Lemelson-MIT Student Prize Retrospective:

Student Prize Winners and Their Impacts

LEMELSON·MIT

Dear Colleagues,

This report, along with the companion piece *Inventor Developmental Pathways*, highlights collegiate students recognized for their creativity and inventiveness through the receipt of the Lemelson-MIT Student Prize. We hope these inspirational role models who are making a significant difference in the world get you thinking about what you could invent. As you read about these students, the problems they chose to address, and their technological solutions, you will learn that:

- Invention is everywhere. Prize winners come from urban, rural, and suburban areas across the United States.
- Invention is often a team sport. Prize winners in the last eight years of the program were undergraduate students who worked as a team. The team approach brought different expertise to bear on the problem being addressed.
- Invention is for everyone. Prize winners represent a variety of majors, gender identities, races/ethnicities, and socioeconomic backgrounds.

There is no shortage of problems in the world that need new and novel, useful, unique, and non-obvious solutions. We welcome you to apply your unique skills and expertise to finding and solving problems that matter through ways of thinking common to inventors. It is never too early or too late to get on the pathway to invention. As you get started, please remember: inventing is just plain fun!

In closing, we wish to thank the Lemelson family and The Lemelson Foundation for their support of the Lemelson-MIT Student Prize program. Their dedication to the next generation of inventors and entrepreneurs has made our work possible. We look forward to the continued joint work of helping more women; young people from low-income families; and Black, Latinx, Indigenous, and other people of color get on the pathway to invention.

Sincerely,

Michael J. Cima
Faculty Director
Lemelson-MIT Program

Stephanie R. Couch
Executive Director
Lemelson-MIT Program

History of the Lemelson-MIT Student Prize

The Lemelson-MIT Student Prize was an award competition administered by the Lemelson-MIT Program (LMIT) from 1995 to 2021 that recognized undergraduate and graduate student inventors. The Student Prize initially honored graduate student inventors from the Massachusetts Institute of Technology (MIT) as an annual $30,000 prize. The prize expanded nationally in 2014 to recognize undergraduate teams and graduate students who had invented technology-based solutions in prize categories that represent significant sectors of the global economy: "Cure it!"—Healthcare, "Eat it!"—Food/Water or Agriculture, "Drive it!/ Move it!"—Transportation or Mobility, and "Use it!"—Consumer Devices or Products. The category "Drive it!" changed to "Move it!" in 2019 to be more inclusive of both transportation and mobility-related inventions. The wide-reaching recognition that collegiate students have received from winning the Lemelson-MIT Student Prize has provided new opportunities and support for their work as inventors. The collegiate prize also brought wider recognition of invention and innovation to K–12 students who may be the next generation of inventors.

2018 Student Prize winners at EurekaFest: the Treyetech team (novel device to revolutionize corneal eye transplants)

CURE IT!
(Healthcare)

EAT IT!
(Food/Water or Agriculture)

MOVE IT!
(Transportation or Mobility)

USE IT!
(Consumer Devices or Products)

Up to eight Student Prizes were awarded each year from 2014 to 2021, with typically one undergraduate team and one graduate student winner per category. Each winning undergraduate team was awarded $10,000, and $15,000 went to each winning graduate student. Winners also received national media coverage, added exposure to potential investors and the business community, and a paid trip to a multi-day celebratory event (EurekaFest) held on the MIT campus in June of the award year. All winners were asked to participate in media opportunities supported by the Lemelson-MIT Program to celebrate their win and recognize their inventiveness.

Lemelson-MIT Student Prize Winners "By the Numbers"

26
YEARS OF AWARDS

119
INDIVIDUAL STUDENT WINNERS

22
SCHOOLS REPRESENTED BY WINNERS

70
PRIZES AWARDED
(48 graduate winners/22 undergraduate team winners)

39
INDIVIDUAL FEMALE WINNERS

$1,225,000
AWARDED IN PRIZES

PURPOSE AND STRUCTURE OF THE LEMELSON-MIT STUDENT PRIZE RETROSPECTIVE

The final Lemelson-MIT Student Prize competition was conducted in 2021. This retrospective celebrates a rich and fruitful history of the Student Prize from two perspectives. One perspective, Student Prize Winners and Their Impacts, begins with the history of the Lemelson-MIT Student Prize and highlights the accomplishments of its winners; their social and economic impacts on society through their invention(s); and their resilience in facing the uncertainties, risks, and challenges that come with inventing and innovating. The other perspective, *Inventor Developmental Pathways*, explores how the winners developed their inventor identity, the resources they drew on that helped them along the way, and the support structures that were necessary to fully realize the potential of their inventions. The Lemelson-MIT Student Prize is documented in these ways to inspire and guide the next generation of student inventors and to inform institutional and policy efforts to establish the economic support structures and other opportunities needed for student inventors to thrive.

A majority of the data used in this retrospective analysis came from the following sources:

1. Survey data of annual student applicants and winners from 2017–2021 (n=269).
2. 2018 Report: *Study of Lemelson-MIT Student Prize Winners: Factors that Support Winners' Development as Inventors* (3Jan2019).
3. Transcripts from Student Prize winner focus-group interviews (2018) [n(undergraduates)=7, n(graduates)=4].
4. Survey data from all previous student winners (2022): of 119 surveys mailed, 38 were completed and returned.
5. Video interviews of 12 Student Prize winners from 2009–2021, representing the diversity of winner backgrounds. Interviews were conducted and provided by Maaia Mark Productions (2022).

The Lemelson-MIT Student Prize Competition

Who could participate in the Lemelson-MIT Student Prize competition?

The Student Prize program, offered from 1995–2013, was open to any MIT graduate student with at least two inventions. The Student Prize program expanded in 2014 to allow applicants from anywhere in the nation. Eligible applicants had to be full-time, degree-seeking students at any U.S. college or university. Undergraduates were required to apply as a team of 2–5 students with a tested prototype of one invention that fit into one of the four prize categories. Teams could include members from more than one school and could have a mix of graduates and undergraduates, provided there was a majority of undergraduates on the team.

Graduate students had to apply individually with at least two inventions with tested prototypes. Only their primary invention had to fit into one of the four prize categories.

What qualified as an invention for the purposes of this competition?

The Lemelson-MIT Program considers an invention to be a new technology, product, or process developed by the student applicant/team that is unique, useful, and solves a real-world problem with an identified user. Strong applications had evidence (data) supporting claims that the invention works as intended, and that the inventor had engaged with end users during the creation of the invention. Software-only projects, such as apps or data analysis tools, typically were not eligible for this competition. Inventions cited in the application needed to have prototypes eligible for a patent, but an approved patent was not a requirement.

What is a tested prototype?

A prototype must be tested and functional. It should work as designed (i.e., beyond proof-of-concept models). Evidence of the functional prototype could be data from the laboratory, human subjects testing, or consumer products testing in which data was collected and analyzed. A qualifying Student Prize applicant needed to provide evidence that the functional prototype performed as intended. Prototypes did not need to be commercially available, but should have been commercially viable. Applicants were not expected to develop prototypes past early stages, nor did they need to present a business plan. Commercialization potential was, however, a criterion of the competition, and prototypes further along in development that exhibited strong commercialization potential were sometimes rated higher than early-stage inventions.

Application and Review Process:

The prize application process consisted of multiple rounds. Applicants in 2014 submitted an initial application, including evidence of meeting minimal requirements, to one of the prize categories. The 2014 prize cycle consisted of two prize categories ("Cure it!" and "Use it!"); the 2015–2021 prize cycles had all four prize categories noted earlier. The initial application was reviewed by staff for eligibility. All eligible applicants were automatically advanced to the category application round where they had to submit a faculty letter of recommendation, detailed written responses to questions, a cover letter, description of inventiveness, potential for commercialization or adoption, description of systems and design thinking, and information about youth mentoring experience. Initial and category application materials were reviewed by four screening committees (one per category) with expertise in the field pertaining to the prize category. The screening committee for each category selected up to three graduate finalists and three undergraduate finalists to advance to the finalist round. Finalists had to submit two additional letters of recommendation and a two-minute video about their invention (the primary invention for graduate applicants). All finalists were reviewed by a separate group of judges called "the National Jury." Jurors were experts from a variety of disciplines, chosen to represent the four categories. The National Jury selected up to eight winners per year (typically one graduate and one undergraduate team per category).

Screening Committee and Jury Members:

The Student Prize screening committee and National

SURVEY QUESTION

WHAT DID YOU MOST ENJOY ABOUT BEING A STUDENT PRIZE SCREENER OR JURY MEMBER?

> **Learning about the projects and the people behind them; they were all outstanding. It was like having a privileged window into the future.... The individuals behind [the inventions] were true inspiring leaders with their lives ahead of them which always left me with a feeling of 'there is a bright future for mankind ahead of us.'"**
>
> — Mercedes Balcells-Camps
> Principal Research Scientist, MIT

> **" The diversity of great ideas, the enthusiasm displayed by the applicants and the discussions during the [juror] review sessions.**
>
> — Burt Adelman
> Chair and co-founder, Verve

Jury members were integral to the success and prestige of the Student Prize. Screening committee members had to be affiliated with MIT in some capacity, such as faculty, staff, alumni, and past Student Prize winners. Screeners and jury members devoted many volunteer hours to review applications and to carefully and thoughtfully select finalists and winners. A majority of screeners and jury members have remained as judges for many years.

2017 Student Prize winners at EurekaFest

Deliberate Efforts to Expand the Applicant Pool:

Starting in 2014, when the Student Prize competition expanded nationally, LMIT worked to identify a broad and diverse pool of potential applicants. They conducted an active marketing campaign by advertising in student newspapers or via social media and reached out to an average of 1,200 promising student candidates each year to encourage them to apply.

> **With all the turmoil in the world, I'm refreshed and inspired when I see all the amazing creativity, energy, and drive to help in the student nominees. It's so challenging to screen because there are so many outstanding candidates with different backgrounds and different things that inspire them to invent. It makes me feel confident that we're in good hands with the next generation!"**
>
> — Ann Westerheim
> Founder and President, Ekaru

> **"I loved seeing the depth of innovation ... and frankly, I got a kick out of how each team creatively worded their applications to maximize the appeal of their proposals.**
>
> — Martin St. George
> Chief Commercial Officer, LATAM Airlines Group

Source: Student Prize Screener and Juror Member survey, dated February 2022

LMIT also compiled a targeted list of schools to find prospective prize applicants for direct outreach.

Additionally, LMIT contacted faculty, staff, and administrators who might refer students. Starting with the 2017 prize cycle, the list of schools to research consisted of the top 100–120 schools from the annual *U.S. News Best Graduate Engineering Schools* (with a doctorate degree) rankings. They also researched the top 30–40 schools on the U.S. News Best Undergraduate Engineering Schools (no doctorate) list.

Approximately 50 more schools not appearing in the *U.S. News* engineering school rankings were added to the school lists beginning with the 2018 prize cycle. These additional schools were compiled from miscellaneous school rankings that aligned with LMIT's desire to both increase the overall diversity in the applicant pool (more women and underrepresented minority applicants) and increase the number of applications submitted in certain categories (particularly "Eat it!" and "Move it!"). Schools added to the research list consisted of Historically Black Colleges and Universities (HBCUs); top female engineering schools; and schools with top industrial design, agriculture, and business programs. LMIT continued to use these lists and expanded to slightly more schools using the same protocols for the 2019 prize cycle. Beginning with the 2020 prize cycle through the 2021 prize cycle, they further expanded the list of targeted schools to include over 200 top community colleges.

WINNERS' PERSPECTIVES ON WHAT MADE THE LEMELSON-MIT STUDENT PRIZE UNIQUE AMONG SIMILAR COMPETITIONS:

- An invention-focused competition (design) versus a business plan
- Monetary award
- Focus on physical inventions that are functional prototypes
- Recognized long-term work rather than software/apps with quick path to market
- Recognized teams of people as well as lone inventors; human aspects of inventing
- Prize application process that also supported an inventor's developmental process:
  - by requiring communication with general audiences in a concise and interesting way
  - helping to 'connect the dots' and synthesize 'who I am' when reflecting on the journey
- Graduate student prize emphasis on the history of one's invention journey rather than limiting the application to one invention that can be borne out of a thesis; valuing invention as a process rather than a one-time discovery
- Prize embedded in a larger community of inventors, and ecosystem of support: Opportunities for exposure to 'near peers' as models for inventing at annual EurekaFest event where high school, undergraduate, and graduate level inventions were celebrated.

Source: SP Winners 2018 Report, dated 3Jan2019

Student Prize Winners: Social and Economic Impacts

OVERVIEW

Interviews and surveys of Student Prize winners indicate that their primary motivation for inventing and innovating is the potential for their invention to improve the lives of people that they know and/or people in society at large. This section includes the personal stories of select Student Prize winners. The inventors share their perspectives on the social and economic impact(s) that their invention(s) are having on society or impacts anticipated in the future when the value of the inventions is fully realized through inventors' entrepreneurial endeavors.

All Student Prize winners who responded to surveys and participated in interviews cited impact on the lives of others as what motivates them to invent. Winners recognized a problem for themselves, their families, their community, or in the greater society—a gap that was not being adequately addressed or a challenge that had not yet been identified as a problem. They found themselves driven to pursue a solution. The prize, for many winners, served as a point of entry to invention or invention-related careers in which they continued their work to address social and economic issues through invention on a wider scale.

SOCIAL IMPACTS

Students' inventions are impacting society in various ways (or will impact society once they have been fully implemented). The nature of some of these social impacts are as follows:

Improving quality of life:

- A wearable behavioral aid for children on the autism spectrum that uses machine learning and artificial intelligence to automate facial expression recognition to deliver real-time social cues, and
- Inventions focus on point-of-use biotech so people in resource-limited areas can access inexpensive sensors and bioremediation devices.

Addressing global food insecurity by using microbiomes to grow food more efficiently.

Addressing national security with inventions that support deployment of national defense devices.

Providing access to educational resources and tools:

- An app that supports hundreds of struggling readers with literacy instruction, and
- Online access to cloud educational 3D printing for K–12 students.

Consumer rights and policy: technological solutions that raise awareness and create consumer demand for better and more complete access to vehicle data.

Safety:

- Keeping farmers and workers safe from dangerous conditions inside grain bins by replacing them with robots, and
- A tool for land mine removal.

Other inventions may not have been fully realized (yet) but may be inspirations to advancing a field or be the predecessor to social and economic impacts yet unknown:

- Work on electric cars in the 1990s helped demonstrate and advance technologies that were ready for the later invention of lithium batteries, and
- Work on a flying car may inspire people to dream about a possible future.

The extent of Student Prize winners' impacts on society is still being realized and has the potential to influence millions of people all over the world (and beyond). The next sections highlight particular Student Prize winners and their stories, which detail their personal motivations for pursuing the inventions that are impacting society.

STUDENT PRIZE WINNERS IN-DEPTH

Student Prize winner stories are as varied as their inventions. Seven winners in this section share their Student Prize stories, including their motivations for inventing. These winners were selected because they represent the diversity of personal backgrounds, disciplinary backgrounds, and ways that they are making a social impact that evolved organically to describe the Student Prize winners collectively. Both undergraduate and graduate winners are represented, as well as the four invention categories: "Drive it!", "Cure it!", "Use it!", and "Eat it!".

WHAT MOTIVATES YOU AS AN INVENTOR?

I want to make an impact on the world.

Social impact service was always primary for me.

It's definitely the impact the inventions can have.

The feeling of accomplishment for creating something never seen before that can have a profound impact on people's lives.

The desire to make a positive impact for humanity, particularly in ways that increase equity.

The impact to my community and broader network… being able to solve problems to improve the lives and world around me is most important.

Creating a better, healthier world for us to live in, along with my children and future generations. We only have a finite amount of time on this earth, and I believe that time should be spent towards making something great that will have a profound impact for decades or centuries to come.

I am motivated by the stories of patients who would benefit from my inventions.

If I am this blessed–then–I always think it becomes my responsibility to try to turn that into "good things" for the world. I've first had that realization in college and have since been motivated to try to use technical tools pretty much exclusively to solve large social challenges.

Source: Student Prize Winner Surveys and Interviews (2015-2022)

CORTEN SINGER AND TOMÁS VEGA

University of California, Berkeley

2017 "DRIVE IT!" UNDERGRADUATE TEAM WINNER

Corten Singer and Tomás Vega are the 2017 "Drive it!" Lemelson-MIT Student Prize winners for WheelSense, a sensory interface for wheelchair users with visual impairment. They first started their work on WheelSense as an effort to help one of Tomás' friends, Daniel Stickney, whose severe motor and visual impairments limited how well he could navigate his wheelchair. Tomás recruited four friends to live in Daniel's home for a week to conduct a hackathon: "We brought 3D printers and monitors … and many tools to basically create solutions for him." Initially, the group took time to "learn about his day-to-day life and the obstacles that prevent [Daniel] from living his best life." The problem centered on Daniel's daily challenge in navigating his wheelchair because he can't see obstacles

Corten Singer (left) and Tomás Vega (right)
Photo credit: Maaia Mark Productions

in his environment, which posed a significant safety hazard for Daniel. Their solution was to create a sensory substitution system that could translate a physical space into haptics (tactile and auditory stimulation to simulate the feeling of touch) to make Daniel more aware of his environment and, thus, improve his ability to navigate in it independently. The system was still too "hacky" for day-to-day use after one week of working on it, but they had produced a proof of concept that this prototype interface could help Tomás' friend live a more independent life. Tomás partnered with Corten to continue this work. What they developed was a wheelchair with added ramp lateral-edge detection, frontal drop-off detection, and backup assistance through auditory and haptic feedback. The chair sounded one tone when it detected a frontal drop-off such as stairs or a curb, and a different tone when it detected an obstacle while the chair was moving in reverse. It also vibrated the appropriate armrest when a wheel got too close to the edge of a ramp. They also worked with a design advisor to improve their prototype to the point where Daniel could use it in his home.

Corten explained the significance and social impact of this initial work during their interview:

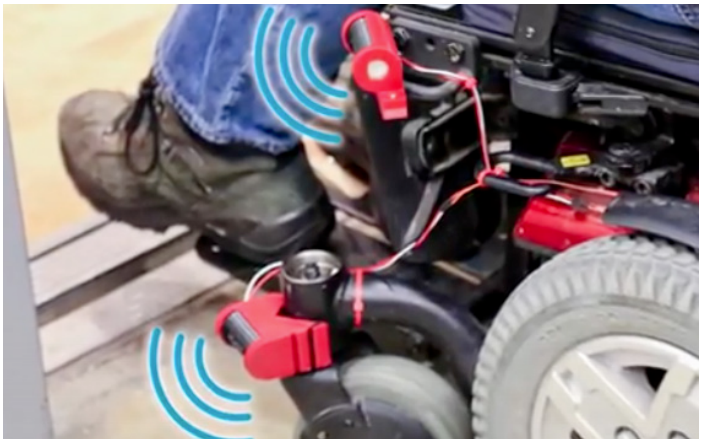
"This exposure to our friend and his lifestyle and recognizing the issues that he deals with … then we can recognize when folks living with various disabilities are prevented from [an] independent lifestyle.… We want to help and enable, because we believe firmly that … that's just a universal right. Everyone should be able to lead the life that they so desire.… If you have a physical disability that requires you to use a wheelchair, oftentimes that's not enough to give yourself that independen[ce].… So, if we could make that great [mobility] tool even more accessible for the user … that's a huge part of our passion."

Although WheelSense did not continue once Corten and Tomás went to graduate school, similar wheelchair interfaces are now commercially available. The aspect of their experience that has propelled them forward in their work, however, is their commitment to the social impact that

> **Imagine feeling like you cannot do anything for yourself; that is a reality for a lot of people [with severe disabilities]."**

We want to help and enable [people with physical disabilities to lead independent lives], because we believe firmly that … that's just a universal right."

their inventions can have on others. Through their exposure to the multiple problems of people with severe impairments, they recognize how disabled people are all "differently-abled" and have incorporated this as a design principle; that is, making their designs "as customizable as possible in order to adapt to as many people—to provide as much value to as many people—as possible." They would like to significantly change the lives of a handful of people rather than having a small effect on many.



User demonstration of the Wheelsense sensors

Photo credit: https://www.youtube.com/watch?v=_fiNtBb3beI

Daniel Stickney and Tomás Vega on their university campus

Photo credit: https://www.youtube.com/watch?v=_fiNtBb3beI

With a clear vision and monies received from the Lemelson-MIT Student Prize, Corten and Tomás expanded from WheelSense to their next venture, Mouth Mouse. Mouth Mouse addresses the problem of providing computer/internet access to people who currently cannot access it because of their disability. Corten and Tomás have co-founded Augmental Tech and continue to work toward meeting their goal of creating interfaces that will allow those with physical disabilities to live independently.

MERCY ASIEDU

Duke University

2019 "CURE IT!" GRADUATE WINNER

Mercy Asiedu is the 2019 "Cure it!" Lemelson-MIT Student Prize winner for Callascope, a cervical cancer self-screen and diagnosis device. Mercy saw family members and friends die from a lack of preventative health care while growing up in her native country of Ghana. She initially planned to become a doctor to help address women's health problems in Ghana:

"I really went down the STEM path to be able to take on challenges and make an impact [as a] doctor to help solve health problems back in Ghana, especially in women's health. But with my biomedical engineering classes, I realized that perhaps I could actually have a bigger impact by developing tools that could be used for diagnostics or treatments."

Current cervical cancer screening involves a medical professional using a speculum, a device that has largely remained unaltered for 150 years, to gain access to a woman's cervix. This method of cervical screening, however, poses several challenges to

> **I had had family members and friends pass away from undiagnosed conditions. So, I really went down into this path [of women's health] to develop [medical diagnostic] tools to solve challenges."**

women's preventative health issues in Ghana and other developing countries. These challenges include:

- resistance to return to a clinic for periodic screenings because of travel distance, loss of work, and/or fear of the speculum, which can be painful;
- lack of access to and high cost of diagnostic tools; and
- reluctance in being examined by a male doctor due to cultural sensitivity among conservative women.

Callascope addresses all of these challenges by enabling patients to conduct a low-cost initial cervical screening themselves, in their homes.

Callascope was designed in the shape of a calla lily, with a stem and mechanical introducer for expanding the vaginal walls in order to obtain accurate visualization of the cervix. Mercy also designed a narrow channel along the stem of the device to inject acetic acid, which is a contrast agent used to visualize areas of pre-cancer on the cervix.

The Callascope was coupled with Mercy's second invention, an algorithm that used machine learning to classify cervix images as normal or pre-cancerous. The algorithm could be deployed on a smartphone application and was based on objectively quantifiable cervix image features.

Mercy explains the significance of this diagnostic tool on women's health:

"I think that Callascope really kind of provides this entryway into the system because it allows for the initial step of screening to be done, you know, less painfully [and] in a more private manner.... So really breaking down those barriers to get in a woman's screen initially. And of course, if [the screen] is positive [for cervical cancer], catching that early on, and then she can go into the clinic to get treated early, rather than what currently happens ... women coming to the clinic too late when they are ... showing symptoms, [when] it really has advanced to a higher-grade cancer. And usually, it requires either much more intensive, expensive treatments, which might not be available, like chemotherapy or radiotherapy or, and a lot of the time ends up in death. So, I'm really hoping this can help women catch pre-cancer early and get women treated earlier by low-cost treatment options that exist."

Mercy found a problem—shaped by her personal experience growing up in Ghana—that motivated her to learn the knowledge and skills that would help her invent a solution that is not limited to Ghana. Once fully developed, the social implications of Callascope in improving women's reproductive health will extend well beyond Ghana as women continue to face these same challenges all over the world.

"[It provides] a highly magnified view of the cervix to see features accurately, but also provid[es] a way to document and image the cervix to get a second opinion [when a community health worker makes the initial assessment rather than a health care] provider in an urban area, and us[es] algorithms to actually provide a risk assessment at the point of care."

> **Cervical cancer is extremely preventable ... but over 250,000 women die each year, 90% [of these] in lower-middle income countries. And it's because more than 60% of women are not being screened at all."**

Mercy Asiedu

Photo credit: Maaia Mark Productions

Community health workers engaging with a patient

Photo credit: https://callahealthfoundation.com/callascope/#Maaia Mark Productions

JOSH SIEGEL

Massachusetts Institute of Technology

2015 "DRIVE IT" GRADUATE WINNER

Josh Siegel won the 2015 "Drive It" Lemelson-MIT Student Prize for his invention, CARduino, a device to connect "hidden" vehicle data with a cloud-based platform to create powerful and transformative applications. Josh developed a passion for building robots and restoring cars while in high school. His appreciation for the craftmanship of these vehicles inspired him to pursue creating technology that can bring our cars into the digital age.

These days cars hold much more data than we may realize. Josh realized that much of this data is highly important information that is likely in the driver's best interest to be aware of to so their cars run as efficiently as possible—like when it's time for repair, or where to find low gas prices. However, the driver is expected to go out of their way to seek out this information.

Seeking to create a centralized system where all this information could be streamlined to the driver in real time, Josh founded CarKnow, a startup that creates software and hardware using data collected from vehicles to enhance the driving experience. CarKnow developed CARdunno, a cellular device designed to ease the daily burdens of driving and car ownership. CARduino uses a storage system called Cloud Think, where any pertinent data relating to the vehicle can regularly be updated and accessed in one place. Some of CARduino's unique features include predicting potential vehicle failures, remote control of vehicle functions, and crowdsourcing information like traffic data and road conditions. Because of the hardware's open-source license, drivers will be able to further customize their own unique driving experience.

Josh continues to engage with his passion for invention by mentoring students interested in science, technology, and entrepreneurship. He has worked with student teams in the MIT Institute for Soldier Nanotechnologies' Soldier Design Competition and participated in the Edgerton Center's FixIt Clinic, which teaches kids and adults lessons on repairing broken products.

> **Inventing has taught me to trust myself."**

Josh Siegel

Photo credit: Maaia Mark Productions

Social and economic impacts of Lemelson-MIT Student Prize winners often go hand-in-hand. Measuring the scale of economic impact of the collective 119 Lemelson-MIT Student Prize winners is difficult to quantify, as the full impact may take time to realize. Impact metrics are not the primary goal for Student Prize winners. The economic facet of their inventions and innovations matter, but the primary motivation for inventing is making a difference in the world.

Economic impacts manifest in two different ways, according to Student Prize winners: 1) The immediate economic support from creating jobs through a new niche industry and/or 2) The long-term and widespread economic impacts of their inventions mitigating the local and/or global negative economic effects of the "problem." Some widespread economic impacts or potential impacts of Student Prize winner inventions are as follows:

- Increasing efficiency in food production and conserving natural resources:
  - Microbiomes that increase food production
  - More efficient swine production
  - Reducing water consumption in industrial cooling
  - Labor savings on farms and commercial facilities
  - Grain quality savings from spoilage
- Stewarding our environment:
  - Reducing pesticide pollution in agriculture
  - Large-scale recycling of plastics in Uganda
- Promoting individual financial/economic security:
  - Empowering hundreds of shopkeepers in Kenya to track inventory and sales, grow their shops, and get connected to the international financial ecosystem
- Increased efficiencies from new technologies:
  - Improved fleet diagnostics for long-life vehicles, reducing the operating cost for vehicles, including fuel/emissions
  - Increased speed in high-speed metal 3D printing
  - Real-time error detection in secondary steel manufacturing
  - Aircraft automation with the potential to lower the operational cost of aircraft

The economic impacts created by many of these inventions are generated by mitigating costs associated with particular problems, including lowering barriers to access—such as reducing the cost of air travel with improved aircraft diagnostics.

The three winners highlighted in this section show the economic impacts of their inventions/innovations. One profile shows a prolific inventor much further down a developed career path while the other shows the early economic potential of a team of inventors in a niche industry.

NICOLE BLACK

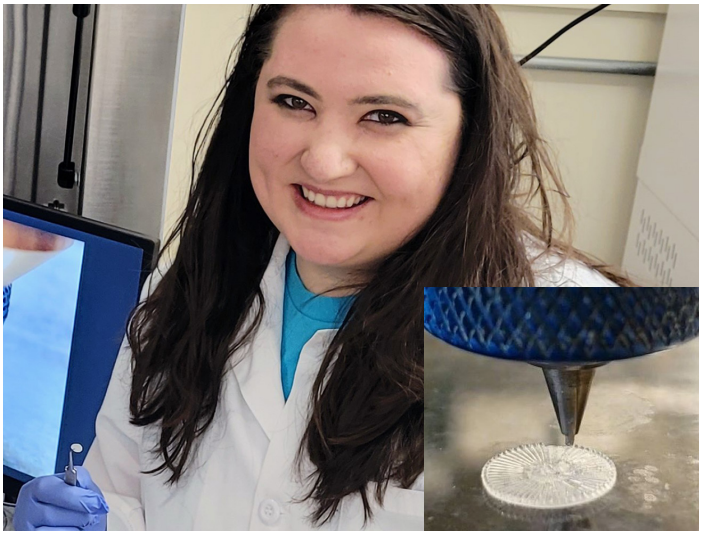
Harvard University

2021 "CURE IT!" GRADUATE WINNER

Nicole Black won the 2021 "Cure It!" Lemelson-MIT Student Prize for her invention of biometric eardrum grafts, called PhonoGraft. Growing up, Nicole suffered frequent ear infections which required tubes to be implanted in her ears. These tubes gave Nicole ear damage and hearing loss. Her personal experience inspired her to seek a solution for this serious medical issue afflicting millions.

The eardrum can become damaged because of traumatic head injuries, blast injuries, and chronic ear infections. Roughly 10% of patients with damaged ear drums visit a professional capable of treating these injuries. Medical procedures can address severe ear damage, however, these procedures can last hours, involve a long recovery process, and are not guaranteed to completely remedy the issue.

PhonoGraft is a 3D printed device matching the structure of the ear drum. Once PhonoGraft is implanted, the material degrades and the body naturally replaces it with human tissue, enabling sound conduction in high and low frequencies. Within 6-18 months, the PhonoGraft will be replaced by natural ear tissue, returning the ear drum to normal functioning capacity. It can be placed in a clinical setting in under 30 minutes without the use of general anesthesia. It also uses the same billing code, lowers cost, accelerates the recovery and healing process, and allows surgeons to perform more procedures each day.



Nicole Black
Photo credit: Zack Chou

A PhonoGraft in production
Photo credit: Zack Chou

Nicole has made it her mission to ensure inventors like her persist in their mission to invent biomedical devices that improve healthcare at an individual and societal level. She continues her endeavors in biotechnology collaborating with research and clinical institutions, medical professionals, and patients to help address our most prevalent health issues.

ABRAHAM ESPINOZA AND MATTHEW ROODA

University of Iowa

2017 "EAT IT!" UNDERGRADUATE TEAM WINNER

Abraham Espinoza and Matthew Rooda are the 2017 "Eat it!" Lemelson-MIT Student Prize winners for SmartGuard. SmartGuard is an autonomous device that uses artificial intelligence to increase swine farm productivity by reducing incidents of sows crushing their newborn piglets by safely alerting the sow to move. Piglet crushing is the largest problem for pork producers today, as 160 million piglets die each year worldwide from their mothers rolling on them during the birthing process.

The problem is one that was very familiar to Matthew growing up and working on farms:

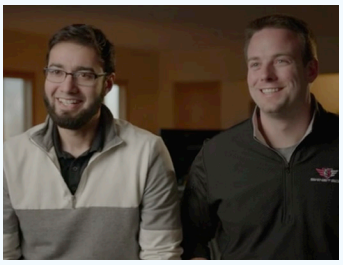
"I walked in at four in the morning to check on these pigs before school. And a mom had laid on eight of her babies. [Of the] eight only four were left alive. And so, I remove all the dead piglets, do some work, come back, and she laid on two more. And to me, I was so angry and frustrated that these healthy little pigs died because we didn't have a heads-up on the mother or a way of saving them when we weren't there. And that is ultimately when it came to my mind that I have to solve this problem."

Their invention comprises one element that encourages the piglet to move from the mother and another that detects if the piglet is in trouble. Automated heat lamps are used to optimize the environment for piglet health.

> **And if we can save all those pigs … now we're using less food, less water, and less resources overall to produce a single pound of pork. Our vision is to feed the world."**

SmartGuard adjusted the lamp's brightness to reach an ideal temperature, then turned off the heat lamp and turned on an orange comfort light that mimicked the heat lamp's brightness. The heat drew piglets away from their mother when they finished eating to reduce instances in which the sow would crush her babies by laying on them. Similar to a baby monitor, A device similar to a baby monitor was constructed to listen to each piglet's every squeal and, through artificial intelligence algorithms, to accurately detect those squeals that signaled a crushing event. When the device heard a piglet in peril, SmartGuard would deliver a strong vibration, followed by a gentle impulse, that motivated the sow to stand up and, over time, conditioned her not to crush her offspring.

Abraham and Matthew further validated their novel technology with local support and national recognition in competitions such as the Lemelson-MIT Student Prize, and were able to raise seed funding from a strategic investor. This support allowed for the expansion of their technology into other tech-based farm management solutions for improving the quality of care for both sows and piglets through the company they co-founded, SwineTech.



Abraham Espinoza (L) and Matthew Rooda (R)

Photo credit: Maaia Mark Productions

Rooda (left) and Espinoza (center) on a pig farm

Photo credit: Maaia Mark Productions

https://www.youtube.com/watch?v=TMjTv2xBmIA

The economic impact is significant. Traditional approaches to sow and piglet care provide a 3:1 or 4:1 return on investment. SwineTech technologies have the potential to increase return on investment to 20:1 or 30:1. Producers at the 90th percentile of this industry may gain $250 per animal per year—amounting to millions of dollars in revenues—by improving farm communication and organization with the added technologies.

This team's efforts significantly impact sustainability:

"For every pig that gets laid on, that's 218 pounds of food that will never go to market. And when we talk about 160 million piglets die from getting crushed and then a total of 550 million pigs across mortality and stillborns and everything else … we're talking about billions and billions of pounds of pork that are never being marketed. That could go to feed the world with resources that are already being expended. So, if we can learn to become better at the way we can save pigs, we can better feed the world without using any more resources than are necessary."

Abraham and Matthew's invention story is somewhat unique in that they developed the idea to use voice-recognition technology as the basis of their solution, but they relied on subject-matter experts to develop the SmartGuard technology:

> **These healthy little pigs died because we didn't have a heads-up on the mother or a way of saving them when we weren't there."**

"I think one thing that mattered so much was [our] being able to be okay with not being the people to build it. We were…the ones that were gonna focus on getting it started and figuring out the model that was gonna make it successful after it was ready."

Beyond Impact: Resilience

OVERVIEW

Resilience is a common theme among Student Prize winners. As winners Abraham Espinoza and Matthew Rooda were first beginning to shape their solution to reduce instances of piglet crushing (as detailed in the last section), they found significant pushback to their initial idea for a solution that was based on voice recognition technology:

"An individual from another university told us that she was gonna do everything she could to make sure that we wouldn't succeed. And she had a lot of pull. And so, we were kind of worried. And so, we met with [our mentor], we were like, maybe we should stop doing this. It'd been six months. And he said, 'Guys, nobody has ever, ever done this before. Nobody knows about the sounds of piglet squeals. Nobody knows about the impact of teaching sows through this process. Go for it, because they [experts] don't know what they're talking about. It's pure speculation.' And that push kept us going."

Each Student Prize winner's invention journey includes significant social and/or economic impacts that their inventions have had on society. Beyond these positive impacts, the hardships that these students faced on their invention journeys also provided opportunities to develop resilience. This section highlights the Student Prize winners' resilience in facing the daunting challenges of invention through the personal perspectives of two winners—one undergraduate and one graduate—who, in addition to proving themselves as inventor-innovators, also identify obstacles in their invention journeys and share how they overcome these challenges through resilience.

KATHERINE JIN

Columbia University

2016 "CURE IT!" UNDERGRADUATE TEAM WINNER

Katherine Jin is the 2016 "Cure it!" Lemelson-MIT Student Prize winner for developing Highlight, a powdered additive for disinfectants that signals which areas have been thoroughly cleaned with a change in color. Highlight is a sprayable application for decontamination that allows users to fully cover surfaces, eliminates gaps in coverage produced by hand wiping, and reduces the rate of evaporation. This powdered additive for disinfectants fades in color over time to prevent staining and indicates to users when decontamination is complete. Highlight enhances the process of decontamination, bridging the gap between having a disinfectant and using it effectively.

Katherine Jin with her co-founders Kevin Tyan, left, and Jason Kang.

When asked what she has learned as an inventor, Katherine spoke about resilience when facing the fear of failure:

"When I first started inventing Highlight, I was terrified to talk to any end user because they were just gonna tell me all the things they hated about the product, and then make me feel like, you know, there was no hope."

She now recognizes that it is her resilience that kept her moving forward:

"Resilience to me is all about experiencing difficult situations and being able to grow and move on from them … there's a really good metaphor from Sun Tzu, who says 'a river that acclimates to its environment that keeps flowing, that's what

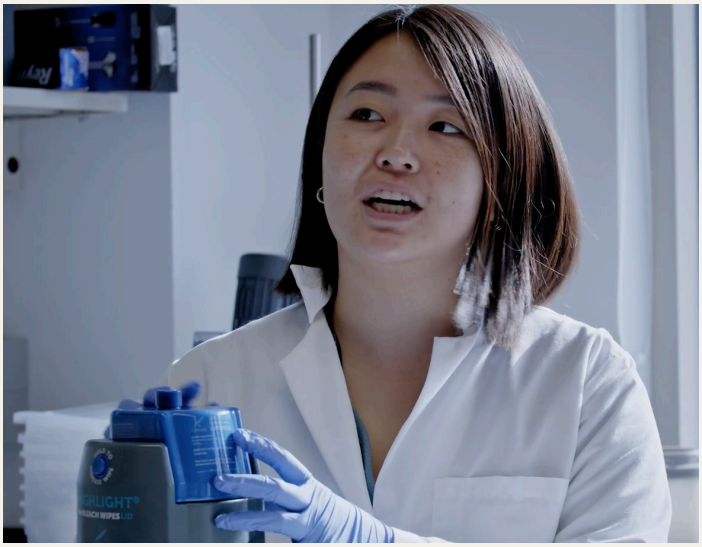
you need to do with your life.' And I've always been the kind of person, probably like everyone, that's afraid of failure, that's afraid of bad news, that doesn't want to know bad things."

Katherine's perspective has been highly influenced by her parents, who immigrated to the United States, learned English, and earned PhDs. Katherine explains:

"All I have to do is just think about all the difficulties my parents were able to push themselves through without even knowing the language as easily as me. And it really recontextualizes my struggles and really makes me realize, you know, I'm descended from these people that were able to be resilient and push through. And I can definitely do that too."

Katherine now sees her invention journey as a "time to recalibrate, a time to pull myself together."

Part of what develops resilience is building confidence in one's ability by seeing oneself represented in others. Katherine is also a fierce believer that representation matters and has been personally influenced by seeing other Asian women inventors in positions of leadership.



Katherine Jin demonstrates her invention, Highlight.
Photo credit: Maaia Mark Productions

MIRA MOUFARREJ

Stanford University

2021 "CURE IT!" GRADUATE WINNER

Mira Moufarrej is the 2021 "Cure it!" Lemelson-MIT Student Prize winner for developing a set of blood tests that could dramatically improve standards in medical care related to the prediction of pregnancy-related complications, including preterm birth and preeclampsia. These tests work by taking a routine blood sample from the expectant mother and measuring a specific portion of the blood in the plasma, called cell-free messenger RNA, to provide early detection for these two dangerous conditions.

Mira's second invention was a research pipeline that allows for semiautomated high-volume, low-cost, customized pipetting in small labs. The semiautomated pipeline that Mira invented extracted RNA 12-fold faster, reduced costs by threefold and and achieved a fourfold reduction in biohazardous waste.. Mira, like Katherine Jin, also identified her family background as playing a significant role in her developing the resilience required to invent:

"My parents are Lebanese and lived in Lebanon until they graduated college during the [Lebanese] Civil War and then they immigrated to find jobs … so, my grandma, for example, lost her husband when she had kids…. And she went from being a math teacher to having to run this business and put her kids through college. And I'd consider that fairly entrepreneurial, which to me are the same skills as inventing and resiliency, which in the face of failure, you find something [a problem], and you change it. And my parents tried to teach me the same things: that I shouldn't be afraid to try stuff just because [out of fear that] I'll fail. [Rather,] I should try and see."

She highlights the importance of curiosity, which was also fostered by her family:

"I really love their resiliency, their ability to put things in perspective, and their ability to encourage curiosity, that because they have lived [through] war [and] have moved so many places, they don't take anything for granted and they understand that nothing is really normal, cuz

> **I think there are certain common traits between inventors. I think resiliency is a huge one."**

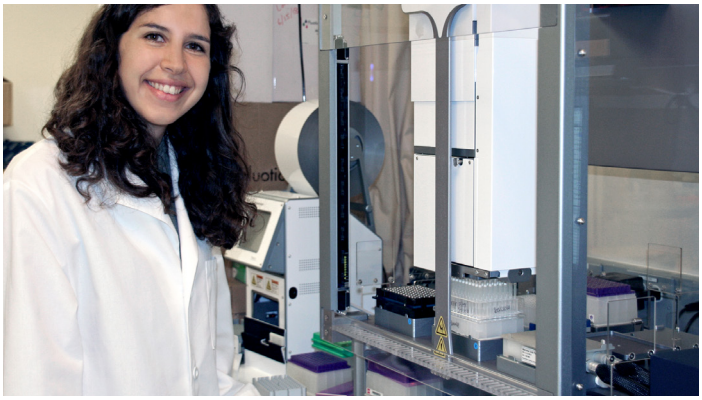
normal is different in different places. And so, if nothing is really normal, then you can be curious and open and ask questions."

But Mira did not initially see herself as a scientist and inventor. She says, "I think that may be the first limitation sometimes … you don't jump into something cuz you think you're not represented there. [You think] it's not for you. But really, who says that anything is for anyone."

> **My parents tried to teach me… that I shouldn't be afraid to try stuff just because [out of fear that] I'll fail. [Rather,] I should try and see."**

Inventing and resiliency for Mira are nearly synonymous, in that both are constantly working against failure, or fear of failure, to enable forward movement. She further explains her perspective on reformulating what it means to "fail":

"Something I've learned as an inventor is not to take failure personally, that it is okay to fail. It's part of the process. In fact, you often grow from it … it is only in the process of failing that you will end up seeing those gems of success that we hear about so often."



Mira in her laboratory

Photo credit: Maaia Mark Productions

Mira Moufarrej

Photo credit: Maaia Mark Productions

fact, you often grow from it … it is only in the process of failing that you will end up seeing those gems of success that we hear about so often."

A facet of Mira's resilience is fostered by her recognizing that in any endeavor, no one has all the answers at the beginning. Facing the uncertainties inherent in inventing takes—and also develops—confidence:

"When you're working on the edge of what you know and what you don't know, you will never know enough and that's okay. Nobody knows enough, but you can learn. And you just have to be confident in your ability to learn and figure out the problems as they go, cuz you'll never know enough going in."

Through winning the Lemelson-MIT Student Prize, Mira was empowered to take ownership of her identity as a scientist and inventor. Reflecting on her own journey, Mira encourages others to take that first step toward invention by saying to themselves, "I'm going to try."

"Something I've learned as an inventor is not to take failure personally, that, it is okay to fail. It's part of the process. In fact, you often grow from it … it is only in the process of failing that you will end up seeing those gems of success that we hear about so often."

> **You have to be willing to jump over that cliff of, 'I don't know enough. That's okay. I'm gonna figure it out as I go.'"**

Lemelson-MIT Student Prize Winners by Year

2021

Nicole Black
PhonoGraft: biomimetic eardrum grafts, and a new type of tympanostomy tube
Harvard University, MA
"Cure it!" Graduate

Mira Moufarrej
Prenatal liquid biopsy tests and a pipeline for high-volume, customized pipetting
Stanford University, CA
"Cure it!" Graduate

Bruce Enzmann, Michael Lan, and Anson Zhou
Innerva: a conical nerve conduit
Johns Hopkins University, MD
"Cure it!" Undergraduate Team

Hilary Johnson
Variable volute water pump
Massachusetts Institute of Technology, MA
"Eat it!" Graduate

Benjamin Johnson and Zane Zents
Grain Weevil: grain extraction and bin management robot
University of Nebraska Omaha, NE
"Eat it!" Undergraduate Team

Seung Hwan An and Maya Burhanpurkar
Adventus Robotics: autonomous wheelchair technology
Harvard University, MA
"Move it!" Undergraduate Team

Paige Balcom
Takataka Plastics: recycling systems to transform PET plastic waste
University of California, Berkeley, CA
"Use it!" Graduate

Paige Balcom
Photo credit: Maaia Mark Productions

2020

Shriya Srinivasan
Healthcare advances for amputees that restore a sense of touch and better mobility
Massachusetts Institute of Technology, MA
"Cure it!" Graduate

Siddharth Iyer, Jasmine Hu, Mathias Insley, Diane Lee, and Eric Lin
Augeo: a cryogel polymer-based embolization solution to treat hemorrhaging patients
Johns Hopkins University, MD
"Cure it!" Undergraduate Team

Tzu-Chieh (Zijay) Tang
Syn-SCOBY: a smart pollutant-sensing filter and DEPCOS for ultra-safe water applications
Massachusetts Institute of Technology, MA
"Eat it!" Graduate

Celestine Ananda, Bennett Bartel, Nicholas Bartel, Cassandra Bossong, and Taylor Peterson
Modal Propellant Gauging (MPG): a system that provides real-time fuel gauging for aircraft and spacecraft
Carthage College, WI
"Move it!" Undergraduate Team

Daniela Blanco
Chemical reactors for sustainable chemical processes and an optimized system for energy storage and hydrogen production
New York University, NY
"Use it!" Graduate

Marx Acosta-Rubio, Grant Christensen, and Hal Jones
Neptune Plastics, Inc.: biodegradable plastic
Brigham Young University, UT
"Use it!" Undergraduate Team

2019

Mercy Asiedu
Callascope: a cervical cancer diagnosis device and a smartphone algorithm to classify cervix images
Duke University, NC
"Cure it!" Graduate

Laura Hinson, Madeline Lee, Sophia Triantis, and Valerie Zawicki
Ithemba: a reusable, low-cost, contamination-free breast biopsy device
Johns Hopkins University, MD
"Cure it!" Undergraduate Team

Julie Bliss Mullen
Electrochemical water purification technology and chlorine generator
University of Massachusetts, Amherst, MA
"Eat it!" Graduate

Enid Partika and William Tanaka
The BioEnergy Project: repurposing food waste
University of California San Diego, CA
"Eat it!" Undergraduate Team

Federico Scurti
SMART Conductor and enhanced optical fiber sensors
North Carolina State University, NC
"Move it!" Graduate

Morgen Glessing and Josh Horne
Portal Entryways: a wireless device that opens disabled-accessible doors
Brigham Young University, UT
"Move it!" Undergraduate Team

Arnav Kapur
AlterEgo: a non-invasive-peripheral-nerve computer interface, and ISGEC: a customizable gene expression measurement platform
Massachusetts Institute of Technology, MA
"Use it!" Graduate

2018

Tyler Clites
Agonist-antagonist Myoneural Interface (AMI) and Pollex Grasp
Massachusetts Institute of Technology, MA
"Cure it!" Graduate

Kali Barnes, Stephanie Cai, Akash Chaurasia, Conan Chen, and Eric Chiang
Treyetech: novel device to revolutionize eye corneal transplants
Johns Hopkins University, MD
"Cure it!" Undergraduate Team

Guy Satat
All Photons Imaging and FemtoPixel
Massachusetts Institute of Technology, MA
"Drive it!" Graduate

Maher Damak
Charged polymers for sticky agricultural sprays and water recovery in cooling towers
Massachusetts Institute of Technology, MA
"Eat it!" Graduate

2019 Lemelson-MIT Student Prize winners

Kayla Nguyen
Electron Microscope Pixel Array Detector (EMPAD) and low-cost airSTEM
Cornell University, NY
"Use it!" Graduate

Melissa Austin, Eric Cao, Talia Kirschbaum, Theodore Lee, and Harrison Nguyen
N-Stent: daily-wear nasal breathing aid
Johns Hopkins University, MD
"Use it!" Undergraduate Team

2017

Katy Olesnavage
Method to design a better prosthetic foot
Massachusetts Institute of Technology, MA
"Cure it!" Graduate

Lisa Tostanoski
Innovative biomaterials-based strategies to combat autoimmune disease
University of Maryland, College Park, MD
"Cure it!" Graduate

Maria Filsinger Interrante, Christian Choe, and Zachary Rosenthal
Novel proteins to fight superbug bacterial infections
Stanford University, CA
"Cure it!" Undergraduate Team

Tony Tao
A small, mid-air-deployable, folding electric drone, and Adaptable Aircraft Manufacturing (AAM) architecture
Massachusetts Institute of Technology, MA
"Drive it!" Graduate

Tomás Vega and Corten Singer
WheelSense: an open-source smart add-on system for wheelchairs
University of California, Berkeley, CA
"Drive it!" Undergraduate Team

Natasha Wright
Solar-powered desalination system for off-grid water production, and usage sensor for household water treatment devices
Massachusetts Institute of Technology, MA
"Eat it!" Graduate

Matthew Rooda and Abraham Espinoza
SwineTech: SmartGuard device—real-time health analysis for farmers
University of Iowa, IA
"Eat it!" Undergraduate Team

Apoorva Murarka
Contact-printed nanomembrane transducers for sound production
Massachusetts Institute of Technology, MA
"Use it!" Graduate

Chen Wang, Chandani Doshi, Grace Li, Jessica Shi, Charlene Xia, and Tania Yu
Tactile: a real-time text-to-Braille converter
Massachusetts Institute of Technology, MA
"Use it!" Undergraduate Team

2016

Catalin Voss
Autism Glass project
Stanford University, CA
"Cure it!" Graduate

Katherine Jin, Jason Kang, and Kevin Tyan
Highlight: a powdered additive for disinfectants
Columbia University, NY
"Cure it!" Undergraduate Team

Dan Dorsch
High-performance, lightweight clutchless hybrid transmission
Massachusetts Institute of Technology, MA
"Drive it!" Graduate

Heather Hava
Better connections between humans and plants on Earth and in space
University of Colorado Boulder, CO
"Eat it!" Graduate

Michael Farid, Braden Knight, Kale Rogers, and Luke Schlueter
World's first completely automated restaurant
Massachusetts Institute of Technology, MA
"Eat it!" Undergraduate Team

Achuta Kadambi
Superhuman visual systems to capture light
Massachusetts Institute of Technology, MA
"Use it!" Graduate

Thomas Pryor and Navid Azodi
SignAloud: gloves that transliterate sign language into text and speech
University of Washington, WA
"Use it!" Undergraduate Team

2015

Carl Schoellhammer
Enhancing pain-free drug delivery in patients via the gastrointestinal (GI) tract
Massachusetts Institute of Technology, MA
"Cure it!" Graduate

Joseph Barnett and Stephen John
Respiratory solution for premature infants
Western Michigan University, MI
"Cure it!" Undergraduate Team

Alexander Richter
Game-changing innovation to help solve the global food scarcity challenge
North Carolina State University, NC
"Eat it!" Graduate

Justin Keenan and Kevin Paroda
ECHOdrive: the next dimension of 3D printing
Pennsylvania State University, PA
"Use it!" Undergraduate Team

Josh Siegel
Connecting "hidden" vehicle data with a cloud-based platform to create powerful and transformative applications
Massachusetts Institute of Technology, MA
"Drive it!" Graduate

2014

David Moinina Sengeh
Next-generation wearable mechanical interfaces that improve comfort for amputees
Massachusetts Institute of Technology, MA
"Cure it!" Graduate

Alex Devon, Tyler Ovington, and Kayla (Gainey) Wilson
GlucoSense: a low-cost glucometer and strip system for diabetics in resource-poor settings
Clemson University, SC
"Cure it!" Undergraduate Team

Christopher Haid, Mateo Peña Doll, AJ Perez, and Forrest Pieper
Automated 3D printing for the classroom
Massachusetts Institute of Technology, MA
"Use it!" Undergraduate Team

Benjamin Peters
Reconfigurable forming tools—looking beyond 3D printing
Massachusetts Institute of Technology, MA
"Use it!" Graduate

For the years 1995–2013, the Lemelson-MIT Student Prize was awarded annually to one graduate student from the Massachusetts Institute of Technology.

2013
Nikolai Begg
Medical devices that make surgical procedures less invasive

2012
Miles Barr
First-ever solar cells fabricated on everyday substrates

2011
Alice Chen
Humanized mouse with a tissue-engineered human liver

2010
Erez Lieberman-Aiden
Hi-C: a groundbreaking method for 3D genome sequencing

2009
Geoffrey von Maltzahn
A new class of therapeutics that provides more precision to cancer ablation

2008
Timothy Lu
Processes to combat bacterial infections by enhancing the effectiveness of antibiotics

2007
Nate Ball
ATLAS: a powered rope ascender

2006
Carl Dietrich
Transition: A personal air vehicle

Photo credit: https://www.auto123.com/en/news/historic-takeoff-makes-flying-car-a-reality/24323/

2005
David Berry
Innovations in stroke and cancer treatments

2004
Saul Griffith
Low-cost device for manufacturing eyeglass lenses, electronic rope, and recyclable 3D LEGO chocolate printer

2003
James McLurkin
"Swarm" microrobots based on the principles of nature to carry out real-world tasks

2002
Andrew Heafitz
Low-cost aerial surveillance system that utilizes a rocket

2001
Brian Hubert
Universal nano-assembly machine

2000
Amy Smith
Motorized hammermill

1999
Daniel DiLorenzo
Implantable microelectrodes to facilitate sensory feedback in prosthetic limbs

1998
Akhil Madhani
Black Falcon: a tool for minimally invasive surgery

1997
Nathan Kane
HydroRail™: a modular hydrostatic bearing for machine tools, and the Pass-It™

1996
David Levy
Fastap™ keypad, formerly known as OneTouch™

1995
Thomas Massie
PHANTOM 3D Touch interface for computers

Conclusion

The Lemelson-MIT Student Prize was awarded between 1995 and 2021 to 119 individual undergraduate and graduate student winners for their inventions. This section of the retrospective recognizes the contributions of the Student Prize program in supporting inventors at the beginning of their careers. Through surveys and personal interviews of Student Prize winners, this retrospective also documents the potential for their inventions to make a social and economic impact on the lives of others, as well as the resilience and confidence their invention endeavor has had on them.

BUT THERE IS MORE TO LEARN...

What can we learn from the experiences of Lemelson-MIT Student Prize winners that can support developmental pathways for future inventors?

The remaining pages of this publication explore what we have learned from Lemelson-MIT Student Prize winners and the implications for developing K–12 educational programs that focus on invention education. To explore this further, move to the "back" of this retrospective, which is the cover page for *Inventor Developmental Pathways*.

https://scholar.harvard.edu/files/xavier/files/inventors.pdf