback, STEM Challenge partnerships will be able to kick off earlier in the school year. Additionally, with shifting schedules meaning that Illinois schools conclude earlier, the STEM Challenge Student Showcase will move from mid-May to late April. ISTI will also be providing suggested milestones and guidelines to teachers and mentors to help set a timeline, define expectations, and maintain accountability throughout the Challenge.

Add mentor training: ISTI has a mandatory professional development day in October as well as ongoing professional development for partner teachers, however no specific mentor training opportunities existed through the 2015–16 academic year. Feedback from mentors indicated that guidelines and best practices would be helpful

to foster successful mentoring relationships and engagement. ISTI interviewed users to determine some helpful parameters around how to make the most of the mentoring experience. This information was then used to develop a new mentoring guide through the MME Help section as well as a handout for mentors.

Mentor Matching Engine: Strategy for 2016-17 Academic Year

ISTI aims to continuously add to the pool of mentors on the Mentor Matching Engine so that more students are able to use the platform and so there are mentors to meet the growing diversity of disciplines and research topics. This includes working with ISTI partner schools to track the number of students, the subject matter of the students' projects, and the timeline of the students' projects so that mentor recruitment can be targeted to meet the need of each ISTI school and student. ISTI has already increased mentor recruitment efforts by establishing new partnerships for 2016–17 and hopes to grow the number of research and corporate institution mentor recruitment events.

"Our students have benefited greatly from taking part in the ISTI STEM Challenge. By problem solving around an industry-related question and interacting with professionals through the Mentor Matching Engine, our Career Pathway students better understand what their career would feel like. They come away from the experience with knowledge, improved problem solving and interpersonal skills, and, most importantly, increased confidence. All of this will help them as they continue their education and pursue their careers."

Jeff Hollenstein, Healthcare Pathway Lead, North Chicago Community High School

"Being a STEM Challenge mentor gives me an opportunity to champion our future leaders. These students may not all become future STEM professionals, but they are our future nonetheless and as a mentor I know I am making a difference in helping them develop lifelong skills and possibly inspiring interest in STEM careers. For me, the rewards of watching the students grow over such a short time and interacting with these incredible young minds is well worth my small time commitment." Jenny Colombo, Mentor, VP Scientific Strategies & Communications at Takeda Pharmaceuticals

Professional Development

ISTI hosts an annual professional development workshop every fall. This full-day event provides teachers with training and insight on best practices for leading students in a STEM Challenge and independent research. Teachers hear from fellow ISTI partner teachers to learn about what methods worked well for them and what they would do differently, participate in a design thinking workshop, and discuss how to best utilize ISTI resources such as Challenge coaches. Teachers also receive technical training about how to use the MME, and they have the opportunity to meet with their industry partner over lunch to begin planning their Challenge implementation.

ISTI also schedules professional development webinars on an ongoing basis to take a deeper dive into topics that teachers have expressed interest in discussing further, such as tips for engaging with mentors, teaching students to ask significant questions, and presentation strategies.

Partnerships

ISTI is built on partnerships. The initiatives that ISTI has built rely on the idea of bringing diverse groups together to advance STEM education and expand opportunities for students.

ISTI staff are always working to identify new industry partners and cultivate those relationships to find mutually beneficial ways to support the goals of each stakeholder. We are excited to bring on new corporate and postsecondary partners this year to host innovative STEM Challenges, as well as tap into the human capital talent in these organizations to lend their expertise as mentors on the Mentor Matching Engine.



Students and mentors come together at the STEM Challenge Student Showcase to share solutions and celebrate achievement.

ISTI Board

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We would also like to thank the RDLE Steering Committee for serving as program ambassadors within their own organizations to spread awareness of ISTI to their broader networks. We appreciate their commitment to ISTI.

Funding Partners





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