



MIT LINCOLN LABORATORY **2016**
COMMUNITY INVOLVEMENT REPORT



LINCOLN LABORATORY OUTREACH IN 2016

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EDUCATIONAL OUTREACH
STEM PROGRAMS
IN K-16

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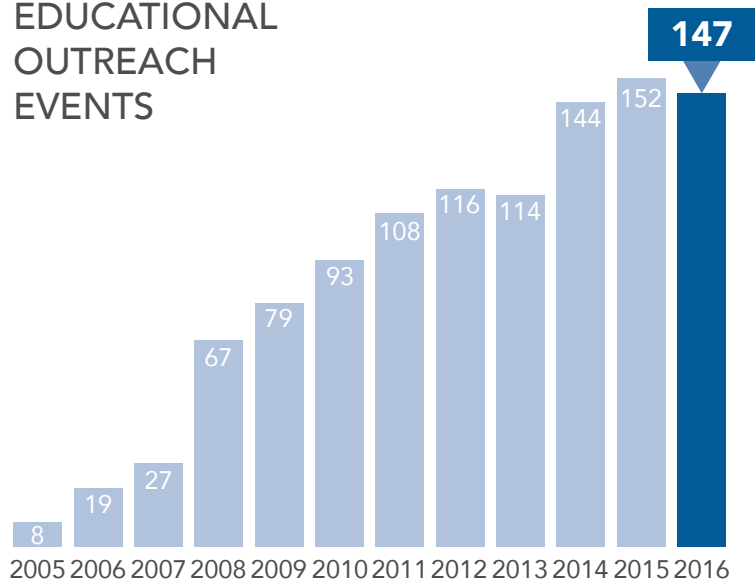
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"We challenge you to get involved!" Lincoln Laboratory's GEM interns create a video to raise awareness of the National GEM Consortium. GEM is a partnership of industry, laboratories, and the academic community to provide fellowships for underrepresented minorities pursuing graduate degrees in STEM fields. Eric Evans is currently the Chairman of the Board of Directors for GEM.



A Message From the DIRECTOR

Community and educational outreach programs are important components of the Laboratory's mission. From the beginning, our outreach initiatives have been inspired by employee desires to help people in need and to motivate student interest and participation in engineering, science, and mathematics. There are many opportunities to be involved.

The Laboratory's educational outreach initiatives include delivering Science on Saturday presentations, sponsoring U.S. FIRST robotics programs, and mentoring college and graduate student interns preparing for science and technology careers. Our staff volunteer to serve as judges for local and regional science fairs and science-based activities.

The Laboratory is committed to giving back to the community by sponsoring fundraising and community service events in support of Wounded Warriors, the Alzheimer's Association, the American Heart Association, and other charitable organizations. The involvement of the entire Lincoln Laboratory community is encouraged and supported. Please let us know how we can do more.

Eric D. Evans
Director



Educational Outreach

Lincoln Laboratory takes pride in promoting science and engineering education for all grade levels in four main areas:

- K–12 STEM Outreach
- Partnerships with MIT
- Support for Local Schools and Teachers
- Community Engagement

Students in the Beaver Works Summer Institute practice steering their self-built robots, a challenge that included using the robots' sensors, programmed to detect a lane marking.



People attending the Science on Saturday demonstration about the sounds of the jungle were surprised to find out that they had just learned how to mimic a chimpanzee's mating call.

Science on Saturday

Amid robotics demonstrations and a liquid nitrogen show, children are always learning at Lincoln Laboratory Science on Saturday events.

In June, the Laboratory's Hispanic Latino Network offered demonstrations in which participants could explore the science of the senses, but in a Latin-American theme, featuring the tastes, sights, sounds, and smells of Latin America and a surprise visit from Carmen Sandiego! While learning about the senses, children were also solving riddles to find an important historic symbol of America hidden somewhere in the Laboratory.

Our "Welcome to the Jungle" show helped children learn how animals make and hear sounds in one of the noisiest habitats on Earth. Dr. Zarin Machanda, a primatologist at Tufts University, explained how she studies the behavior and communication of chimpanzees.

At the MIT Open House Demonstrations and Activities at MIT Campus in April, Lincoln Laboratory offered 10 activities and demonstrations, exploring topics such as lunar laser communications, passive microwave radiometers, unmanned air vehicles, an aluminum-water electrical generator, and X-band radar.



Among the 350 activities offered at the MIT Open House, Lincoln Laboratory offered 10 booths, including one that demonstrated the different ways we can observe and forecast weather.



One Science on Saturday participant stopped to ask "Carmen Sandiego" for hints while he was learning about the senses and racing to find a hidden object.

Open House

The Laboratory opened its doors on September 18 to approximately 7000 employees and family members for the biggest event of the 65th Anniversary celebration. The Laboratory transformed into a science museum for the day as visitors participated in over 100 exhibits and activities, from firing a diode laser to testing a collision avoidance simulator. Children could sit in a Humvee outfitted with a mobile communication terminal, race student-built robotic mini-cars, and fly an autonomous robot designed to capture video surveillance. The young and young-at-heart competed in the egg drop challenge in which participants designed and built a system to protect an egg from a one-story fall. The activities were designed to showcase innovative technology developed at the Laboratory while providing entertainment for all age groups during this once-every-five-years event.

65 years ago, MIT Lincoln Laboratory was established to build the nation's first air defense system. Today, we develop many technologies and provide STEM outreach locally and nationally.



Daniel Souza shows a participant how to use augmented reality glasses to navigate through a virtual maze.



"Do you offer this every weekend? Because I had so much fun, I want to do this every weekend!"

At left, a Lincoln Laboratory volunteer helps a student try filtering a chemical out of water. Below, a participant shows her light-emitting diode glove after she connected the circuits.

Wow! That's Engineering! Workshop

In March, 100 girls in grades six through eight attended a Wow! That's Engineering! Workshop at Lincoln Laboratory. This workshop, a partnership with the Society of Women Engineers, allows girls to learn about reverse engineering by dismantling appliances, electrical engineering by connecting a circuit to make a light-emitting diode glove, chemical engineering by applying technology to filter water, and civil engineering by designing a tower on a budget. Each participant engaged in an hour of software coding as an introduction to programming and computer science. The activities proved to be educational and entertaining, best exemplified by one participant who asked, "Do you offer this every weekend? Because I had so much fun, I want to do this every weekend!"





The three Laboratory CyberPatriot teams participated in a state competition and ranked 2nd and 4th in the platinum tier (highest difficulty level) and 3rd in the gold tier (second-highest difficulty level.)

CyberPatriot

Lincoln Laboratory sponsored three teams in CyberPatriot, a national competition for high-school students learning defensive computer security. Lincoln Laboratory has mentored CyberPatriot teams since 2012.

The 17 students (six of whom were new to CyberPatriot) were mentored by Jorge Coll, Patrick Cable, and Andrew Fasano.

The students learned how to identify malware, “clean” a computer system, and establish a secure network in a simulated corporate network setting. After practicing these skills, the Laboratory-mentored teams competed in a statewide competition, where

two of the three teams achieved the ranks of first and third. The six-hour competition was filled with team members cleaning systems, rooting out malware, correcting categories of vulnerabilities, and establishing a secure environment. The teams also competed in digital forensics and networking challenges. The two ranked teams advanced to compete in the Northeast Regional competition, but did not place.

Chiamaka Agbasi-Porter, coordinator of Laboratory STEM outreach, said, “The students learn about cyber defense and communication—skills which will help them get internships and jobs, or just help them see if they want to pursue computer science classes.”

Team America Rocketry Challenge

Francesca Lettang mentored three students in Lincoln Laboratory’s Team America Rocketry Challenge (TARC) team in 2016. The objective of the competition was to launch and recover two eggs, one oriented perpendicular to the rocket’s long axis, the other oriented parallel, while reaching an apogee altitude as close as possible to 850 feet and a flight time between 44 and 46 seconds. Other requirements included a minimum rocket length, a maximum rocket mass, and that the rocket land as one unit. The team designed, built, and tested four rockets (two each of two different designs).

Numerous test launches included an incident during which the delay on the ejection charge was incorrectly set, resulting in a completely ballistic trajectory (a.k.a. “lawn dart”), and ending up a much shorter rocket than that with which the team started. After other rebuilds and many successful launches, the team attempted their qualification launches. The rocket reached an altitude of 861 feet with a flight time of 53.29 seconds on the first attempt, for a score of 40.14 (a perfect score being zero). On the second attempt, the rocket reached an altitude of 857 feet with a flight time of 41.59 seconds, for a score of



The TARC team performs field tests to test their rocket design and make refinements before competition.

16.64, the best score of the day at that Central Massachusetts Spacemodeling Society-sponsored launch. Despite its excellent scores, the team did not make the national finals, which had a cutoff combined score of 36.72.



At left, MIT Lincoln Laboratory volunteers stand with the participants of the programming lab for the Harvard Merit Badge University Programming Merit Badge. Below, Laboratory volunteers guide scouts in making a video explaining the new merit badges for game design and space exploration, a task that helped scouts learn about the scientific aspects of these topics and how to create a professional video.



Scouting@Lincoln Laboratory

The Scouting@Lincoln Laboratory group hosted a programming lab to support the Programming Merit Badge during Harvard's Merit Badge University. Thirty scouts learned and practiced using Python and C++ programming languages. The Harvard Merit Badge University was sponsored by the Harvard Friends of Scouting.

Phil McKinley helped to organize the Math Science Technology Expo in Nashua, New Hampshire. The Expo offers STEM merit badges and career information to more than 250 scouts. McKinley also taught the Robotics Merit Badge, which included a field trip to Boston Dynamics. Several other Laboratory staff volunteered for this event by assisting on the organizing committee and teaching other topics for merit badges.

The Boy Scouts of America is creating online digital editions of their merit badge pamphlets. The Scouting@Lincoln group organized a photo shoot and provided subject-matter experts for the Game Design and Space Exploration Merit Badges. The digital content provides search capabilities, instructional videos, virtual tours, animations, and pop-up definitions.

Venture Crew 1775

Venture Crew 1775 is a co-ed STEM-focused high-adventure group chartered by Lincoln Laboratory. The group has experienced presentations on aeronautical and astronautical engineering and tours of Haystack Observatory, the Lincoln Laboratory Flight Facility, and the Terrafugia flying car facility. Because they also focus on high-adventure outings, they embark on monthly camping trips (including the trek up to Mt. Cardigan in New Hampshire) and back-packing trips, and meet other crews to join in archery, riflery, and mountain-boarding activities.

This year, the crew visited Florida National High Adventure Sea Base to explore the ecosystem in the Florida Keys. Plans for next year include a trip to Kandersteg International Scout Centre in Switzerland to meet with scouts from all over the world.

Explorer Post 1776



High-school boys in Explorer Post 1776 (sponsored by Lincoln Laboratory) gained hands-on experience designing, building, and testing water-powered rockets with the help of Richard Marino, pictured in back.

Established in October 2015, Explorer Post 1776 is a youth development program offered through the Boy Scouts of America. Its purpose is to provide experiences that help young people prepare to be responsible and caring adults. Explorers gain in-depth experience in building engineering systems and are challenged to build prototypes using creative problem-solving strategies. The six participants in Post 1776 toured Lincoln Laboratory and MIT Haystack Observatory. Students have engaged in reverse engineering, building water rockets, designing a vehicle that can travel a straight path on a track, and testing a device to propel a ball on an established path. Richard Marino and Curtis Heisey serve as mentors for Explorer Post 1776.

LLCipher

The LLCipher workshop is a one-week program that introduces students to modern cryptography, which is a theoretical approach to securing data. The program offers lessons in abstract algebra and number theory that students use to understand theoretical cryptography. Based on feedback from last year, Sophia Yakoubov, instructor of the cryptography workshop, extended each lesson by four hours. "Many students said they wanted to learn more than one cryptography technique," said Yakoubov.

With the help of Uri Blumenthal and Jeffrey Diewald, Yakoubov created an online platform that includes challenges in two different cryptosystems to allow students to apply the theory. "Students could see examples of flawed cryptography and understand how easily it can be broken," said Yakoubov.

Students toured the anechoic chambers and the Flight Test Facility and listened to a guest lecture from Emily Shen on a more specialized cryptography topic. "Cryptography is a tool that is very important—it's an interesting intersection of math and computer science to which people are not often exposed," said Shen.

Following the program, students indicated their interest in taking computer science courses in college. "LLCipher helped us understand the cryptography-based concepts that we see in our everyday lives," said student Brandon Chu. "At the end of the program, everything came together and made sense, which was really exciting. We were doing things that seemed impossible at first—I definitely feel smarter and more empowered now than when we started."

Sophia Yakoubov lectures the LLCipher class on public key encryption, a method that uses both public keys that many people can use and private keys that belong to just one person.



SPOTLIGHT:

Girls Who Build Cameras Workshop Sparks Future Engineers

Most photography classes discuss lighting and composition, but in Lincoln Laboratory's first Girls Who Build Cameras workshop, 40 high-school girls learned how to build their own camera and write code for Instagram-like filters.

Kristen Railey, founder of a series of workshops called Girls Who Build and the organizer of the event, said her idea to host a workshop based on cameras and programming filters came about because of the abundance of image-based social media apps like Instagram and Snapchat that use filters to alter photos taken with smartphones. "Cameras," Railey said, "require versatile engineering, including optics, computer science, and mechanics, so the students were able to see which field of engineering they might find most interesting."

Working in teams of four, the girls used Raspberry Pi single-board computers to build cameras of their own, and then programmed several different image effects. During the coding process, the girls learned programming concepts like loops and logic, and how to program an Instagram-type filter to flip the image, create a vignette, tint the photo, or single out one color from the image.

Engineers from Lincoln Laboratory spoke to the girls about their own research involving cameras. Kristin Clark talked about space cameras, including a project



Students learn how to code in order to program the Instagram-like filters used on their self-built cameras.

aimed at discovering exoplanets. Jessica Johnson displayed a light-field camera that captures the light density and direction in an image. Robert Schulein demonstrated using photography to measure and map distances.

After the workshop, 90 percent of the girls said they wanted to continue learning to code. "This was a great experience for me because I wanted to start programming, but I didn't know how or where to start," said one participant.

LLRISE

Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE), a radar immersion course for high-school juniors, ran from July 11–23 at the Laboratory. In its fifth year, the program drew 277 applicants and accepted 18 students. Participants learned to design and build their own radar, in addition to learning about the history of radar and the Laboratory's role in its development.

"Not only did students learn how to design a radar, they built it from scratch," said Chiamaka Agbasi-Porter, coordinator of LLRISE. "They learned the engineering design process and learned how to troubleshoot when problems arise." The students developed models of their own radars and then created them using 3D printers at the Technology Office Innovation Laboratory.

The students also toured the Flight Test Facility and visited MIT Haystack Observatory. This year's program included more Laboratory tours and staff speakers than in the past. Nineteen staff members volunteered their time to deliver lectures, help with software, direct experiments, and assist in building radars. At the end of the program, students delivered presentations at both Lincoln Laboratory and the MIT Museum.

Students accepted to the 2016 Lincoln Laboratory Radar Introduction for Student Engineers workshop assemble on their first day of the two-week program.



The Laboratory hosted a Girls Who Code computer science immersion program at Beaver Works. Students are provided with laptops and given lessons that cover HTML and CSS coding basics.

Girls Who Code

This summer, Lincoln Laboratory had the honor of being the first non-profit laboratory to host a Girls Who Code (GWC) program. The seven-week immersion program offered 300 hours of introductory programming for 20 11th and 12th grade females. Students learned the basics of computer science, from robotics to web development, while gaining exposure to the tech industry. The curriculum was provided by GWC and taught by local teachers. Lessons covered HTML and CSS for web design and Python for programming. In one lesson, the girls interacted with an Arduino robot controlled by programming a basic computer board.

Eric Evans, Director of Lincoln Laboratory, visited the class to talk about the kinds of projects developed at

the Laboratory, and 18 female Laboratory staff members visited the class to talk about their experiences, discussing everything from college classes and professors to gender bias and navigating a job after college.

A field trip to the Laboratory helped the girls gain exposure to a range of technology jobs. They learned about laser communications and toured the air traffic control and persistent surveillance workspaces. Lalitha Parameswaran demonstrated how to use a scanning electron microscope and Donna-Ruth Yost showed the group the Microelectronics Laboratory. The group also learned about interviewing and internships from Alexandra Day. The visit concluded with a robotics demonstration by Ekaterina Kononov.

Robotics

Robotics Outreach at Lincoln Laboratory (ROLL) takes advantage of the popularity of robotics to interest K-12 students in science and technology. ROLL sponsors teams in For Inspiration and Recognition of Science and Technology (FIRST) competitions, hosts robotics workshops, and provides technical mentors to local schools. In 2016, more than 135 students participated in 16 Laboratory-mentored teams.

Seven teams advanced to the East Super-Regional in Scranton, Pennsylvania, in March. Lincoln Team 2875 ranked third after qualifying rounds. Nikhaar Shah from Lincoln Team 7297 was selected as a Dean's List Finalist, thereby advancing to the national selection level.

Some of our volunteers, including Jacob Huang, Loretta Bessette, Peter Klein, Carol Chiang, Curtis

Heisey, Kenneth Cole, Nancy List, Richard Czerwinski, Kara Greenfield, and Hemonth Rao have been involved in ROLL for many years and have escalated their volunteerism well beyond coaching by hosting scrimmages, tournaments, and instructional workshops in addition to participating in the Affiliate Partner Organization. This organization is responsible for coordinating the FIRST Tech Challenge events in Massachusetts; running two workshops and the State Championship; and hosting a kick-off event, scrimmages, and qualifying tournaments. Members of ROLL participate on the Affiliate Partner Planning Committee; serve as technical advisors, judges, and

referees for tournaments; and run workshops to introduce high-school students to programming, electrical wiring, and mechanical design for robotics.

Each year, ROLL assists with outreach at several events, including the Cambridge Science Festival, a robotics-themed Science on Saturday show, the Discover STEM program in Acton, Massachusetts, as well as demonstrations for Boy Scouts, Girl Scouts, and the Girls Who Code program. Many Laboratory employees volunteer for the Massachusetts FIRST Tech Challenge workshops, scrimmages, qualifiers, and state competitions.



Above and right, all-girl robotics team mentored by Ekaterina Kononov assembles the foundation of their robot.

90% of the graduating seniors in our FIRST Tech Challenge program go on to study engineering



Richard Lippmann sits with the students he instructed in a one-week robotics programming course.

Robotics Course

Richard Lippmann volunteered to teach a one-week robotics course in a small high school in Newport, Vermont.

This very successful course taught students how to program a humanoid NAO robot to answer questions, recognize objects, move around the stage, and dance. Students exhibited creativity in developing robot interactions and showed persistence in overcoming both software and mechanical bugs. Their final human-robot interactions were presented as part of a school gathering to celebrate a week of special teaching events.

"It was inspiring to see students exhibiting humor and creativity in developing robot interactions and persistence in overcoming both software and mechanical bugs."

— Richard Lippmann

Beaver Works Summer Institute

A select group of students from across the country spent the summer learning about the development of self-driving vehicles in Lincoln Laboratory's Beaver Works Summer Institute (BWSI). During the four-week program, students learned how to develop algorithms and software to teach a miniature car navigation, mapping, and object detection.

"We see a lot of autonomy slowly making its way into our lives," said Robert Shin, the program creator.

"Autonomous vehicles are a hot topic, but it turns out it's an incredibly interesting research project as well. I think this program helped the students appreciate what it means to work on a real problem," said Shin.

With plans for next year's program already underway, Shin is hopeful that participating students can carry the problem-solving lessons with them as they embark on their careers.

"Teaching robots tasks that come easily to humans, like making the correct turn at a three-way intersection, was the most challenging part of the program."

— A BWSI participant



The program culminated with the students racing their vehicles against each other in MIT's Walker Memorial. Inside the building, the cars raced around a miniature replica of a Grand Prix racecourse.



High-school students from across the country participated in the first Beaver Works Summer Institute.



David Scott shows students visiting the Technology Office Innovation Laboratory the variety of 3D-printing technologies available. The Form 1 stereolithography 3D printer pictured above produces parts by curing liquid resin with an ultraviolet laser.

MIT OEOP Programs

The MIT Office of Engineering Outreach Programs (OEOP) in the School of Engineering offers deserving students rigorous academic experiences that encourage the pursuit of careers in technical fields and provide a hands-on curriculum that strengthens foundational math, science, and communication skills in a challenging learning environment. Lincoln Laboratory plays a part in three OEOPs: STEM, SEED, and MITES.

Science, Technology, Engineering, and Mathematics (STEM)

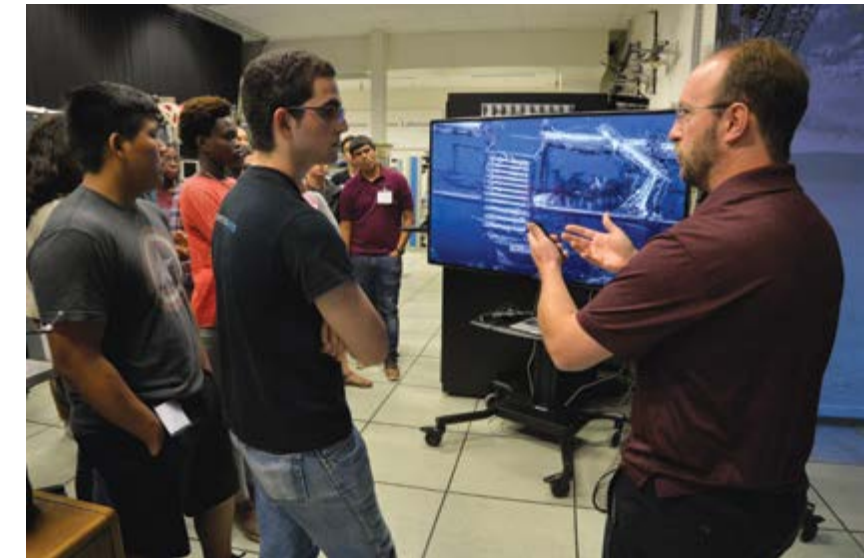
STEM is a year-round academic enrichment program for talented local middle-school students who want to get ahead in math and science. The courses use lectures, projects, and experiments to help participants develop mathematical thinking and problem-solving abilities. Lincoln Laboratory sponsored a short robotics course for the students.

Saturday Engineering Enrichment and Discovery (SEED) Academy

The SEED Academy is a seven-semester technical career exploration program for underserved high-school students in Boston, Lawrence, and Cambridge, Massachusetts. Lincoln Laboratory sponsored two students and an aeronautics and astrophysics course. Laboratory staff member George Baah presented a talk on what he does at work and how he has benefited from a technical career.

Minority Introduction to Engineering and Science (MITES)

In June, promising high-school seniors from across the country arrived at MIT to participate in MITES. Students were immersed in college-level courses



Mark Donahue, right, explains the operations of the Autonomous Systems Lab to visiting students in the MITES program.

in math, physics, life sciences, engineering, and humanities. The program stresses the value of pursuing advanced technical degrees and helps students develop skills to achieve success in science and engineering. Lincoln Laboratory sponsors two students in this program and hosts a guided tour of Laboratory facilities. MITES students listened to presentations by Laboratory staff members Melissa Smith and Kyle Morrison, who explained how they chose their respective career paths and why jobs in the technical field are important.

Daughters and Sons Days

Lincoln Laboratory extends its outreach to the students of many local schools by way of the annual Daughters and Sons Days offered for employees' children. In 2016, children enjoyed stations that offered interactive demonstrations and tours of a fabrication lab, a clean room, a robotics lab, and a machine shop, and a science fair of demonstrations on fiber optics, water rockets, augmented reality, laser communications, and 3D imaging. Staff members demonstrated scientific principles of data fusion and air flow and conducted an experiment to see how infrared sensors can track an object. Parents enjoy this opportunity to create excitement about STEM. Presentations were given by Kristen Railey, Emily Clemons, and John Nwagbaraocha.

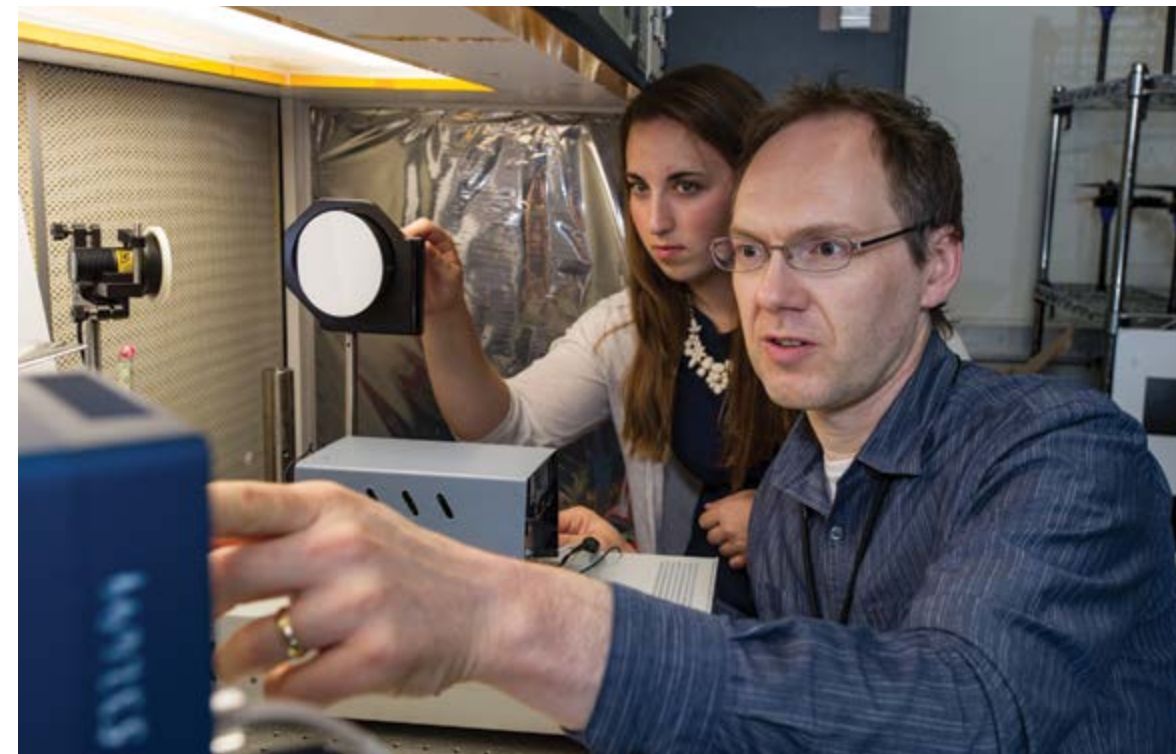


Children visit the Laboratory on Daughters and Sons Days to learn about the different projects researched at Lincoln Laboratory, including robotic hands.

Ceres Connection

More than a decade ago, Lincoln Laboratory partnered with the Society for Science & the Public to promote science education through the Ceres Connection program. This program names minor planets in honor of students in grades 5 through 12 and their teachers. Students and teachers are selected through worldwide science competitions, such as Broadcom MASTERS, the Intel Science Talent Search, and the Intel International Science and Engineering Fair. Since 2003, more than 3500 students and their teachers have been honored. Each year, the Ceres Connection program awards this honor to about 250 students.

250 students are honored each year with a minor planet named after them through the Ceres Connection program



Bridget Sullivan and mentor Mark Woolston align the optical path of a Schlieren airflow imaging system that Sullivan helped design. The system will be used to better understand airflow dynamics around electroaerodynamic thrust surfaces.

AFCEA International

The Lexington Chapter of the Armed Forces Communications and Electronics Association (AFCEA) arranges internship opportunities for graduating high-school seniors interested in science, technology, engineering, or mathematics. Each summer, Lincoln Laboratory selects two applicants to work with experts who mentor the students in real hands-on work in their fields of interest.

In 2016, two Massachusetts graduating high-school seniors worked at the Laboratory under an AFCEA

internship program. Mentored by Mark Woolston, Bridget Sullivan assisted in the Control and Autonomous Systems Engineering Group on an autonomous systems research program called Electroaerodynamic Propulsion. She focused on electronics that ionize the air to generate thrust for unmanned vehicle propulsion. Wesley Olson in the Surveillance Systems Group had AFCEA intern Neha Prasad help conduct modeling and simulation to support developing a new airborne collision avoidance system for unmanned aircraft systems.



"We hope that these lectures are planting the seeds for the next generation of great scientists and engineers."

— Edward Shultz

Aaron Enes, Kwajalein Field Site, taught a lecture on free-space laser communications to seniors at Kwajalein High School.

Kwajalein School Outreach

Laboratory staff members at the Kwajalein Field Site brought a lecture series to 18 seniors at Kwajalein High School located 2100 miles southwest of Hawaii. Volunteers talked about the projects they have worked on at the Laboratory, widening the students' views on careers in science and technology.

"Kwajalein students are isolated from modern culture," said Alexander Divinsky, co-organizer of the series along with Edward Shultz. "Sharing our expertise is a way to bring those experiences back to enlighten and inform the seniors." Shultz added, "Living on a test range, students are surrounded by science projects, but are left out of the excitement." Through nine lectures, almost every staff member on site showed the breadth of exciting topics a scientist can explore.

Aaron Enes presented "Talking to the Moon with Lasers," named after his experience with the Lunar Laser Communication Demonstration program. "I showed how many different types of engineering skills are needed on teams," said Divinsky. He discussed design in technology, using computer graphics as an example. "One student said, 'If I work on video games, I don't have to choose between art and science?' That's the kind of realization we were hoping to see," said Divinsky. Jessica Holland taught students about satellite technology and the role it plays on Kwajalein. "I used several examples, such as network TV and the GPS navigation they use to get to dive sites," said Holland. The organizers felt the lecture series was a great success, and they hope to continue inspiring students.

Local School Science Fairs

Technical staff members from Lincoln Laboratory support Lexington High School and Carlisle Middle School by volunteering as judges for the schools' respective science fairs. Countless other schools are supported by Laboratory employees contributing to their children's school science fairs or career days without deliberately representing Lincoln Laboratory. Their participation supports community outreach and STEM education on a local level.

Massachusetts State Science and Engineering Fair

Lincoln Laboratory has supported the Massachusetts State Science and Engineering Fair (MSSEF) for 16 years, serving as a bronze donor to the event by awarding \$500 scholarships from the John Welch Memorial Fund to the second-place winners in the physics and engineering competitions. This fund, among others, is part of the MIT Lincoln Laboratory Giving Program. Lincoln Laboratory technical staff volunteering as judges for the MSSEF in 2016 included 11 staff members: Eric Austin, David Brown, John Cho, Joshua Dettman, Eli Doris, Christopher Lloyd, Robert Moss, Sean O'Melia, Jean Piou, Brady Tello, and Sivasubramaniam Yegnanarayanan.

Cambridge Science Festival

Lincoln Laboratory volunteers enjoyed interacting with some of the 15,000 attendees of the Cambridge Science Festival, an annual, weeklong, citywide event. Mentors from the Robotics Outreach at Lincoln Laboratory (ROLL) program showcased a competition robot fabricated by high-school students. Spectators were able to guide the robot around a mini obstacle course. ROLL also featured a booth showing how Hexbug Nanos swarm. Beaver Works offered an open house for attendees to tour the innovative workspace and to view the unmanned aerial vehicles built by MIT students at the facility.



Participants at the Cambridge Science Festival enjoy maneuvering robots to do tricks and navigate a path.

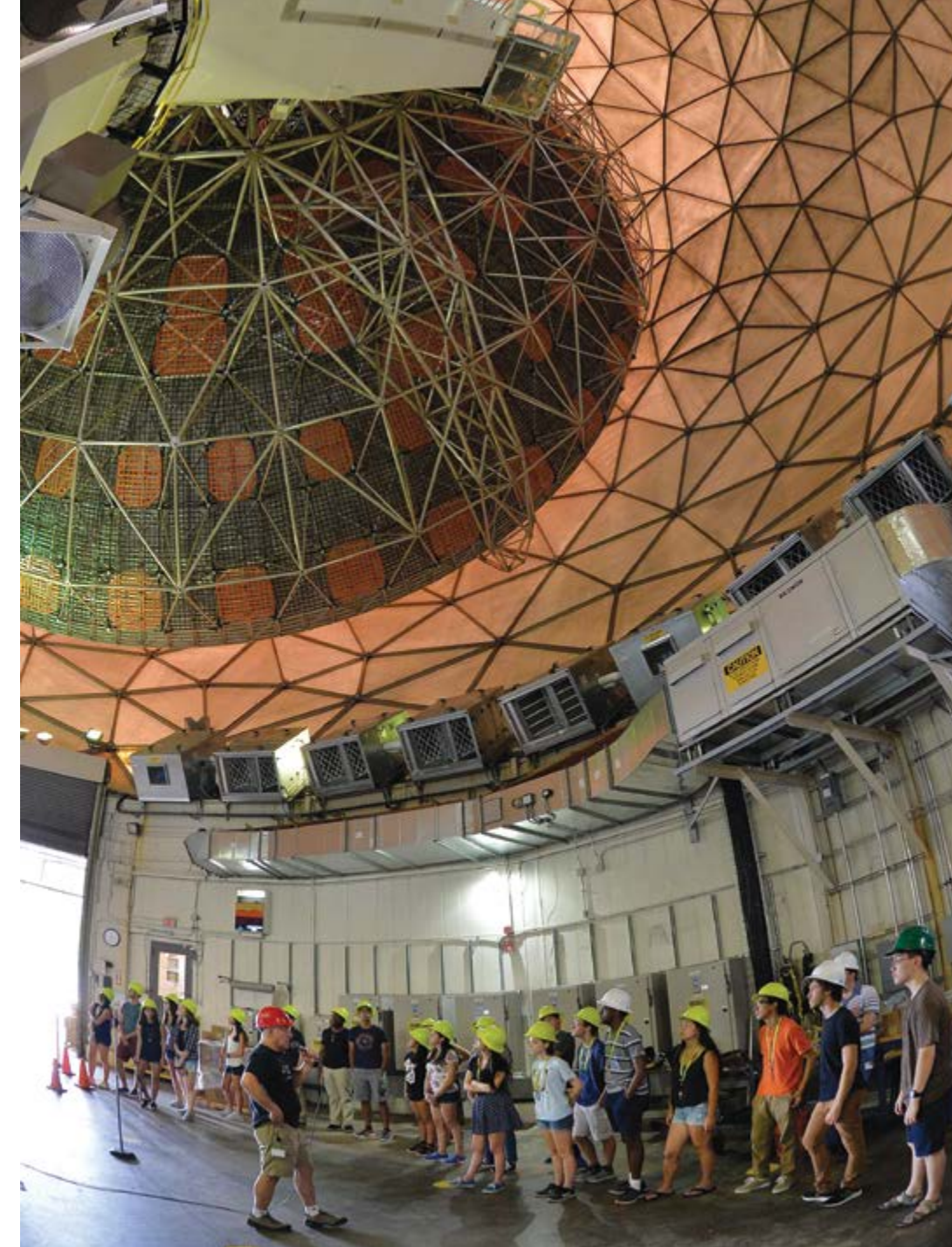


Dana Hall, a school for girls in Wellesley, Massachusetts, toured the Lincoln Laboratory Flight Test Facility during a visit to see the latest in engineering technology.

Tours and Visitors

As part of the Lincoln Laboratory Community Outreach initiative, tours of Laboratory facilities, such as the Microelectronics Laboratory, the Air Traffic Management Laboratory, the Rapid Hardware Integration Facility, RF Systems Test Facility, and Flight Test Facility, are given annually to a number of groups. In 2016, tours were given to

- Governor Charlie Baker
- Congressman Seth Moulton
- Congresswoman Niki Tsongas
- Research Science Institute program students
- U.S. Air Force cadets
- ROTC students
- U.S. Army Test and Evaluation Command
- U.S. Army Soldier Systems Center
- U.S. Military Academy at West Point
- National Reconnaissance Office fellows
- U.S. Association of Former Members of Congress
- Congressional and executive branch staffers
- Dana Hall School



Students from LLRISE program (see page 16) viewed the Haystack Ultrawideband Satellite Imaging Radar from within its radome in Westford, Massachusetts.



Educational Collaborations

Inspired by employee desires to connect with the community and to motivate student interest in science, technology, engineering, and mathematics, our outreach initiatives include

- Technical Staff Programs
- Military Student Programs
- Student Programs
- MIT Student Programs

MIT students enjoy "field testing" in a campus basement during the RACECAR: Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot IAP course led by Laboratory staff, including Michael Boulet and Kenneth Gregson.

Part-Time Graduate Studies Program

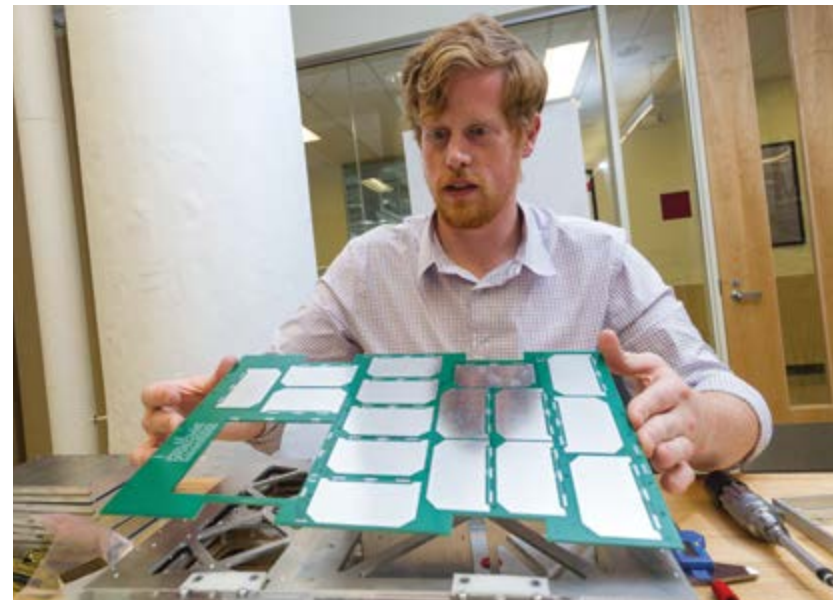
The Part-Time Graduate Studies Program (PGS) enables staff to work full time at the Laboratory while pursuing part-time technical and nontechnical graduate studies via distance learning or at local universities. Of the 16 employees participating in the pilot program, six have graduated from their degree program and completed the PGS program.

Lincoln Scholars Program

The Lincoln Scholars Program funds full-time graduate study at MIT or other Boston-area universities as scholars complete thesis research that pertains to a Laboratory mission. The students work at the Laboratory in between semesters and make substantial technical contributions to the Laboratory. Each scholar is paired with a mentor throughout the duration of the program. In return, scholars work full time at the Laboratory for two years after ending their studies. Currently, 24 staff members are enrolled in the program. There have been almost 200 staff who have pursued full-time technical graduate work through the Lincoln Scholars Program.

“The Lincoln Scholars Program is a strategic investment in enhancing our technical staff, both to benefit their careers and to benefit the Laboratory’s long-term research program,” said James Ward, Lincoln Scholars Committee Chair. “Scholars return with enhanced knowledge and capability for independent research, bringing relevant university research back to the Laboratory, where it is applied to our national security problems.”

“Through the Lincoln Scholars Program I joined my interests in spacecraft and plasma dynamics,” said J.



J. Brent Parham prepares to attach solar panels to Boston University’s first CubeSat. The frame is engraved with the name of each student who worked on the project. When on orbit, the CubeSat will study electrical currents that cause the aurora borealis.

Brent Parham. “The Laboratory’s support has given me the freedom to design a PhD founded on my work here at the Laboratory in satellite aerodynamics and continue building the satellite concept I began during my master’s degree.”

Technical Education Program Onsite Courses

Lincoln Laboratory offers technical education programs designed to help employees expand their knowledge and versatility in unique areas across the Laboratory. A range of technical, programming, and software application courses are taught by Laboratory experts or outside instructors. Technical courses cover topics such as microelectronics and undersea technologies. Certification courses for operating systems, network devices, and programming languages are offered regularly. In the fall of 2016, the Technical Education Committee offered Adaptive Antennas and Phased Arrays, Big Data, Build Anything, Build-a-Radar, Radio Frequency Signals Intelligence Concepts and Applications, and Statistical Learning and Signal Processing.



The instructors for the Big Data course held the course for 13 weeks from January through May. The Big Data course covered a variety of perspectives and technologies within the emerging field of big data.

Technical Seminars

Technical talks motivate and inspire staff while facilitating working relationships. The Technology Office Seminar Series invites nationally known experts to the Laboratory. Each seminar is designed to offer insights on specific technology, provide a forum to develop technology applications, and foster future collaborative efforts. The seminars offered in 2016 covered a variety of leading-edge topics and trends in technology:

- Our Robots, Ourselves: Robotics and the Myths of Autonomy
- Additive Manufacturing of Micro and Nanosystems
- What to Do with a Good Idea

Boston University Program

Core and elective courses from Boston University’s master’s program in computer science are offered onsite at Hanscom Air Force Base. These courses, which have included computer networks, cryptography, and software engineering, can be taken independently, as part of a certificate, or as a master’s degree program through Boston University. Since the program started in 2012, nearly 130 staff members have enrolled in the program.

"I was inspired when I heard of the level of impact and fulfillment that the previous cadets had experienced while participating in the program."

– U.S. Air Force Cadet Daniel Reynolds

Service Academy Research Program

Military interns spent three to five weeks of their summer working at the Laboratory under the Service Academy Research Program. The interns represent each of the United States service academies and—for the first time—the U.S. Army Reserve Officers' Training Corps (ROTC) program. The Laboratory started hosting ROTC interns in 2012 to recognize the importance of involving the warfighter in the technology development process.

Under the mentorship of Laboratory advisors, Richard Younger and Jonathan Frechette, Air Force Academy cadet Casey Evans focused on the microladar program. John Kuconis of the Director's Office stated, "It's important to educate the next generation of military officers about Lincoln Laboratory and its capabilities."

The Service Academy Research Program has grown significantly over the past four years. More than 50 cadets and midshipmen participated in the program this year—the largest group to date.



Military Fellows Program

Each year, Lincoln Laboratory awards fellowships to support the educational pursuits of active-duty military officers from all of the Service branches. This partnership acquaints military officers with the process of developing technologies that directly impact national security while providing the Laboratory with constructive insights of officers.

Officers enrolled in Senior Service School work in research programs at the Laboratory and take national security management courses at MIT campus. Senior officers participating in the Army's Training with Industry program are assigned full time to a Laboratory technical group to engage in hands-on research. Military liaisons are employed at the Laboratory and Fellows pursuing graduate degrees work on Laboratory-sponsored programs that complement their thesis research.

Military University Electives

Laboratory staff teach elective courses to the level officers attending the Naval War College in Newport, Rhode Island. The Ballistic Missile Defense course was led by Claude Noiseux, with lectures drawn from the Air, Missile, and Maritime Defense Technology Division. This course explores the critical technologies, capabilities, operational concepts, and policies that influence how ballistic missile defense affects the military capabilities of the United States.

Space Technology and Policy, taught by Jonathan Birge and supported by Robert Guerriero, explores



Colonel Stephen Gabavics works with Christina Zook to use a next-generation DNA sequencing system.

It is mutually beneficial to educate active-duty officers about Lincoln Laboratory's capabilities and enlighten Lincoln Laboratory staff to the opinions and mindsets of military officers.

critical space technologies, capabilities, and policies that shape how the United States uses space for military and government purposes.

The Cyber Security course, taught by Reed Porada and Jeffrey Gottschalk, provides an overview of cyber operations and cyber threats. It explains how to defend critical systems. This course inspired development of a similar course for the Air Force's Logistics Management Center at Hanscom Air Force Base.

West Point Collaboration

Lincoln Laboratory partners with the U.S. Military Academy at West Point to offer real-world experience to cadets.

Laboratory staff Kent Patterson and Bruce Bray worked with a West Point faculty advisor to lead several cadets in developing a novel radar calibration satellite for important radar assets. The measurements made in the Laboratory's radio-frequency anechoic chamber were analyzed to evaluate prototype spheres and trade studies. This work was conducted as part of an elective course on essential features of independent research in physics.

Through a partnership with West Point, cadets visit the Laboratory for technology demonstrations. Byron Stanley, who organizes the cadets' visit to the Laboratory each year, explained why the collaboration is important: "Building and maintaining connections



The Laboratory hosts West Point cadets for a day of technology demonstrations.

with the cadets and officers will help us better serve the U.S. military in the future."



Peterson Air Force Base Collaboration

New in 2016, this program is a partnership with the 21st Operations Group at Peterson Air Force Base that leverages the Laboratory's experience and education in an Air Force internship. The intern selected by the Operations Group provides the Laboratory with operational insights, methodologies, and tactics involved in a launch mission. In turn, he learns about Laboratory-developed technologies that could be advantageous to military operations. Plans for the future of this collaborative internship include 10-12 interns annually.

First Lieutenant Theodore Kruczek is the first space operator to participate in the collaborative internship between Peterson Air Force Base and Lincoln Laboratory.

Internships for University Students

Lincoln Laboratory offers several opportunities for university students to engage in meaningful internships in technical groups. Under some programs, students fulfill an academic requirement, while other programs support thesis work at specific universities or offer paid internship positions. The students broaden their education through the experience of tackling real-world engineering problems, and their internships can evolve into post-graduation employment.

Summer Research Program

In 2016, 215 undergraduate graduate students from top universities across the country participated in Lincoln Laboratory's Summer Research Program, which offers students internships in technical groups. The students gained hands-on experience in a foremost research environment while contributing to projects that complement their courses of study.

Each summer, cadets from the military academies accept internship positions at the Laboratory. They acquire engineering experience and insight into the ways advanced technology can solve problems faced by the military. In summer 2016, 57 cadets worked in technical groups across the Laboratory.

University Cooperative Education Students

Technical groups at Lincoln Laboratory employ students from area colleges under cooperative education arrangements. The students work full time with mentors during the summer or work/study semesters and part time during academic terms. Highly qualified cooperative education students are significant contributors to technical project teams. In 2016, 78 co-ops worked in divisions and departments at the Laboratory.

Worcester Polytechnic Institute Major Qualifying Project Program

In summer 2016, six students worked as Laboratory interns under the Worcester Polytechnic Institute's Major Qualifying Project Program, which requires students to complete an undergraduate project equivalent to a senior thesis. Under this program, students participate in Laboratory programs that are applicable to their senior projects, learning to apply their skills and knowledge to problems typical of those encountered in industry.



88 schools were represented by undergraduate and graduate students who participated in Lincoln Laboratory's Summer Research Program

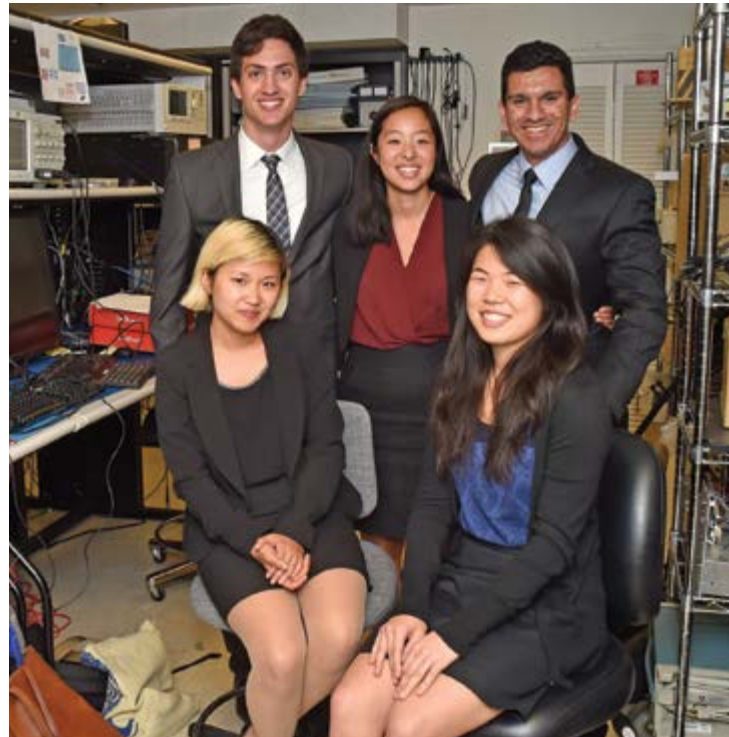
Harvey Mudd Clinic Program

The Harvey Mudd College (HMC) Clinic Program engages students in solving real-world, technical problems for corporate clients and national research laboratories. Five HMC students worked for a year under the guidance of a faculty advisor and a Laboratory mentor. The objective was to have the student produce useful results on an open-ended, authentic project.

Working with staff from the Advanced Concepts and Technologies Group, the HMC students focused on establishing timing synchronization for systems separated in space that require precise clock alignment. Laboratory staff mentored the students as they produced a software model to compare synchronization architectures, algorithms, and hardware in terms of synchronization accuracy. The students were tasked with selecting a time synchronization system to implement that would be measured by a test bed and would provide results to compare with their model.

The HMC team presented both a software model and hardware test bed that can be used to test the various timing synchronization methods. "I'm still in awe that this was done by undergraduate juniors and seniors," said Stephen Uftring at the conclusion of the students' briefing.

"The Clinic Program was hugely impactful on my education," said Sarah Lichtman, reflecting on her own experience as an HMC student. Lichtman, along with fellow alumni Masato Kocerber and Bryan Teague, organized the Laboratory-funded clinic.



Harvey Mudd College students Max Waugaman, Jessica Iwamoto, Jonathan Perez, Joanna Ho, and Bonny Chen presented a software model that can be used to test methods for timing synchronization of wireless systems.

"I valued the opportunity to visit the Laboratory and present our project. It was great to share our work with people who may actually be using it in the future."

— Jessica Iwamoto, who participated in the 2016 Clinic Program

Intern Innovative Idea Challenge (I³C)

To provide summer students an opportunity to flex their technical skills beyond assigned work, Lincoln Laboratory initiated a program that encourages interns to envision a new technique or device to solve a current problem. Eighteen teams undertook this Intern Innovative Idea Challenge (I³C), devoting out-of-work hours to developing their concepts and working with Laboratory mentors. This investment in creativity and imagination elicited intriguing ideas: a hologram projection technology, an app that evaluates cognitive fatigue, and an app that displays parking space availability.

Raoul Ouedraogo first proposed the idea of a tournament for summer interns. "The I³ Challenge gives interns the opportunity to come up with their own concepts while leveraging the vast knowledge available at the Laboratory," he said.

After an initial proposal and online voting phase, the top 12 teams had three minutes to sell their idea to a judging panel. Two weeks later, employees saw

presentations by the top three teams and selected the winner: Blast Block, a collar that protects soldiers from traumatic brain injury associated with exposure to an explosive blast.

The design competition facilitated collaboration between interns and mentors. "We feel we have become more connected with the Laboratory community," said Lisa Pinals, a Blast Block team member. James Wall, another intern participating the challenge, said that the competition made him feel more prepared to work in a technical field, from writing an idea proposal to collaborating with a diverse team.

The organizing committee has already planned to expand the competition. Some of the teams from this year will receive funding next summer to build prototypes of their ideas at the Laboratory. The competition succeeded in offering interns a challenging, engaging summer, and it may attract future creative young engineers to the Laboratory's Summer Research Program.



Interns on the A-SUIT team proposed their idea for the Advanced Self-Sustaining Uniform with Integrated Telecommunications and won second place in the I³ Challenge.

National GEM Consortium

In 2016, the Laboratory hosted 20 students affiliated with The National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM). GEM is a network of leading corporations, laboratories, and research institutions that enables qualified students from underrepresented communities to pursue graduate education in applied science and engineering.

GEM fellows work as summer interns while completing their studies and receive financial support that is often the deciding factor in pursuing graduate education. The internship process also allows companies to access and recruit talented employees that they may not find otherwise. “By reaching out to underrepresented top research students who may eventually join us full time, we are creating an environment where other underrepresented students will see a path for success at Lincoln Laboratory,” said William Kindred, Diversity and Inclusion Program Manager. GEM students work alongside Laboratory staff and bring their own fresh perspectives to the Laboratory.

GEM fellowships at the Laboratory have offered numerous returns, from networking opportunities to high-level research experience. GEM fellow Celine Irvine said she appreciated how interns are given the opportunity to work on big prototyping projects with a lot of risk at the Laboratory. Her summer research involved machine learning techniques. “Participating in GEM has allowed me to extend the depth of my technical knowledge of machine learning,” said Irvine. “Now that I have that experience, I can apply it to all the areas of my thesis research, where I was unable to see its applicability before.”



Lincoln Laboratory's 2016 GEM interns.

“The GEM program has been a major factor for our diversity and inclusion improvements at Lincoln Laboratory.”

— Eric Evans

Marshallese Internship Program

Two Marshall Islands citizens completed the 2016 Republic of Marshall Islands (RMI) Intern Training Program, a joint effort established by Lincoln Laboratory and the Reagan Test Site Headquarters, located on U.S. Army Garrison-Kwajalein Atoll (USAG-KA). The 10-week summer program provides an opportunity for motivated RMI students to gain valuable on-the-job training in computer system administration and networking. The RMI internship program began in 2008 and was designed to complement college education for RMI students.



Nealson Neptali, front left, and Suevelyn Johannes, front middle, pictured with Laboratory and RMI staff, as they complete the 2016 RMI Training Program in August.

Chosen from among 60 applicants in 2016, the two interns were both graduates of the College of the Marshall Islands and committed to work within their community upon completion of the program. Each week, the students tackled a new computer-related topic, beginning with the basics. Ranny Ranis served as the program instructor, teaching the interns how to take apart and reassemble computers; install operating systems, virtual machines, and servers; and build their own networks. Since the program's inception, 19 local students have been mentored, all of whom have used the internship experience to direct them towards a higher education opportunity in the IT field or to gain employment in the industry—investing in the future of the Marshall Islands.

SPOTLIGHT:

Teaching Radar at the University of Puerto Rico



Photo courtesy of Prof. Rafael Rodriguez

Above, UPRM students show off the small “coffee-can” systems they built and demonstrated. At left, Juan Brunet Navarro and Nestor Lopez organized an information booth at UPRM while teaching the LLRISE workshop.

The Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE) program has now reached as far as the coastal campus of the University of Puerto Rico at Mayagüez (UPRM). A group of undergraduate students at UPRM were the first at their school to participate in the LLRISE workshop. Adapted from the full two-week course, the three-day workshop taught students how to build and test small radar systems.

Nestor Lopez and Juan Brunet Navarro teamed up to bring LLRISE to UPRM. The decision to bring LLRISE to UPRM was easy—both Lopez and Brunet earned their undergraduate degrees at UPRM and have kept close ties to the faculty. “As a UPRM graduate, I thought this workshop would be of interest to students there, since they have a strong Applied Electromagnetics program,” said Lopez.



A UPRM student begins assembling his radar system after soldering the circuit board.

More than 20 students spent the weekend immersed in the curriculum. The students learned about radar signal processing, the main functions of Doppler, target ranging and detection, and how to build the system. Students worked in small groups to assemble their radar systems by populating and soldering a circuit board. The end result was seven synthetic-aperture imaging systems built with tin cans.

UPRM has committed to organizing demonstrations of the system across high schools in Puerto Rico, and plans to give future workshops on campus and support an LLRISE summer event. “These efforts are important,” Lopez said, “because they give people the opportunity to figure out what they are capable of learning and accomplishing.”



Students serving as research assistants at Lincoln Laboratory gain valuable hands-on experience while offering a fresh perspective to technical staff members.

MIT VI-A Master of Engineering Thesis Program

Students in MIT's VI-A Master of Engineering Thesis Program spend two summers as paid interns at Lincoln Laboratory, contributing to projects related to their courses of study. Then, the students work as research assistants while developing their Master's of Engineering theses under the supervision of both Laboratory engineers and MIT faculty. In summer 2016, two VI-A students participated in the program, gaining experience in testing, design, development, research, and programming.

MIT Research Assistantships

Lincoln Laboratory employs research assistants from MIT. Working with engineers and scientists, these students contribute to sponsored programs while investigating the questions that evolve into their doctoral theses. The facilities, the research thrusts, and the reputations of staff members are prime inducements behind the graduate students' decision to spend three to five years as research assistants in a technical group.

MIT Undergraduate Research Opportunities and Practice Opportunities Programs

Lincoln Laboratory is one of the research sites that partner with MIT's Undergraduate Research Opportunities Program (UROP) and Undergraduate Practice Opportunities Program (UPOP). Students undertaking a UROP or UPOP assignment may choose to do a research project for course credit or accept a paid internship. Most participants at the Laboratory are interns working under the direct supervision of technical staff members. The students engage in every aspect of onsite research—developing research proposals, performing experiments, analyzing data, and presenting research results. In summer 2016, eight undergraduates were hired as UROP interns and four as UPOP interns.

8 undergraduates were hired as UROP interns in summer 2016

4 undergraduates were hired as UPOP interns in summer 2016



Undergraduate students can make meaningful contributions to any of the Laboratory's research areas.



David Caplan, far right, teaches IAP students how to build a laser audio link in the Introduction to Lasercom IAP course.

MIT Independent Activities Period

During MIT's Independent Activities Period (IAP), which is a four-week term between semesters, Lincoln Laboratory technical staff lead activities ranging from academic seminars to hands-on engineering projects. During the 2016 intercession, David Sun Kong taught a for-credit course offered by the MIT Department of Biological Engineering: Fluidics for Synthetic Biology: Prototyping Microbial Communities.

Lincoln Laboratory staff members organized the following academic classes and hands-on engineering projects for the 2016 IAP:

- Build a Small Radar System
- Designing Systems for Humanitarian Assistance and Disaster Relief
- Developing Systems for Humanitarian Assistance and Disaster Relief
- Hands-on Holography
- Introduction to Lasercom
- RACECAR: Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot
- Software Radio
- Software Reverse Engineering

MIT Lincoln Laboratory Beaver Works

Beaver Works, an initiative between Lincoln Laboratory and the MIT School of Engineering, provides students with space and mentors for project-based learning opportunities. MIT faculty and Lincoln Laboratory staff work together at Beaver Works to strengthen research and educational partnerships.

The main Beaver Works collaboration is the capstone course, an MIT engineering class which features a project to develop technology that solves a real-world problem. During two semesters, the students design a system that addresses a need and then fabricate a prototype system. Lincoln Laboratory researchers serve as advisors for these capstones and provide expertise in engineering design and fabrication of proof-of-concept models built by the students.



The Beaver Works space is also used for various MIT intercession courses, as well as some Laboratory educational outreach programs, such as LLRISE, CyberPatriot, LLCipher, and of course, the Beaver Works Summer Institute.



Community Giving

Laboratory employees walk, run, bike, bake, and give to support local and national causes throughout the year. The Laboratory community is happy to engage in

- Helping Those In Need
- Helping Those Who Help Others
- Feeding Body and Soul

Sarah Lewis asked for pet supply donations to assist with displaced pets after serious flooding in Louisiana. In four days, the Laboratory gathered 25 crates, 20 bags of dog food, 100 collars and leashes, 200 cans of cat food, 150 bags of treats, and countless other products.

Grab a C.A.B.

Carrie Perry saw a problem among patients undergoing chemotherapy; they were bored while receiving treatment. Perry created Project Grab a Chemo Activity Bag (or C.A.B.) to solve the problem. With generous help from Laboratory donations, Perry creates gift bags that are filled with all kinds of games, books, and inspirational items. Each bag is different so that patients can each choose one that fits their preferences, whether they prefer coloring, crosswords, puzzles, stickers, or comfort items like pencils, hand warmers, hand sanitizer, or sugar-free candies. Perry, who has collected thousands of items and filled hundreds of bags, said, "The Laboratory community has been so very generous in donating to this project. It warms my heart!" Next year, this project will expand to include chemotherapy activity bags for children.



Activity bags for chemotherapy patients have been "a big hit" in medical centers in the greater Boston area.

Coats for Kids

The Laboratory donates approximately 500 gently used coats annually to Anton's Cleaners for their Coats for Kids program, which distributes much needed cold-weather items to needy families in the greater Boston area.

2016 marked the eighth year of the Laboratory's participation in the Coats for Kids donation program.



Cradles to Crayons

In the spring, the Laboratory's Hispanic/Latino Network held a donation drive for supplies, such as books, school supplies, toys, clothes, and shoes, to help low-income and homeless children in Massachusetts. More than 200 collected supplies were given to Cradles to Crayons, an organization that provides needy children up to age 12 with the essential items they need to thrive at home, school, and play.

Giving Tree

For 10 years, Paula Mason has chaired this giving event at Lincoln Laboratory, which fulfills specific gift requests from a local person in need. Each year, Mason works with Somebody Cares to deliver multiple bags of wrapped gifts to thankful recipients.



Holiday Support

In 2015, the Laboratory's Colorado Springs Field Site started a holiday tradition of helping one local family by voluntarily and anonymously supplying all their gifts. Without help from the office, this needy family would have nothing under their Christmas tree. The family (a U.S. Air Force Staff Sergeant, his wife, and two daughters, aged 3 and 6) had fallen on hard times with many financial setbacks. The office collected clothing, jackets, pajamas, books, art supplies, bikes, dolls, food items for a holiday dinner, and stocking stuffers for this very appreciative family. Gifts for the parents were also collected and included movie tickets, a restaurant card, gift cards, and bath products. Jo Wilson, who coordinates the annual effort said, "The family is so grateful for what we do, it makes the effort worthwhile. We receive a beautiful, heartfelt thank-you letter after the holidays each year. We feel privileged to give something back to a soldier who supports our country."



A full array of presents were collected by the Laboratory's Colorado Springs Field Site and delivered to a family in need in time for the holidays.

Toys for Tots

Lincoln Laboratory has served as a drop-off point for the U.S. Marines' Toys for Tots holiday toy drive for more than 20 years. Lincoln Laboratory employees generously provide more than 400 toys annually to local children.



From left to right, the people representing Lincoln Laboratory in the Ride to End Alzheimer's were: Richard Jensen, Sarah Jensen, Farzana Khatri, John Kaufmann, Jade Wang, Steve Bedrosian, Bryan Babcock, Bruce Bray, John Murphy, David Caplan, and Jay Caplan.

Ride to End Alzheimer's

The Lincoln Laboratory team raised more than \$10,000 and ranked fourth in fundraising among more than 90 teams that did the Ride to End Alzheimer's in Portsmouth, New Hampshire.

TeamWalk for CancerCare

The Lincoln Laboratory team participating in TeamWalk for CancerCare has met or exceeded their fundraising goals every year. In 2016, the eight-member team raised \$4500 to better the lives of those being treated for cancer at Lowell General Hospital.

Lions Club Eyeglasses Donation

With the help of Santo Lucente, Lincoln Laboratory began collecting eyeglasses for the Lions Club in November 2015. In one year, 500 pairs were collected and delivered to the Lions Club, which repairs eyeglasses and sends them to Honduras, Rwanda, Uganda, and El Salvador. If you know of a mission that could use donated eyeglasses, please contact Santo Lucente for the assistance of the Lions Club.



The Laboratory community joins in the fight to end Alzheimer's by observing a "Purple for a Purpose" day at the Laboratory.

Walk to End Alzheimer's

Since its first walk in 2009, Lincoln Laboratory's Alzheimer Support Community has raised \$225,000 and has consistently ranked among the top five teams in the region during the Greater Boston Walk to End Alzheimer's. In 2016, 46 walkers raised \$44,832 through bake sales and other clever fundraising to help support research. Each year, a generous "mystery matcher" meets donations dollar for dollar during the last two weeks of fundraising.



The Laboratory's Heart Walk Outreach team hosts a "Wear Red" day in February to raise awareness of heart disease.

Heart Walk

The Lincoln Laboratory Heart Walk team of 10 members raised \$5000 to help promote physical activity as part of a heart-healthy lifestyle, and raise awareness of prevention and treatment of cardiovascular disease and stroke. The Laboratory team has raised more than \$23,000 in their five years of support of the Heart Walk in Boston.

Pan-Mass Challenge

The Lincoln Laboratory Pan-Mass Challenge team biked 190 miles to raise more than \$20,110 for cancer research and honor cancer survivors. The four-member team has participated in the Pan-Mass Challenge for a total of 16 years.

Claddagh Fund

In February, Elizabeth Salesky hosted a bake sale for the Claddagh Fund, which raises funds and awareness for underfunded organizations in our communities, focusing on children's and veterans' organizations and recovery programs.

Autumn Escape Bike Trek

Over three days in September, the Lincoln Laboratory team rode 160 miles from Plymouth to Provincetown, Massachusetts, to support the American Lung Association. The team raised \$4000 and consisted of five riders and two volunteers.



Members of the Mechanix team pause after their three-day Cape Cod ride for charity.

\$90,500

was raised by Laboratory employees to support their favorite causes and charities in 2016



80 care packages for U.S. troops were packed by Laboratory staff this year

Support Our Troops

The Lincoln Laboratory Veterans Network and the Recent College Graduates group united to send holiday care packages to U.S. troops in Afghanistan and Iraq. This effort brightens the days of those fighting for the nation's safety and gives them a sign of how much they are appreciated.

In November, nearly 100 pounds of Halloween candy was sent to the troops. Michelle Colburn and Debbie Shaw shared their motivation to help send parcels of happiness abroad: "We understand what it is like to be deployed and have someone you care about be deployed. We know how important it is to receive a thoughtful care package. This pick-me-up often seems to come when a soldier really needs it."

The Hispanic/Latino Network also packed boxes to send specifically to Hispanic or Latino soldiers. Each package contained traditional Hispanic treats and Spanish playing cards.

Stairs for Our Troops

Lincoln Laboratory led a team at Stairs for Our Troops, a fitness event that funds Homes for Our Troops, a program that builds specially adapted homes for injured veterans. To honor the service and sacrifice of many veterans, Stairs for Our Troops participants walk, jog, run, cheer, climb, and hold American flags while climbing the stadium stairs at Harvard University in Cambridge, Massachusetts. The \$1175 raised for Homes for Our Troops by Steven Smith and his team will be used to build specially-adapted homes in the local area for disabled veterans of the Afghan and Iraq wars. This year, the homes will be for Army Specialist Sean Pesce and Marine Corporal Roger Rua.



SPOTLIGHT: Jesse Mills, Racing to the Summit

Jesse Mills felt a calling to honor the victims and the spirit of the Boston Marathon in the aftermath of the attacks. He had no running experience, but felt determined to run the Boston Marathon. He was accepted to the Dana-Farber Marathon Challenge team without any running experience. "Dana-Farber was something I believed in," he said. His mother, Marlene, passed away from lung cancer when he was 11 years old, and she left behind a legacy of community service.

To begin training, Mills explored routes through central Massachusetts and soon developed his own course: a challenging half-marathon distance that ends on the summit of Wachusett Mountain. "I knew I could handle Heartbreak Hill if I could do Mile Hill Road," Mills recalled with a smile, referring to the road that motorists take up to the summit.

Climbing the summit, Mills envisioned an event to give back to the community. With the support of co-workers and family members, Mills formed the Marlene A. Mills Foundation, through which they would establish the 5K and half-marathon race to continue his mother's example of community betterment. Mills said, "It really makes me proud to work here at a place where supporting charitable causes outside of work is important."



Above, participants line up for the first Race to the Summit. Left to right, Dinara Doyle, Jeremy Coombs, John Kruskowski, Jennifer Falciglia, Jesse Mills, Brandon Dilworth, Matt Lape, David Stott, Mark Silver, and Carl Hart. Below, Jesse Mills.

The inaugural Race to the Summit in 2016 raised funds for the Dana-Farber Cancer Institute, Martin Richard Foundation, and the Marlene Mills Memorial Scholarship. Mills looks forward to seeing what the Marlene A. Mills Foundation's Race to the Summit will accomplish and where it will take him next. "If I can raise money for Dana-Farber to help a family avoid a sudden and traumatic loss, or bring something unexpected and positive out the marathon bombing," said Mills, "I'm going to do it."



157 pounds of food were collected and delivered to the Merrimack Valley Food Bank

Food Drives

The Lincoln Laboratory Hispanic/Latino Network (HLN) sponsored a food drive to coincide with the peak of the summer season. “The purpose of our ‘No Hunger Summer’ food drive was to help offset the increased demand on the food bank due to children who rely on free school lunches during the school year,” said Karen Gettings. More than 157 pounds of food were collected and delivered to the Merrimack Valley Food Bank warehouse in Lowell. “This is the second year that HLN sponsored a food drive for the Merrimack Valley Food Bank, and we are very appreciative to the MIT Lincoln Laboratory community for their continued support,” said Gettings.

Lincoln Laboratory’s Out Professional Employee Network (OPEN) group volunteered at the Arlington Food Pantry to help their local community. OPEN also supports The Trevor Project, an organization that provides lifesaving and life-affirming services to LGBTQ (lesbian, gay, bisexual, transgender, and queer) youth.



Many of the donated food items were consistent with children’s summertime needs, such as cereal, peanut butter, pasta, beans and rice, and canned fruit.



Marshallese Handicrafts Sale

As part of Lincoln Laboratory’s Marshallese Outreach effort, the sales of Micronesian handicrafts are offered each year. The handicrafts offered for sale at the Laboratory are purchased through the Micronesian Handicraft Shop on Kwajalein Island. Our Marshallese Outreach team sells items crafted by islanders and distributes the profits to educational grants for schools throughout Micronesia.

The needs of the island schools are great. Frequently, the schools do not have textbooks, chalkboards, or even desks. Some schools do not even have safe drinking water for the students. On Kwajalein’s neighboring island of Ebeye, there are 7000 children ages 6 to 18, but the schools only have capacity for



Items for sale include wooden sharks with real shark teeth, intricately woven baskets, bowls, and fans, and carvings of turtles or fish.

3500 students. Half of the schools are public, with 50 students per class; the remaining schools are private, many of which could not function without contributions from organizations like Lincoln Laboratory.

Used Clothing Drive for Epilepsy Foundation New England

In August and September, Richard Frederickson chaired a used-clothing drive to benefit Epilepsy Foundation New England. Over several months, used clothing and linens were donated. All money raised through the Epilepsy Foundation New England Donation Center goes directly to providing information, support, and services to the 200,000 people living with epilepsy and their families in New England.



Laboratory donations totaled more than 300 pounds of items for Epilepsy Foundation New England.

Other Community Outreach Events

The Laboratory encourages its staff to support a variety of causes on their own and to join colleagues in their charitable efforts. In the past year, Lincoln Laboratory staff members have supported several charities or events:

- St. Baldrick's Foundation
- American Red Cross
- AVON 39 The Walk to End Breast Cancer
- AFCEA Golf Tournament
- Bedford Special Education Parents Advisory Council 5K and Fun Run
- Emily Letourneau Memorial Volleyball Tournament
- American Diabetes Association's Tour de Cure



Laboratory staff supporting certain charities often host bake sales as a method to raise funds, gain participants for events, and increase awareness of diseases and/or charities.

About Our Volunteers

The Laboratory thanks those who have offered their time, talents, and support this past year. We are proud to say that volunteerism among Laboratory employees grows each year. The Lincoln Laboratory Community Outreach Committee will continue to offer many opportunities for employees to participate in educational outreach and community giving events. The involvement of the entire Lincoln Laboratory community is encouraged.

If you engage in outreach or are interested in starting a new outreach program, please contact the Communications and Community Outreach Office. We can help you see where volunteering can take you!



Lincoln Laboratory's outreach activities are funded in part through the endowments listed on the plaque above, hanging in our lobby. Donations to these funds provide ongoing support to educational programs.

About Our Programs

MIT Lincoln Laboratory Giving supports activities directed by the Laboratory's Communications and Community Outreach Office, funding for special STEM events and workshops offered at the Laboratory, and grants to participants in programs run by MIT.

If you would like to support STEM outreach, visit the Give to MIT Lincoln Laboratory website, found on the Support STEM Programs link under the Outreach tab on the Laboratory's external homepage. You can contribute to any of the following funds:

- Roger W. Sudbury Memorial Fund for community outreach
- The John Welch Memorial Fund for educational outreach

- The Barbara P. James Fund for general support
- The Lincoln Laboratory Director's Fund for STEM education
- The Carl E. Nielsen Jr. Family Fund for MIT graduate students in electrical engineering and computer science

These endowed and expendable funds enable the Laboratory to support programs that complement its mission of developing technology in support of national security by helping ensure that the U.S. workforce remains preeminent in technology. Contributions in any form sustain efforts to motivate and prepare students to become the next generation of scientists and engineers.



244 Wood Street ■ Lexington, Massachusetts 02421-6426



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Communications and Community Outreach Office

- 781-981-4204
- www.ll.mit.edu
- ccoo@ll.mit.edu

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