LINCOLN LABORATORY COMMUNITY OUTREACH

MIT LINCOLN LABORATORY

2017 COMMUNITY INVOLVEMENT REPORT

Lincoln Laboratory employees gathered outside on August 21 to witness a rare solar eclipse.

Contents

In a video made by GEM students in which they describe their internships, Eric Evans pauses to take a selfie with the students and MIT's mascot, Tim the Beaver.

A Message

From the Director

Community outreach and education programs are an important component 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 and science. There are many ways to participate.

The Laboratory's educational outreach provides in-classroom presentations and Science on Saturday demonstrations to regional K–12 schools. We sponsor U.S. FIRST robotics programs and offer opportunities for mentor-based internships for college and graduate students preparing for science and technology careers. There are also opportunities to be a part of the Laboratory's volunteer base by serving as judges and advisors for local and regional science fairs and science-based activities.

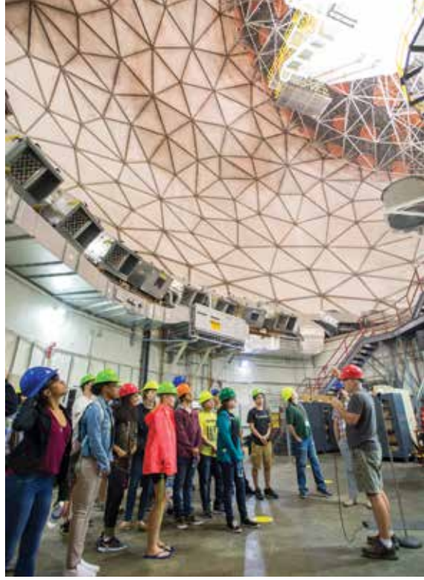
The Laboratory is committed to giving back to the community by sponsoring fund-raising and community service events in support of the Alzheimer's Association, Wounded Warriors, and other charitable organizations. The involvement of the entire Lincoln Laboratory community is encouraged, and suggestions on how we might improve our outreach activities are welcome.

Eric D. Evans
Director

01 / EDUCATIONAL OUTREACH

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

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



(Left) Students practice soldering as part of assembling their radar.
(Below) The 18 students accepted for LLRISE were assisted by 4 teaching assistants, 7 lecturers, and 7 student assistants.

Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE)

Lincoln Laboratory offers high school students a summer engineering workshop that provides an understanding of radar systems and a chance to do hands-on engineering. The seniors from across the United States are challenged in this two-week project-based enrichment program to apply knowledge from college-level lectures and solve problems in innovative ways as they build their own radar systems. The students attend classes on physics, electromagnetics, Doppler radar, pulse compression, signal processing, circuitry, and antennas. In addition to learning how to use a 3D printer, the students tour Laboratory facilities, hear career exploration presentations, and learn about the college application process. After the self-built radars are completed, the students stage experiments and present a technology demonstration. /

> “LLRISE opened my eyes to engineering. This program taught me not only how to build a radar but also how to be a college student.”
>
> —LLRISE PARTICIPANT

Crystal Jackson (far left) assists students in conducting their radar experiments. The students learn how to detect targets with radars.

Local LLRISE – One-Day Workshop

Lincoln Laboratory offered a one-day radar workshop based on the two-week LLRISE program. The workshop was offered to eighth-to twelfth-graders and was held at the Beaver Works Center in Cambridge, Massachusetts.

In the past two years, more than 400 students applied for the 18 spots available in the two-week summer program. Considering that level of demand, Chiamaka Agbasi-Porter, coordinator of the outreach program, offered an additional short course for local students. “This one-day workshop was a great way to provide a sampling of the full program,” Agbasi-Porter said.

The real challenge was how to convert two weeks of lectures into an eight-hour course. “The main reason the program could be altered into a one-day workshop,” said Agbasi-Porter, “was the hardware. Students in the two-week program build their own working small radar system. Limiting the program to one day did not allow for such a heavy time investment, so we removed the hardware build portion and gave the students prebuilt radars for their experiments.” Students used an oscilloscope to calibrate their radar, viewed a signal in waveform, created Doppler spectrograms, and changed variables to affect the spectrograms. Agbasi-Porter said, “This program was very successful in the form of a one-day workshop. I’m glad we could offer it to local students from underrepresented areas. This kind of experience can lead to more opportunities.” /

Spotlight:

High school teachers learn about radar systems

For the first time since LLRISE's inception, two high school physics teachers participated in the first week of the program. The teachers, both of whom were from Michigan, took part in all aspects of the curriculum along with the students; they attended lectures on the basics of radar systems, assembled radar systems that could perform range-Doppler imaging, learned about computer-aided design and 3D printing, and went on tours of Lincoln Laboratory's facilities.

The teachers were interested in how the radar workshops could be incorporated into their own physics classes. They were particularly excited about integrating the radar lessons into labs and projects and supplementing conceptual lectures with hands-on building activities.

"It's great to not just talk about the Doppler effect, but to have examples of how it affects the real world," said Scott Brunner, who has been teaching physics for 10 years in Grosse Pointe Woods, Michigan. He plans to implement lessons about the construction and use of radar into the electricity and magnetism class at his school. With so much material to cover in the school year, he said, the radar lessons will likely be part of the after-school curriculum.

The teachers said one of the things that made their learning experience at LLRISE so productive was the Lincoln Laboratory staff instructors. "I've been impressed by the instructors – they don't dumb anything down for the students," said Gary Campbell, a physics teacher of 20 years in Rochester, Michigan.

The students certainly were able to keep up with the material and asked advanced questions, said Brunner. As they spent the week together, the teachers and students developed a friendly relationship based on mutual learning. They ate lunch together every day, and the teachers helped students through difficult problems. In return, the teachers said they often gained insight into alternative ways of learning from the students.

"It was great having teachers in the classroom," said Chiamaka Agbasi-Porter, one of the developers of LLRISE. "This year, there was a different dynamic in the classroom. It was great to see the teachers enthusiastically building their radar and thinking about how to incorporate the LLRISE curriculum into their schools."

Both Campbell and Brunner were eager to bring back new material to their classrooms, and they said they enjoyed being the first teachers to collaborate with LLRISE and are looking forward to providing feedback about their experience to help the program next year.

High school physics teachers Gary Campbell (left) and Scott Brunner (above) spent time at Lincoln Laboratory to learn how to build small radar systems.

Robotics Outreach

Robotics Outreach at Lincoln Laboratory (ROLL) is an educational outreach program designed to stimulate youth interest in science and technology through hands-on activities. Each year, ROLL provides demonstrations at several events, including the Cambridge Science Festival, a robotics-themed Science on Saturday show, and a variety of community STEM programs in the area. Members of ROLL mentor robotics teams participating in regional and national competitions. Staff volunteers Loretta Bessette, Jacob Huang, and Nancy List guide many other volunteers to help children learn how to program robots to compete in challenges specified by the FIRST (For Inspiration and Recognition of Science and Technology) organization.

The FIRST robotics competitions are divided into groups: K–4, grades 4–8, and grades 7–12, and grades 9–12. The younger age groups research engineering challenges, learn teamwork, and become familiar with motorized LEGO elements. Teams of middle and high school students are challenged to design, build, and program a robot to play a floor game and complete an obstacle course of the students' choosing. High school–aged teams compete head to head on a special playing field with robots they have designed, built, and programmed.

In 2017, 30 volunteers served as coaches and mentors for 21 Laboratory-sponsored teams totaling 160 students. ROLL has continuing collaborations with sister robotics teams in many nearby towns, as well as from Hanscom Air Force Base. ROLL ensures these teams have adequate supplies to build their robots. Sister teams stage scrimmages and share design concepts to ensure that each team is ready for competition. /

Students in the FIRST robotics program explore real-world scientific challenges, develop a solution, and compete with LEGO-based robots of their own design.

8,400

Annual number of students impacted by Lincoln Laboratory STEM outreach

Code Creative, a 10-week educational outreach program, introduced students to the core concepts of computer science. Each participant took home a certificate of achievement.

Code Creative

With the goal of making computer science more accessible, Lincoln Laboratory's Karishma Chadha organized a new outreach program called Code Creative. The 10-week course taught high school students the core concepts and problem-solving skills behind computer science. "Our goal was to show students that computer science is fun and powerful. We wanted to emphasize code as a tool to feed creativity," Chadha said.

Staff gave lessons on different fields within computer science to show the range of career possibilities. Benjamin Kaiser shared insight on what cyber security is, why it is important, and what cyber security professionals do. Andrew Fishberg taught students how to build an arcade-style game using a program called GameMaker. The students added features and new levels. Upon conclusion of this pilot program, Fishberg reflected, "The initial feedback indicates we really helped make a difference—many students indicated that we helped influence their career paths and, at the very least, promoted code literacy." /

(Left) Ben Kaiser presents a lecture for LLCipher students, explaining how a blockchain is used to link and secure a continuously growing list of records. **(Above)** Sophia Yakoubov discusses public key encryption with students.

LLCipher

The LLCipher workshop is a one-week program that introduces high school juniors and seniors to cryptography, which is an approach to securing data. The program offers lessons in abstract algebra and number theory that students use to understand theoretical cryptography. "There were interesting types of math that I would never learn about in school," said one eager LLCipher student.

With the help of Uri Blumenthal and Jeffrey Diewald, Sophia Yakoubov, instructor of the cryptography workshop, created an online platform that includes challenges in two different cryptosystems to allow students to apply theory. "Students could see examples of flawed cryptography and understand how easily it can be broken," said Yakoubov. "I liked the hands-on activities where we could try out the different crypto-schemes. It really rooted the theory we learned in real-world practice and showed how cryptography is used," said an LLCipher student.

Students toured Lincoln Laboratory's anechoic chambers and Flight Test Facility and listened to guest lectures from David Wilson and Emily Shen on a more specialized cryptography topic. "Cryptography is an interesting intersection of math and computer science to which people are not often exposed," said Shen.

Following the program, students indicated that their interest in taking computer science courses in college had grown. "LLCipher helped us understand the cryptography-based concepts that we see in our everyday lives," said one student. "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." /

CyberPatriot

CyberPatriot is a nationwide Air Force program and competition that teaches high school students defensive computer security. This year, the CyberPatriot team and the Capture the Flag team are working in unison, learning how to identify malware, "clean" a computer system, and establish a secure network in a simulated corporate network setting. Under the guidance of Andrew Fasano, Christine Fossaceca, and Robert Elkind, five students competed in digital forensics and networking challenges. /

Capture the Flag

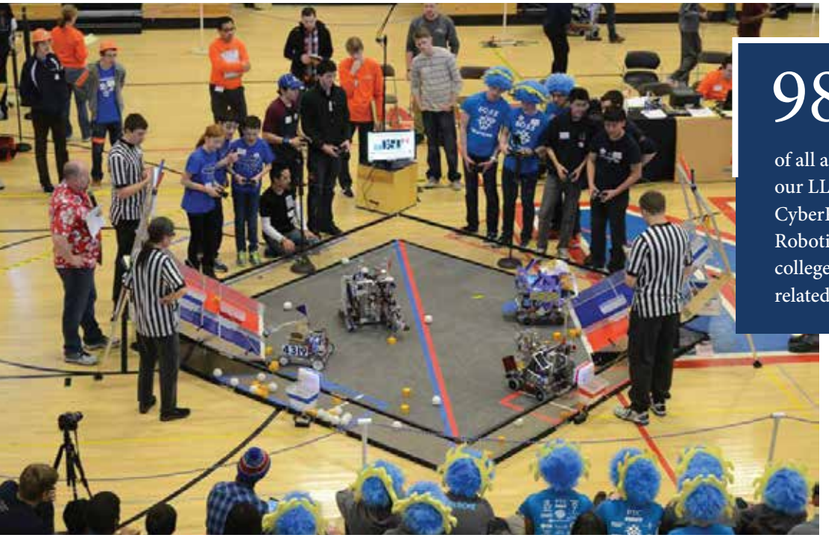
Capture the Flag is a cybersecurity game in which teams are given a set of challenging puzzles and each team races to solve as many puzzles as possible over a weekend. These puzzles cover a wide variety of real-world cybersecurity skills, ranging from identifying flaws in cryptographic algorithms, to recovering forensic artifacts of a damaged hard drive, to exploiting a remote server to steal sensitive information. This year's team of 12 students is mentored by Andrew Fasano, Christine Fossaceca, and Robert Elkind and will be competing in their first competition in early 2018. /

Girls Space Day Adventure

In May, the Society of Women Engineers, Lincoln Laboratory, MIT Department of Aeronautics and Astronautics, and MIT Women's Graduate Association of Aeronautics and Astronautics held the first-ever Girls Space Day Adventure. The goal was to provide middle school girls the opportunity to do hands-on engineering and see what it is like to be an engineer or scientist. Some of the interactive demonstrations included lessons in star orientation, asteroid mapping, inertia of axes, gravity assist, planetary orbits, and discovery of exoplanets. Throughout the day, girls learned about planetary science, materials science, chemistry, spectroscopy, observation methods, signal processing, light spectra, satellite mechanics, engineering stability measures, and solar system dynamics. /

> "While CyberPatriot teams learn about cyber defense, they are also learning to be leaders and better communicators."
>
> —CHIAMAKA AGBASI-PORTER, OUTREACH COORDINATOR

Everyone wants to do cyber! Students in CyberPatriot and Capture the Flag team up to learn about the intricacies of cybersecurity.



98%

of all alumni from our LLRISE, AFCEA, CyberPatriot, and Robotics programs enter college with a STEM-related major.

MASSFTC ensures that all teams engaging in the FIRST Tech Challenge have the information and mentorship needed to be successful at statewide competitions.

Massachusetts FTC Robotics

Massachusetts FIRST Tech Challenge (MASSFTC) is an organization created by the Laboratory's own Loretta Bessette. It is dedicated to spreading STEM through the FIRST program to students in Massachusetts. All high school–level robotics teams in the state belong to MASSFTC, which helps Laboratory-sponsored teams hold workshops and scrimmages to promote team cooperation prior to competitions. MASSFTC hosts a regional qualifier tournament, using ROLL volunteers as referees, judges, and volunteers. /

Job Shadowing

As part of Lincoln Laboratory's 2017 Daughters and Sons Days, the Human Resources Department piloted a job-shadowing program for junior and senior high school–aged children of Lincoln Laboratory employees. The students chose to explore a field from among electrical engineering, mechanical engineering, physics, aerospace, biology, computer science, chemistry, meteorology, mathematics, and business. Each student spent the day with an employee to learn about a typical day in a particular field. The 23 students selected for the job-shadowing program also enjoyed two lectures developed specifically for their age group: Intro to Managing Money and Thinking about College and Your Future. Mentor Naomi Hachen said, "I was thrilled to expose a high school student to exciting biology-related activities. Perhaps when she decides what to study in college, she will be influenced by what she saw here at Lincoln Laboratory." /

Team America Rocketry Challenge

Paul Devlin mentored three students in the Team America Rocketry Challenge (TARC) competition in 2017. The objective of the TARC challenge this year was to design, build, and launch a rocket that could reach an altitude of 775 feet and return safely to the ground within 41 to 43 seconds. The rocket had to meet certain specifications for length and mass, and be able to fly and land while carrying an egg. Michael Cooper, Brian Tyrrell, Fran Lettang, and Curtis Heisey also assisted in mentoring the students, who quickly established a correlation between launch weight and the goals for launches in calm conditions. Unfortunately, their very lightweight design showed a wide fluctuation of performance on the day of competition, which was blustery, and therefore the team did not reach the next level of competition but did learn a lot about launch conditions. /

David Patterson (left) helps students in Explorer Post 1776 understand the functionality of seismic monitoring instrumentation.

Boy and Girl Scouts of America

Lincoln Laboratory support of scouting is separated into three programs. Each group has plans to develop exciting outreach efforts, find new ways to connect with the community, and increase program participation in the coming years.

Explorer Post 1776

Explorers is a youth development program offered through the Boy Scouts of America. Exploring is based on a dynamic relationship between youth and the organizations in their communities and provides experiences to help young people become responsible, caring adults. Explorer Post 1776 focuses on STEM and hands-on design projects. Students gain in-depth experience in building engineering systems and are challenged to build prototypes by using creative problem-solving strategies. In the past, the Post has taken tours at the main Lincoln Laboratory campus and the Haystack radar site. Activities include numerous hands-on engineering challenges, but also teach skills the scouts will need in job searching and applying for college, such as resume writing, college essay writing, and presentation planning. The Post meets monthly for two hours in the evening from October through May at Lincoln Laboratory. /

Scouting (continued)

Scouting@Lincoln

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

Phil McKinley helped 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 event, which included a field trip to Boston Dynamics. Several other Laboratory staff volunteered for the Expo 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 developing the digital pamphlets for the Game Design and Space Exploration Merit Badges. The digital content provides search capabilities, instructional videos, virtual tours, animations, and pop-up definitions of unfamiliar terms. /

Venture Crew 1775

Boy Scout Venture Crew 1775 is a co-ed group of scouts, aged 14 to 20, that focuses on adventure, STEM, and service. Venture Crew's outdoor adventures have spanned skiing, snorkeling, kayaking, sailing, mountain boarding, and bird banding. The scouts have taken hiking trips to Mount Cardigan, Grape Island, Mount Greylock, Carter Notch, and many other locations.

The Crew's weeklong excursions consisted of summer camp in New Hampshire, a trip to Kandersteg Scout Centre in Switzerland, and a trip to Florida Sea Base in the Florida Keys. An upcoming 10-day backpacking trip at the Philmont Scout Ranch in Cimarron, New Mexico, is being planned for next year.

STEM activities have included touring the Lincoln Laboratory Flight Test Facility and talking with test pilots; exploring virtual-reality simulations; visiting the Haystack radio telescope and Woods Hole Oceanographic Institution; visiting laboratories at Tufts University and MIT; and visiting local companies like Boston Dynamics and Terrafugia. /

When not pursuing STEM activities, Venture Crew 1775 enjoys monthly activities, like hiking Mount Katahdin (far right) and traveling to interesting scouting locations, like Kandersteg Scout Centre in Switzerland (right).

Daughters & 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 2017, children enjoyed stations that offered interactive demonstrations and tours of a fabrication lab, a clean room, a robotics lab, and a machine shop. This special event also featured a science fair of demonstrations on detecting disaster survivors, augmented reality, laser communications, and 3D imaging and simulations of intercept missions and air traffic control tower decision support. Staff members demonstrated the scientific principles of data fusion and air flow, and conducted an experiment to see how infrared sensors can track an object. Kathleen Bihari and Edward Wack gave presentations describing the work they do and their paths toward a technical career. /

Children visit Daughters and Sons Days at the Laboratory to learn about different research projects and see new technology, like 3D printing and decision support for air traffic controllers.

Republic of Marshall Islands Summer Internship

Republic of the Marshall Islands (RMI) students Yoster Jibon and Markus Milne completed summer internships in information technology (IT) with Lincoln Laboratory staff at the Kwajalein Field Site. During their 10 weeks with Lincoln Laboratory staff, the interns honed their abilities in computer management, server administration, and computer networking. The interns were awarded scholarships should they choose to continue their education at the university level or obtain advanced IT certificates. For their final project, the interns upgraded Ebeye Hospital's medical records system with new IT equipment donated by Lincoln Laboratory.

Jibon and Milne described assignments they faced with program instructor Ranny Ranis and technical advisor Jessica Holland. Troubleshooting hardware, learning to program different operating systems, and building networks were among the toughest tasks. Milne said the network training had challenged him to consider long-term network maintenance while he and Jibon assembled a server rack at the Ebeye Hospital.

Ranis, a longtime employee of Lincoln Laboratory, said he enjoys guiding students through IT studies. "It's great fun to teach these guys," said Ranis. "Their first day, they asked what every piece of equipment was. By the end of their internship, they had learned a lot." Both Jibon and Milne plan to pursue higher education and a career in IT and ultimately educate others about it. /

Kwajalein School Outreach

Last year, Laboratory staff members at the Kwajalein Field Site in the Marshall Islands brought a lecture series to 18 seniors at Kwajalein High School. Volunteers talked about the projects they have worked on at the Laboratory, widening the students' views on careers in science and technology. The effort was so successful that it warranted a repeat performance to this year's senior class.

"Kwajalein students are somewhat isolated," said Alexander Divinsky, co-organizer of the series along with Edward Shultz. "Sharing our expertise is a way 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 Lincoln Laboratory staff member at Kwajalein shared topics a scientist can explore.

"I showed how teams need different types of engineering skills," 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. /

Lincoln Laboratory RMI summer interns Markus Milne and Yoster Jibon plan to continue their IT education and become instructors.

(Above left) A show of hands indicates how many members enjoyed the Science of Weather demonstration. **(Above)** Volunteers from the Recent College Graduates group organized the Science on Saturday session on the Sound of Science.

Science on Saturday

Since 2005, the Science on Saturday demonstrations offered at Lincoln Laboratory once every other month throughout the school year have engaged children in many interactive science activities. Robotics was the focus of the December show, the Science of Weather was featured in March, and a new show, The Sound of Science, was developed for the May demonstration. In the newest Science on Saturday demo, children witnessed the journey of a mad scientist teaching a struggling music group (of Laboratory staff members) the fundamentals of sound. The session was organized by the Recent College Graduates (RCG) group. "The kids loved the show! Their enthusiastic participation was energizing," said Emily Clemons, co-organizer. A dozen RCG members taught lessons about pitch, sound wave structure, and resonance. The audience watched in awe as staff moved a wine glass with sound and changed their voices by inhaling different non-toxic gases. Omar Salama found joy in volunteering: "I was very excited to be involved in organizing a Science on Saturday. We created a learning environment in a fun and playful way." /

AFCEA intern Darian Rivera spent his summer modifying firmware.

> "I love that members of my group, including group leaders, have taken the time to talk with me and give me advice toward future goals. I enjoyed learning about all different kinds of material that I wouldn't have been exposed to in school."
>
> —DARIAN RIVERA, AFCEA INTERN

AFCEA International

The Armed Forces Communications and Electronics Association (AFCEA) arranges summer internships for graduating high school seniors interested in STEM careers.

Each summer, two to four students are offered Laboratory internships, and at least 40 AFCEA students from schools in the local area tour the Laboratory facilities, learning about the latest research and career options in math and science. In 2017, three AFCEA interns were accepted to work at Lincoln Laboratory. Mentors of AFCEA interns have agreed that it is beneficial to host interns.

Darian Rivera worked in the Active Optical Systems Group under the mentorship of Greg Rowe, modifying firmware in an existing camera to calculate a real-time centroid. "Darian demonstrated genuine curiosity and an eagerness to learn as much as possible during this opportunity," said Rowe. "It was a pleasure working with him."

The Surveillance Systems Group accepts AFCEA interns every year. This year, the interns for this group were Ryan Harm, who helped the group develop an automated avionics test bed, and Pooja Patel, who assisted with developing a modeling and simulation environment to support a new airborne collision avoidance system for unmanned aircraft systems. Mentor Luis Alvarez said, "Pooja and Ryan were exceptional interns and surpassed all expectations. The group will benefit from their summer research for years to come. The AFCEA program always brings talented students, but this year's interns were able to work independently and ask complex questions to further their understanding." /

Boys & Girls Club in Chelsea

In February, Yari Golden-Castano visited the Boys & Girls Club in Chelsea, Massachusetts, to speak to high school students about her career path in a technical field at Lincoln Laboratory. Golden-Castano explained, "The theme for the talk was Dream Big, so I spoke about my dream of becoming a Martian settler and the journey I've gone through to prepare for it, despite many people telling me that I would not make it as an engineer." She also explained the Mars One project and led an open discussion with the students on why humans should explore Mars. The students learned the logistics involved with living on another planet, how rigorous equipment needs to be to survive in space, and the importance of science in our society. /

> "The best takeaway from my Dream Big talk: 'Don't let anyone tell you that you can't do something.'"
>
> —YARI GOLDEN-CASTANO, VOLUNTEER SPEAKER

High school students fill the Boys & Girls Club in Chelsea, Massachusetts, to hear Yari Golden-Castano discuss the steps she has taken to follow her dream of becoming an engineer living on Mars. Golden-Castano encouraged the students to enter technical fields and find their own paths to success.

Massachusetts State Science and Engineering Fair

Lincoln Laboratory has supported the Massachusetts State Science and Engineering Fair (MSSEF) by serving as a bronze donor to the event and awarding 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. Since 2000, Lincoln Laboratory technical staff have been volunteering as judges for the MSSEF, held on MIT campus in the Johnson Athletic Center. This year, 16 staff members assisted in judging science fair projects. /

> "My favorite part of judging was being in a space filled with young people who are really enthusiastic about STEM."
>
> —DENISE MAURAIS-GALEJS, SCIENCE FAIR JUDGE

Local School Science Fairs

Technical staff members from Lincoln Laboratory support Lexington High School by volunteering as judges for the school's Science and Engineering Fair. Many 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. /

Stoneham STEM Outreach

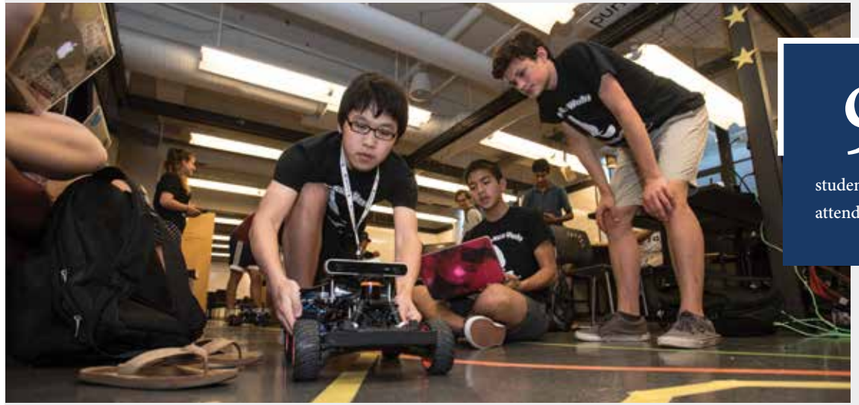
Lincoln Laboratory staff members visited Stoneham Middle School to host activity stations at the school's first STEM fair. Students visited each activity station to learn about infrared imaging, the principles of radar, and different outreach programs at the Beaver Works Center. The Laboratory's participation at the Stoneham Middle School was instigated by David Maurer, who also spoke to the students about the importance of careers in science, technology, and engineering. Plans are underway to increase Laboratory outreach to Stoneham Public Schools in 2018. /

Laboratory volunteers help the participants in the Stoneham Middle School STEM fair learn about radar technologies through a variety of hands-on projects.

(Left) Zachary Weber (at right) asks a student questions as she explains her science project. Lincoln Laboratory staff have volunteered as judges for this statewide science fair for the past 17 years.

Spotlight:

Beaver Works Summer Institute



95
students selected to attend BWSI this year.

(Left) A BWSI participant tests his vehicle after programming it to follow a yellow line. **(Below)** Amazon's Alexa may have a "sister" among the cognitive assistants developed by students like these in the BWSI build-your-own-cognitive-assistant course.

The MIT Beaver Works Summer Institute (BWSI) offers rigorous programs for rising high school seniors from across the country. In its first year, the program featured the Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot (RACECAR) Grand Prix, which taught 46 students to develop and program a self-driving vehicle. Students learned how to develop algorithms and software to teach a miniature car to navigate, map a course, detect objects, and win a race.

This year, BWSI expanded the RACECAR Grand Prix program and incorporated two new programs, Autonomous Air Vehicle Racing and the Autonomous Cognitive Assistant. More than 300 students signed up for the online version of the RACECAR program.

Spotlight (continued)

RACECAR Grand Prix

The 2017 summer program included more in-depth coverage of pose estimation and recovery for localization, visual servoing for local navigation, machine learning with neural networks for object detection and identification, simultaneous localization and mapping, and global planning for navigation in unknown and dynamic environments. The 2017 Grand Prix Challenge expanded nationwide to include high school teams that adopted the RACECAR platform for a robotics program in their own school or department. Two teams from Mexico took the online course, built their own RACECARs throughout the program by watching the online lectures, and participated in the final race in August. /

Autonomous Air Vehicle Racing

In this air vehicle racing workshop, students programmed, and raced autonomous flying drones through an aerial race course. The students engaged in rapid building and testing on a quadcopter and demonstrated basic vision-based autonomy. Working with advanced sensors and processors, the participants demonstrated the cutting edge of airborne autonomy while implementing computer vision techniques. /

Autonomous Cognitive Assistant

The Cog*Works: Build Your Own Cognitive Assistant program helped students learn how to use computer science to build and apply the foundational technologies of artificial intelligence. The class taught students how to work with audio, visual, and linguistic data; what the fundamentals of deep learning are; and how to customize their own cognitive assistants by using Amazon's Alexa.

By providing these types of learning opportunities, students are exposed to real-world science and engineering problems and the tools and technology for research and development in a team-oriented environment. Lincoln Laboratory will rely on these next-generation scientists and engineers to continue their mission of research and development for national security. /

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

(Above left) Participants at MIT Museum Girls Day investigate hands-on demonstrations about physics. **(Above)** Elizabeth Kowalski and Ekaterina Kononov prepare a demonstration at the MIT Museum.

MIT Museum Girls Day

MIT Museum holds Girls Day every April and November to celebrate science, technology, engineering, and math. Now in its third year, the event includes hands-on activities, informal talks, and demonstrations for girls aged 10 and older. The latest Girls Day focused on physics and chemistry, and included presentations in materials science, chemistry, along with a chemistry magic show, interactive demonstrations, and a "chemistry kitchen" that gave the visitors hands-on experience working as a chemical engineer. Elizabeth Kowalski and others demonstrated the physics of radar to several hundred girls at the MIT Museum. After explaining what a radar is, the volunteers showed the radar in "live" mode calculating distance and demonstrated the Doppler radar working when pointed toward a moving object. Lincoln Laboratory hopes to be a fixture of this biannual event to continue to inspire girls. /

MIT OEOP Programs

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

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. /

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. /

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 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 Melva James, who explained how they chose their respective career paths and why jobs in technical fields are important. /

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

(Above) Kristina Kaldon explains to a young visitor to the Lincoln Laboratory booth how a meteor impact might affect an ocean. **(Below)** A participant hurls a "meteor" at the "ocean" to witness the effect.

Cambridge Science Festival

Each April, Lincoln Laboratory takes part in the Cambridge Science Festival, a week-long citywide event that offers hundreds of science-based demonstrations and activities to the Greater Boston area. This year, Laboratory volunteers invited participants to measure the changing speed of objects by using radars built by high school students in the Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE) program. A Lincoln Laboratory robotics team was on hand to let participants control miniature robotic cars built with LEGOs. Laboratory scientists also set up an activity station where children could learn about the effects of meteorites colliding with Earth's land and oceans. /

200

asteroids are named each year through the Ceres Connection program.

Ceres Connection

The Ceres Connection is a cooperative program between Lincoln Laboratory and the Society for Science and the Public dedicated to promoting science education. The program names asteroids discovered under the Lincoln Near-Earth Asteroid Research (LINEAR) program in honor of students who performed outstandingly in the following Society for Science and the Public competitions: the Discovery Education 3M Young Scientist Challenge, the Intel Science Talent Search, and the Regereron Science Talent Search. /

Military Invention Day

In late May, crowds gathered in front of the Smithsonian Museum of American History to see examples of today's leading-edge military inventions alongside historical technologies from the museum's world-class collections. More than 30 inventions from the armed forces and associated technology firms were showcased during Military Invention Day—a premier event hosted by the Smithsonian's Lemelson Center for the Study of Invention and Innovation.

Lincoln Laboratory was onsite to demonstrate a self-driving vehicle that uses localizing ground-penetrating radar (LGPR), a radar system that enhances an autonomous vehicle's ability to know its position on a roadway even when other approaches fail. Byron Stanley, Aaron Gawlik, and Henry Wegiel helped people understand LGPR's wide range of uses and envision how advances in military technology might impact their daily lives in the future. Stanley said, "Many people were amazed that we could use a unique underground map to keep vehicles in their lanes." Gawlik added, "It seemed like people visiting our demonstration appreciated the fact that the self-driving car of the future may be equipped with ground-penetrating radar."

Reflecting on Lincoln Laboratory's participation in Military Invention Day, Stanley said, "We were honored to help represent the many novel inventions and significant contributions funded by the armed forces and Department of Defense. We enjoyed introducing our concept to a wide range of the military as well as the general public." Stanley indicated that there was a great deal of interest in the LGPR technology as well as their ladar and video display demonstrations. /

Byron Stanley (far right) explains how localizing ground-penetrating radar demonstrates centimeter-level localization to help keep a self-driving vehicle in its own lane.

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, the RF System Test Facility, and the Flight Test Facility, are given annually to a number of groups. Our 2017 tour groups included U.S. Air Force cadets, U.S. Association of Former Members of Congress, ROTC students, and National Reconnaissance Office fellows and people from

AFCEA Diversity Career Day at Hanscom Air Force Base
UMass–Lowell U.S. Air Force Reserve Officer Training Corps
Research Science Institute Program
Mitsui Interbusiness Research Institute
JetBlue Foundation
U.S. Army Test and Evaluation Command
U.S. Army Soldier Systems Center
U.S. Military Academy at West Point
Electronic Systems Center at Hanscom Air Force Base
Aviation Career Education Camp

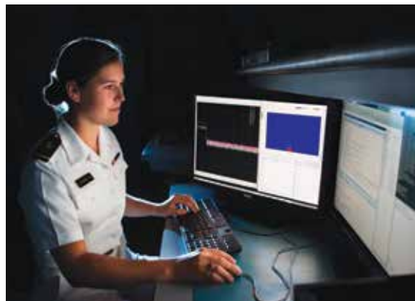
3500
school students tour Lincoln Laboratory facilities each year

Special tours included distinguished guests Senator Elizabeth Warren and Senator Jack Reed, shown above, and Lieutenant Governor of Massachusetts Karyn Polito.

02 / 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

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



(Left) Raoul Ouedraogo explains the premise of the Intern Innovative Idea Challenge to summer interns working at the Laboratory. **(Below)** An intern presents a proposed technology to clean up the geostationary Earth orbit.

Internships for University Students

Lincoln Laboratory offers several opportunities for university students to engage in meaningful internships in technical groups. Some programs help students fulfill an academic requirement, while other programs support thesis work 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. /

> "The Laboratory as a whole benefits from the interns' ideas."
>
> —RAOUL OUEDRAOGO, I³C COORDINATOR

Intern Innovative Idea Challenge (I³C)

To provide summer interns an opportunity to flex their technical skills beyond assigned work, Lincoln Laboratory initiated a program in 2016 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 develop their concepts with the help of Laboratory mentors. This investment in creativity and imagination elicited intriguing ideas: improving lower-limb prosthetics, powering naval ships with Stirling engines, and purifying water with titanium dioxide.

Raoul Ouedraogo, one of the program's coordinators, explained, "The I³ Challenge gives interns the opportunity to come up with their own concepts, learn to give a concise pitch, and present their concepts to the entire Laboratory."

After an initial proposal and online voting phase, each of the top 13 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. Team STELLA won first place for designing predictive mapping software to monitor where North Korean missile launchers are capable of traveling. The second- and third-place winners offered an injury-detecting fabric that transmits information to medics and a way to remove defunct satellites from geostationary Earth orbit, respectively.

The organizing committee has already planned to expand the competition. Next summer, the winning teams will return to the Laboratory to begin beta prototyping their projects with the goal of transitioning them into a full-time Laboratory program. /

Students from across the country converge at Lincoln Laboratory for internships offered through the 2017 Summer Research Program.

Harvey Mudd College Clinic Program

The Harvey Mudd College (HMC) Clinic Program engages students in solving real-world, technical problems for corporate clients and national research laboratories. Six HMC students worked for a year under the guidance of a Laboratory mentor.

With staff from the Advanced Concepts and Technologies Group, the HMC students created a system to detect, discriminate, and characterize pulsed radio emitters. The team researched existing pulse detection, deinterleaving, and frequency estimation algorithms and implemented the algorithms in Matlab. Laboratory staff mentored the students as they explored novel pulse detection and chip-rate extraction methods. Reflecting on her experience as an HMC student, alumna Sarah Lichtman recalled, "The Clinic Program was hugely impactful on my education." Lichtman, along with fellow alumni Masato Kocberber and Bryan Teague, organized the clinic. /

Summer Research Program

In 2017, 213 undergraduate and graduate students from 82 colleges and universities and three high schools participated in Lincoln Laboratory's Summer Research Program, which offers students internships in technical groups. The students gained hands-on experience in a technical 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 to acquire engineering experience and insight into the ways advanced technology can solve problems faced by the military. /

Eighteen students pursuing graduate degrees through the National GEM Consortium interned at the Laboratory this summer.

National GEM Consortium

This summer, the Laboratory hosted 18 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 science and engineering. The Laboratory has welcomed GEM interns since 2012, when Eric Evans, Lincoln Laboratory Director, began serving as President of GEM.

GEM fellows work as summer interns while completing their studies and receive financial support that is often the deciding factor in their pursuing graduate education. The internship process also allows companies to access and recruit talented candidates that they may not find otherwise. "By reaching out to underrepresented research students, we are creating an environment where underrepresented students will see a path for success at Lincoln Laboratory," said William Kindred, Diversity and Inclusion Program Manager.

GEM fellowships at the Laboratory offer the students numerous returns, from networking opportunities to high-level research experience. Students this year represented a range of research areas. Josue Lopez enjoyed hands-on experience in nanophotonics. "The photonic integrated circuits that I worked on are a great way to learn how a complete system is designed, fabricated, and packaged," Lopez said. Alain Anton was tasked with improving the isolation between transmit and receive channels on an unmanned aerial vehicle–based radar that can detect breathing targets through rubble in disaster-ridden areas. /

Worcester Polytechnic Institute Major Qualifying Project Program

From August to October 2017, 11 students worked as Laboratory interns under 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 work that is applicable to their senior projects, learning to apply their skills and knowledge to problems typical of those encountered in industry. /

Finn O'Brien, intern from Worcester Polytechnic Institute, sets up the test platform that will be used to determine the thrust of small satellite propulsion systems.

Co-op students are exposed to a variety of research efforts and engage in hands-on experience in their fields of study. While working in the Systems Engineering Group, Sean Parks modeled a satellite and analyzed its solar-power availability.

Northeastern Co-op Program

For the past 30 years, Lincoln Laboratory has had a partnership with Northeastern University, hiring more than two dozen students as interns during the summer and the school year. Students from the College of Computer and Information Science and from the College of Engineering gain valuable skills as they work with hardware, learn software, develop prototypes, and practice teamwork and communication while working on engineering projects and the administration of computer systems. Eric Evans, Lincoln Laboratory Director, said, "We see it as a 6- to 18-month interview, in a sense. We get a good feel for how they think and how they work on teams, and then we try to hire the best." /

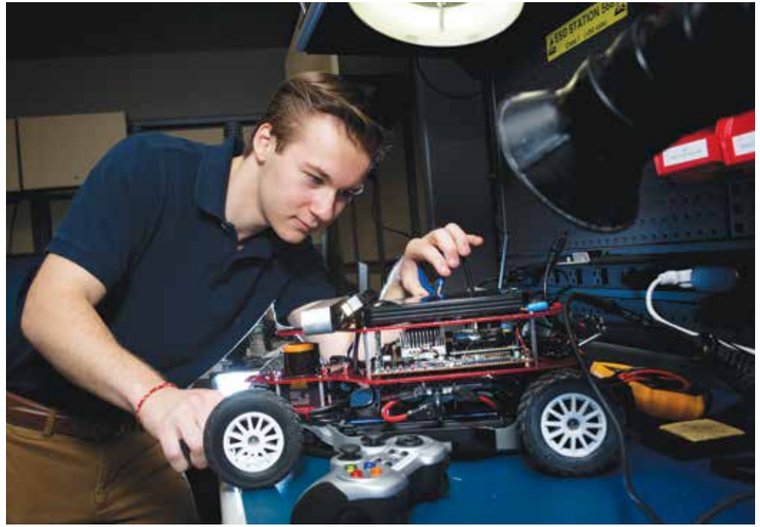
Co-ops like Imani Kai-Horton gain valuable experience doing hands-on work at Lincoln Laboratory while offering a fresh perspective to technical staff members and contributing to Laboratory projects.

University Cooperative Education Program

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 2017, 107 co-ops worked in divisions and departments at the Laboratory. College and universities that regularly partner with Lincoln Laboratory in this program are Wentworth Institute of Technology, University of Massachusetts–Boston, and Rochester Institute of Technology. /

Minuteman Regional High School Internship

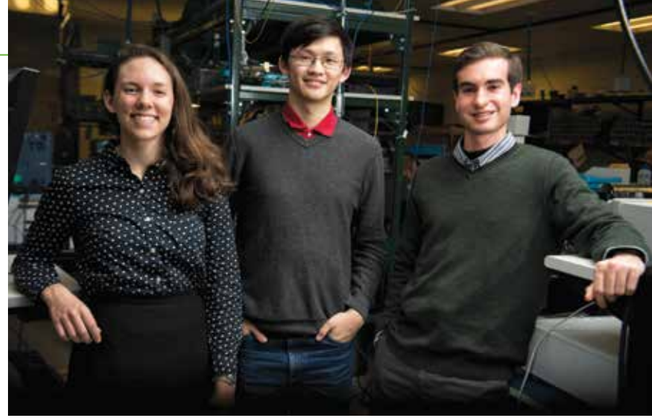
Each year, Lincoln Laboratory offers nine-month internships for one or two graduating students from Minuteman Regional High School in Lexington, Massachusetts. Through their work at the Laboratory, the interns receive a behind-the-scenes look at an engineering career while being mentored by a Laboratory staff member. This year, Davis Kahmann was selected for the internship and was mentored by Kenneth Gregson. Kahmann said, "The best parts of my internship were the hands-on fabrication and having direct access to high-tech components. My internship here at Lincoln Laboratory has helped me tremendously in my goal of becoming a mechanical engineer." /



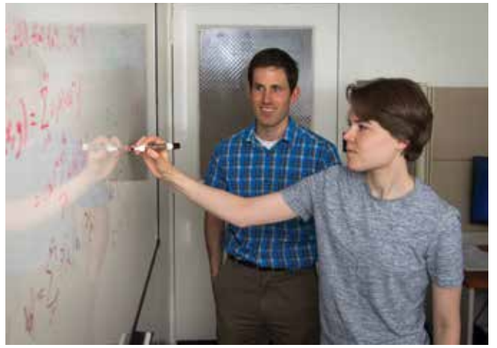
Minuteman Regional High School intern Davis Kahmann learned CAD modeling and used a 3D printer and a laser cutter to make and build autonomous race cars for the Beaver Works Summer Institute program.

MIT Research Assistantships

Lincoln Laboratory employs research assistants from MIT. Working with engineers and scientists, MIT graduate 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 students' decision to spend three to five years as research assistants in a technical group at the Laboratory. /



MIT interns worked at Lincoln Laboratory during winter break. Sophomores Clair Nord and Ben Wang teamed up with freshman Jason Paulos to build a "test executive" that configures and controls instruments for various tests.



As mentor Henry Romero looks on, UROP student Gabriela Studt does calculations to compare soft-decision decoding algorithms for Reed-Solomon error-correcting codes.

> "At Lincoln Laboratory, my internship allowed me to apply my knowledge to a real-world project!"
>
> —EMILY SEGLER, MIT RESEARCH ASSISTANT

MIT Undergraduate Research Opportunities and Practice Opportunities Programs

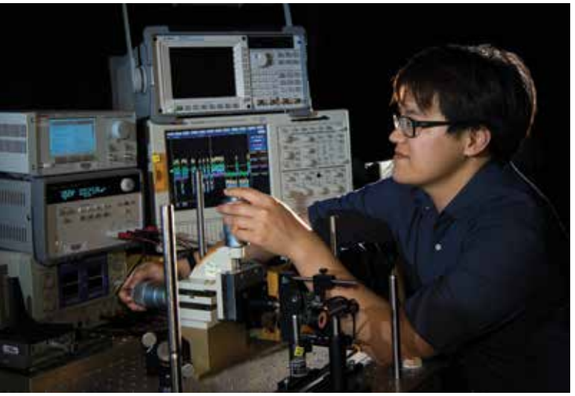
Lincoln Laboratory is one of the research sites that partners with MIT's Undergraduate Research Opportunities Program (UROP) and Undergraduate Practice Opportunities Program (UPOP). Students undertaking a UROP or UPOP assignment may choose to do a research project for course credit or accept a paid internship. 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 2017, nine undergraduates were hired as UROP interns and six as UPOP interns. /

David Caplan, far right, taught an IAP course on Free-Space Laser Communication, in which teams of students designed and built their own lasercom systems.

MIT Independent Activities Period

During MIT's Independent Activities Period (IAP), a four-week period in January between semesters, Lincoln Laboratory technical staff lead activities ranging from academic seminars to hands-on engineering projects. Lincoln Laboratory staff members organized the following classes for the 2017 IAP:

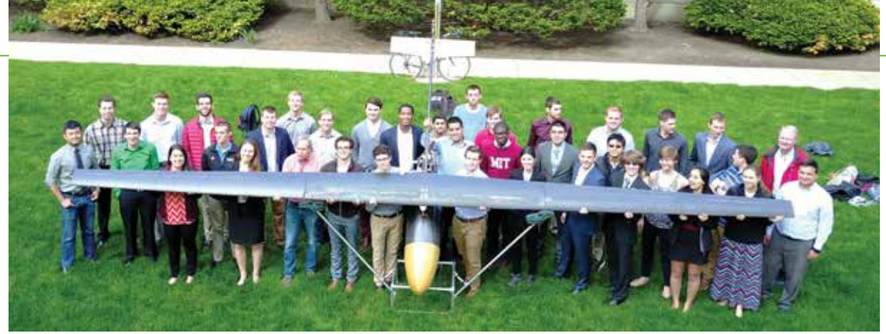
- Build a Small Radar System
- Free-Space Laser Communication
- Hands-on Holography
- Mathematics of Big Data
- RACECAR: Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot
- Software Radio



MIT 6-A student Jesse Chang aligns a narrow laser beam on a quad-cell photodetector in preparation for a direct-to-Earth optical communications uplink.

MIT 6-A Master of Engineering Thesis Program

Students in MIT's 6-A Master of Engineering Thesis Program spend two summers as paid interns at Lincoln Laboratory, contributing to projects related to their studies. Mentors are matched with students in order to relate the scientific and engineering principles from the classroom to engineering problems in industry. While working as research assistants, the students develop their Master of Engineering theses under the supervision of both Laboratory engineers and MIT faculty. Several staff members at the Laboratory have had their involvement in the 6-A Program lead to a rewarding career at the Laboratory. When recalling his own 6-A internship, Robert Atkins, Advanced Technology Division Head and 6-A intern from 1985 to 1987, said, "The Laboratory offered practical work experience through immersion, and the Laboratory culture helped me understand topics from a systems view, which was especially helpful in my graduate work." In summer 2017, four 6-A students participated in the program, gaining experience in testing, design, development, research, and programming. /



Students in the MIT Flight Vehicle Development course at Beaver Works pose with the UAV they designed and built to provide temporary telecommunications coverage. (Photo credit: Sally Chapman/MIT)

MIT Lincoln Laboratory Beaver Works

Beaver Works, an initiative between Lincoln Laboratory and the MIT School of Engineering, provides students with space, mentors, and tools for project-based learning. 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 in which students develop technology that solves a real-world problem. During two or three semesters, the students design a system that addresses a need and then fabricate a working prototype. 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. One of this year's capstone courses involved designing, building, and testing a medium-altitude, long-endurance unmanned air vehicle (UAV) that provides temporary telecommunications coverage and can stay aloft for five days—a first for gas-powered UAVs. The UAV, named Jungle Hawk Owl, resembles a thin glider with a 24-foot wingspan and flies at an altitude of 15,000 feet. The Laboratory's Navid Yazdani, Thomas Sebastian, Bryan Phan, David Cipolle, and Stephen Targonski lent their expertise and guidance to the effort. "We helped the students solve interference problems for the installed radio," said Cipolle, "and also helped attach a camera to get real-time video. It was great to see students make this project come to life." /

> "I enjoyed my first Professional Education course so much and there were so many interesting topics available that I went back for more!"
>
> —TINA CHEN, LINCOLN LABORATORY STAFF MEMBER

MIT Professional Education

Lincoln Laboratory collaborates with MIT faculty to offer courses through MIT's Professional Education Short Programs. These professional education courses attract participants from industry and business to the campus for topics designed to expand familiarity with emerging technologies, like biotechnology, cybersecurity, data modeling and analysis, machine learning, big data, robotics, mechanical design, radar, and systems engineering. Lincoln Laboratory staff have led a variety of such courses since 2012, including Build a Small Radar System and Design and Analysis of Experiments, which are offered every year.

Lincoln Laboratory's Tina Chen has enjoyed several MIT Professional Education courses, including two radar courses and a machine learning course. "Professional development courses are a great way to discover a new topic," said Chen. "Through the courses I've taken, I have learned quite a few applicable concepts in a very organized fashion and in a fun setting." /

Team members in Product Engineering Processes, MIT Course 2.009, demonstrate their product ideas to the audience.

MIT Product Engineering Processes Mentoring

The Product Engineering Processes course (2.009) final presentation in Kresge Auditorium has become a seminal event each year at MIT. For the past 22 years, professor of mechanical engineering David Wallace has been at the helm of the class, which serves as a capstone for seniors. He leads a team of dedicated teaching assistants, course instructors, and support staff to ensure students leave this class with an understanding of how products are created and launched. Four to six Laboratory staff volunteer to lend advice to the mechanical engineering students in the course. Mentors help each team of 14 to 20 undergraduate students to research markets, feasibility, costs; to design options; and create product ideas, models, prototypes, and a functional product. After months of ideating, modeling, and testing, each team has seven minutes to pitch and demonstrate its product, explain the product's unique features, and propose a business model. Laboratory volunteers have described their involvement in this course as an exciting learning experience to help students create a new product. /

Military Fellows Program

From May to September 2017, 42 military officers representing each of the United States services worked at Lincoln Laboratory under the Active-Duty Military Fellows Program. Fellows spend three to six weeks at the Laboratory working on sponsored projects under their mentors. The program, which started 20 years ago with just four interns, was established to involve the warfighter in the technology development process.

Officers enrolled in Senior Service Schools 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.

"The Active-Duty Military Fellows Program has two purposes," said John Kuconis, program coordinator. "The first is to educate young officers about Lincoln Laboratory and its capabilities. The second is to expose Laboratory staff members to officers-to-be."

U.S. Naval Academy midshipman Emma Chesire said, "This experience has given me a great deal of respect and appreciation for those who serve our country outside of the uniform by working every day to provide our military with the best systems possible, constantly preparing for the future." /

> "It's important that military officers visiting the Laboratory in any capacity understand all that the Laboratory can do for them."
>
> —JOHN KUCONIS, MILITARY FELLOWS PROGRAM COORDINATOR

U.S. Naval Academy midshipman Emma Chesire interned with the Tactical Defense Systems Group. This summer, she helped develop the Integrated Ka-band Radar Instrumentation System while working at the Laboratory through the Military Fellows Program.

Service Academy Research Program

Military interns spend three to five weeks of their summer working at Lincoln Laboratory under the Service Academy Research Program. The interns represent the service academies and the U.S. Army Reserve Officers' Training Corps (ROTC) program. The Laboratory started hosting Service Academy interns in 2012 to give Laboratory staff a clear view of the warfighter's perspective and needs while on the battlefield. John Kuconis, Executive Officer in the Director's Office, stated, "Educating the next generation of military officers about Lincoln Laboratory and its capabilities can have mutual benefits in the future." The cadets and midshipmen pursued a wide variety of research efforts, including laser communications interoperability standards, design of a microsatellite payload, and demonstration of a high-performance airborne lasercom terminal. /

Cadets and midshipmen from the U.S. Air Force, Military, and Naval Academies arrive at Lincoln Laboratory for the 2017 summer research program.

Spotlight:

Space Tactics Internship inspires creativity among operators

Air Force Space Command Public Affairs / Published November 30, 2017

PETERSON AIR FORCE BASE, Colo. — Space operations groups from across Air Force Space Command have collaborated with the Massachusetts Institute of Technology Lincoln Laboratory on a Space Tactics Internship that allows space operators to work with scholastic experts in a research environment.

Col Troy Endicott, executive officer to the AFSPC commander, initiated the program in 2016 when he was the 21st Operations Group commander at Peterson Air Force Base, Colorado. The program accepts 15 total AFSPC operators a year from the 21st Space Wing, the 50th SW at Schriever Air Force Base, Colorado, and the 460th SW at Buckley AFB, Colorado.

"This internship is a great opportunity to take our sharpest space tacticians and expand their thinking, to envision their operations in a warfighting domain, and be taught from the best to address growing threats," Endicott said. "When we originally discussed goals of the program with Lincoln Laboratory, I asked that they return our operators dissatisfied with our current way of doing business, more energized and motivated to think and lead their peers differently."

"I'm so pleased with the program and am thrilled to see space operators across AFSPC growing as tactical warfighters," he added.

The Space Tactics Internship is a four-week program where interns receive over 120 hours of hands-on instruction with Lincoln Laboratory operators, engineers and analysts at the Lexington Command, Control and Collaboration Testbed and Lincoln Space Surveillance Complex, both located in Massachusetts.

Lincoln Laboratory is a federally funded research and development laboratory that is aimed at creating solutions to problems critical to national security and is a place where innovative ideas and tactics can be fostered and tested. The 14th Air Force detachment at Lincoln Laboratory organizes and leads the internship with the support of the Laboratory staff.

The program was created with the Space Mission Force in mind, allowing for enlisted, officer and civilian participants. The internship encourages space operators to think creatively and critically on how best to use information from the course to further evolve Department of Defense space tactics across multiple domains.

Senior Airman Jake Pullen, a staff evaluator with the 16th Space Control Squadron at Peterson AFB, believes this internship is vital to the Space Mission Force. The objective of the SMF is to advance the knowledge and skills of AFSPC space operators to better function in today's contested space environment.

Spotlight (continued)

"We must use every resource we have available to propel the mission forward," said Pullen. "Attending the internship is one of the best ways to do that."

The interactions between space operators across the spectrum increase awareness of mission possibilities while allowing a creative and critical thinking approach to evolve space war fighting tactics.

"The skills and knowledge I have obtained from the internship have allowed me to find new ways to encourage my fellow Airmen to dig deep into the system and identify previously unrealized potential," said Pullen. "The relationship built with Lincoln Laboratory has also allowed the crossflow of information and resources, making our system and personnel better prepared to complete the mission."

Capt Stefanie Coward, a deputy flight commander with the 1st Space Operations Squadron at Schriever AFB, who attended the internship at a different time, went further, adding that her mentors from the program are actively helping her now with some new projects.

"Getting the opportunity to step away from operations and talk to people who aren't operators helps me to approach problems in a different way," Coward said. "It allows us to be creative in how we solve problems now."

Not only did Coward and Pullen both get to work with professionals within Lincoln Laboratory, but attending the space tactics internship allowed them to work with other space operators from across AFSPC.

"This internship is one of the few opportunities we get as space operators to interact with people who work in different mission sets," Coward said. "It was great getting to know them and how they work."

As the program moves into a new year, Coward stressed that all space operators should take up the opportunity to learn at Lincoln Laboratory. "This program provides value to every space operator who attends because the lab has such broad-reaching mission areas and capabilities they are constantly working with," she said. "People should absolutely take advantage of this incredible opportunity." /

Capt Stefanie Coward attended Lincoln Laboratory during her internship in October 2017. The program encourages space operators from across Air Force Space Command to think critically on how to further the evolution of space tactics across multiple domains. (Photo credit: USAF)

Cadets from West Point visit the Beaver Works facility in Cambridge, Massachusetts, to see cutting-edge technologies being developed.

West Point Collaboration

Lincoln Laboratory partners with the U.S. Military Academy at West Point to offer real-world experience to cadets via internships and technology demonstrations. Internships to West Point cadets are included in the Military Fellows Program and the Summer Research Program. Each year, West Point cadets visit the Laboratory, the Flight Test Facility, and Beaver Works for demonstrations of cutting-edge technology and presentations on research areas currently investigated by Lincoln Laboratory scientists and engineers. John Kuconis, who organizes the cadets' visit to the Laboratory, explained why the collaboration is important: "Building and maintaining connections with the cadets and officers will help us better serve the U.S. military in the future and will help the cadets understand the work performed at the Laboratory." /

Military Courses

Laboratory staff teach elective courses to the officers attending the Naval War College in Newport, Rhode Island. The Ballistic Missile Defense course is 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 Robert Guerriero, explores critical space technologies, capabilities, and policies that shape the use of space for military and government purposes.

The Cybersecurity course taught by Jeffrey Gottschalk describes cyber operations, cyber threats, and cyber defense. This course inspired a similar course for the Air Force's Life Cycle Management Center at Hanscom Air Force Base in Bedford, Massachusetts. Plans are underway to offer this course in-house at Lincoln Laboratory next year.

Lincoln Laboratory offers a Homeland Protection course at the Homeland Security Institute on Hanscom Air Force Base. This course provides a broad understanding of homeland protection missions, enabling technologies, and current challenges in homeland security. The key areas of disaster response, critical infrastructure protection, and chemical and biological defense are covered and followed by a half-day of hands-on exercises. /

In-house experts and outside instructors offer a range of technical, programming, and software application courses onsite at Lincoln Laboratory.

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. Technical courses last 10–14 weeks for up to 60 students, while computer courses are generally 1–5 days for 12 students. Certification courses for operating systems, network devices, and programming languages are offered regularly. In fall 2017, the Technical Education Committee offered Adaptive Antennas and Phased Arrays, Build Anything, Build-a-Radar, and Mathematics of Big Data. Newer courses include Technology in Humanitarian Assistance and Disaster Response, Hyperspectral Imaging Remote Sensing, and Probability and Random Processes. Forty courses have been recorded and are available for staff via the Technical Education Course Video Index for staff. /

As a Lincoln Scholar, Michael Long performed finite element modeling and analysis on the bracket that will support the Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS) optical communication payload for NASA's Orion vehicle.

Lincoln Scholars Program

The Lincoln Scholars Program supports Laboratory staff graduate education in areas of strategic importance to the Laboratory. The program promotes the recruitment and retention of talented technical staff, enhances the technical capabilities of Laboratory staff, and improves relationships with local university research faculty in fields relevant to the Laboratory. 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 program. Scholars work full time at the Laboratory for two years after ending their studies. Currently, 18 staff members are enrolled in the program, six of whom began graduate studies in September. Almost 200 staff members 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 national security problems."

"The Lincoln Scholars Program afforded me the opportunity to contribute to campus satellite program subsystems and stages of the development cycle I would not otherwise have been exposed to," said Michael Long. "Hands on experience in these areas helped me develop a more holistic understanding of satellite missions, positioning me to be a more well-rounded engineer and more effective teammate when I return to the Laboratory full time." /

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 include computer networks, cryptography, and software engineering, and can be taken independently, as part of a certificate program, or as a master's degree program through Boston University. Since the program started in 2012, more than 160 staff members have enrolled in the program. /

Part-Time Graduate Studies Program

The Part-Time Graduate Studies (PGS) Program enables motivated and talented staff members to pursue a master's degree part time via distance learning or at local universities, in areas of importance to the Laboratory, while continuing to work at the Laboratory full time. The program objective is to provide developmental opportunities to highly motivated employees to the joint benefit of the Laboratory, its sponsors, and the employee. In 2017, 29 employees participated in the program. One PGS participant, Matthew Brady, summed up a benefit of the program when he said, "Through PGS, I can complete my degree in a shorter amount of time and be able to apply these new skills to my growing career." David Radue appreciated the program for a different reason, saying that the PGS program allowed him to pursue an advanced degree while maintaining work-life balance. /

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 Technology Office seminars offered in 2017 covered a variety of leading-edge topics in technology:

Enabling the First Interstellar Missions

Reinvention of Education

Enhancing Human Capability with Intelligent Machine Teammates

Pluto Revealed! Latest Results from NASA's New Horizons Mission

03 / 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

LEAN volunteers sorted through donated books while helping staff the More Than Words bookstore in Waltham, Massachusetts.

More Than Words

Lincoln Employees' African American Network (LEAN) hosted a book drive for the More Than Words organization, which helps at-risk youth take charge of their lives by learning business skills associated with managing a bookstore. Jamal Grant, who coordinated this event, said, "We were drawn to this organization because of its commitment to giving opportunities to some of the most disadvantaged youth in the community." LEAN members volunteered in the More Than Words bookstore, helping youth sort, scan, and store the more than 2,000 books, CDs, and DVDs that were donated in the Laboratory book drive. Grant added, "The opportunity to meet with these youth and contribute to the bottom line of More Than Words was extremely rewarding and could not have been made possible without the tremendous work from the LEAN volunteers and the many generous Laboratory employees who contributed to the book drive's success!" /

Robotics Donation

In November, the Lincoln Laboratory field site in Huntsville, Alabama, donated surplus robotics equipment to the FIRST Robotics Competition Team #5845, Twisted Gears, of East Limestone High School. East Limestone High School in Athens, Alabama, is a poorly funded high school in the Huntsville area and relies on donations to operate STEM programs. The donated equipment included three remote-controlled ground vehicles, three remote-controlled octocopter drones, a remote-control unit, and assorted batteries, chargers, and replacement parts valued at more than $22,000. Nine of the Huntsville field site staff attended the presentation of the equipment donation to the students.

In appreciation of the donation, the team sponsor, Dawn Martin, invited the Laboratory staff to the team's first robotics competition of the year. Brian Smith, Huntsville field site facility security officer, organized and led this highly rewarding and successful community outreach event. /

Brian Smith provided an overview of the robotic items, followed by an explanation of the work performed at the Huntsville Field Site.

The 19-member Lincoln Laboratory Ride to End Alzheimer's team raised more than $15,000 and cycled 62 miles of coastline near Rye, New Hampshire.

Alzheimer's Association

This year marks nine years of Lincoln Laboratory participation in the Greater Boston Walk to End Alzheimer's and six years of participation in the Ride to End Alzheimer's. Thanks to the extraordinary support from the Lincoln Laboratory community, the team has contributed more than $300,000 dollars to the cause since 2009. The team is open to anyone at Lincoln Laboratory as well as friends and family members. If you'd like more information about how to participate in either event or how the Laboratory's Alzheimer's Support Community can help you, please contact alzheimers@ll.mit.edu. /

Autumn Escape Bike Trek

Over three days in September, the nine-member Lincoln Laboratory Autumn Escape Bike Trek team rode 160 miles from Plymouth to Provincetown, Massachusetts, to support the American Lung Association. This year, the team surpassed its fundraising goal and raised $7,440. The cycling team is always looking for new members for this fun event on Cape Cod. Part scenic bike-a-thon, part camping with friends, it includes a lobster dinner, a potato bar, beer tastings, a bonfire, and many more activities and incentives. The team has multiple reasons for participating, whether it's a personal fight with lung disease, the struggle or loss of a loved one, a deep commitment to the cause, or just the camaraderie. The Lincoln Laboratory team is committed to raising awareness about preventing lung disease and promoting lung health. /

TeamWalk for CancerCare

In 2009, Julie Arloro-Mehta formed a team for Lowell General Hospital's TeamWalk for CancerCare in memory of her father, who played a major role in establishing the walk. The Lincoln Laboratory team has met increasing fund-raising goals every year for eight years to better the lives of those being treated for cancer at Lowell General Hospital. In 2017, the team raised $5,000 to help Lowell General Hospital provide support and services for local area cancer patients. /

Marshallese Island Outreach

Lincoln Laboratory operates a field site on Kwajalein Atoll in the Marshall Islands, where 20 staff members serve two- to three-year assignments. The amicable relationship enjoyed by the Laboratory staff and the local community prompted the initiation of an outreach program to enrich the educational experiences of Marshallese students. In addition to the educational outreach programs Lincoln Laboratory offers on Kwajalein Atoll, the Laboratory has several giving programs in place.

Lunches: Donations from Lincoln Laboratory staff help provide boxed lunches for students in Ebeye who do not have the opportunity to return home for lunch.

School supplies: Lincoln Laboratory donates textbooks and school supplies for the students in Ebeye.

Crafts: Marshallese ornaments, woven baskets, necklaces, wall hangings, and intricately carved wooden turtles are displayed and sold at the Laboratory's main complex in Massachusetts to support Marshallese artisans and Micronesian schools.

During the Outreach Fair in October, customers could select from many items crafted by people from the Marshall Islands.

Carrie Perry collected donations from Laboratory employees to prepare activity gift bags for cancer patients.

Grab a C.A.B

Carrie Perry created Project Grab a C.A.B (short for Chemo Activity Bag) to help alleviate cancer patients' boredom while receiving chemotherapy treatment. Using donations from Lincoln Laboratory employees, Perry assembles gift bags filled with all kinds of games, books, and inspirational items. Each bag is unique, enabling patients to select a bag according to their favorite tastes and activities, whether they prefer coloring, crosswords, and puzzles, or spa items like candles, lotions, and hand warmers. Plans are underway to expand this giving program to include activity bags specifically for children. /

More than 6,000 cyclists wait at the starting line of the Pan-Mass Challenge, ready to pedal their way through Massachusetts.

Pan-Mass Challenge

In August, Kim Hebert, Craig Perini, and Robert Schulein participated in the Pan-Mass Challenge by cycling 190 miles across Massachusetts over two days. This Lincoln Laboratory team raised more than $16,400 for the Dana-Farber Cancer Institute and the Jimmy Fund. Each Lincoln Laboratory participant rides for varying reasons: to honor a child in treatment, a family member lost to cancer, and the many people affected. Hebert thanked Laboratory employees for their support: "I know we could not be motivated to keep going without the community here at the Laboratory." The Pan-Mass Challenge, now in its 38th year, raises more money for charity than any other single athletic fundraising event in the world. /

Lincoln Laboratory's Heart Walk team stand together on National Wear Red Day to support the fight against heart disease.

American Heart Association

Lincoln Laboratory's Heart Walk Team gathered in February for the American Heart Association's National Wear Red Day. Each year, the first Friday of February is a day to call attention to heart disease and stroke. Efforts of the team have been spearheaded by Sandra McLellan and Susan Curry for the past five years. A total of $5,650 was raised toward their fundraising goal for the Boston Heart Walk. The Heart Walk is held each September at the Charles River Esplanade. At the walk, the goal is to reduce death and disability from cardiovascular diseases and stroke by 20 percent by 2020. /

Spotlight:

Hurricane Relief

Karen Gettings and Jamilcar Ramirez-Ramos hold armfuls of coats that were donated for residents of Puerto Rico who relocated to New England.

The 2017 Atlantic hurricane season was extremely active, with Hurricanes Maria and Harvey causing much destruction. In response to these storms, the Laboratory community provided clothing, food, medical supplies, and water to make a positive impact for those in need.

Hurricane Maria

Hurricane Maria made landfall as a Category 4 hurricane in Puerto Rico on 20 September, leaving 75 percent of the island without power and one million people without safe drinking water. Recognizing the need in Puerto Rico, members of the Lincoln Laboratory Hispanic/Latino Network (HLN) employee resource group actively sought ways to lend a helping hand.

"The Laboratory has a sizable group of Puerto Ricans who were distraught after seeing the devastation that Hurricane Maria caused," said Karen Gettings. "Since there was no communication with our loved ones on the island, we scrambled to find a way to help immediately, and a bake sale was a simple way to help with the relief effort." The sale resulted in $5,790, which was used for medicine, food, and supplies.

Two full carloads of food, toiletries, batteries, flashlights, and water were collected from Laboratory personnel. HLN members Pedro Torres-Carrasquillo and Joel Acevedo-Aviles donated these supplies to Terika Smith Ministries in Lawrence, Massachusetts, which shipped the supplies directly to Puerto Rico through the National Guard.

As island evacuees arrived in Boston, they needed warm clothing for winter. With this in mind, HLN members collected winter clothes of all sizes. The Laboratory community generously responded by offering approximately 450 pounds of cold-weather clothes and shoes. /

Hurricane Harvey

The Laboratory was ready to help those affected by Hurricane Harvey after 60 inches of rainfall caused flooding in one-third of Houston, Texas. Elizabeth Seibold and Roslyn Wesley organized a clothing drive to help the people of Houston in the aftermath of the Category 4 hurricane. The Laboratory donated hundreds of bags filled with new and gently worn clothing and shoes for men, women, children, and infants.

Donations were sent to the American Red Cross to be distributed to residents of Houston and other areas affected by Hurricane Harvey. /

Lincoln Laboratory technology in Puerto Rico

Dr. Mabel Ramirez led the effort to find technology at the Laboratory that could help Puerto Ricans in their time without power or clean water. Erik Limpaecher said, "We started looking at water treatment and learned about Infinitum Humanitarian Systems (IHS) (supported by the Roddenberry Foundation), who has deployed their water purification system to disaster-stricken communities. Their Water Aid and Renewable Power (WARP) system requires a generator, which can be difficult to find after disasters." Limpaecher, however, had a solution: the Laboratory's Modular Aid and Power Pallet (MAPP). The MAPP is an easily shipped pallet of solar panels and everything needed to install them. The solar-panel mats are flexible, thin, waterproof, and extremely durable. The array of solar mats feeds into an inverter, which converts the DC energy into AC energy to power the system. While the inverter can eventually connect to the electric grid, it can also work off-grid and without batteries.

Laboratory staff quickly tested a surrogate system and flew to Loíza, Puerto Rico. The local director of the Loiza Boys and Girls Club offered its building for WARP and staff for installing and maintaining it. The disaster team laid out the solar mats and ran cables to the inverter inside the building. After five days of troubleshooting and reconfiguring, Laboratory staff were delighted to see the taps dispensed clean water. Children gathered around the faucets, taking turns filling cups and thanking the staff again and again. The Boys and Girls Club will now run the system. Two Boys and Girls Club staff members helped install the system and can repeat the effort at other facilities.

Back at the Laboratory, Limpaecher and fellow staff are researching disaster response systems in hopes of developing a system that could serve 4,000 people a day. Ramirez said, "Seeing the positive result of our hard work was a testament to the impact that we can have when our teams are committed to a mission." /

Lincoln Laboratory staff designed an off-grid solar-power source to energize a water purification system in Loíza, Puerto Rico. The system is providing safe drinking water to the 600 students and families of the Loíza Boys and Girls Club.

(Left) This year's Race 2 the Summit had more than 100 participants. (Photo credit: Carl Hart). **(Below)** Laboratory volunteers helped support the troops by packing necessities and niceties to ship to U.S. soldiers serving in Iraq or Afghanistan.

Race 2 the Summit

In 2016, Jesse Mills formed the Marlene A. Mills Foundation in honor of his mother, who passed away from lung cancer but left behind a legacy of community service. Through the foundation, he established a 5K, called Race 2 the Summit, to continue his mother's example of community betterment. The race traverses the hills of central Massachusetts and follows Mile Hill Road up to the top of Wachusett Mountain. The Race 2 the Summit raises funds for the Dana-Farber Cancer Institute, Martin Richard Foundation, and the Marlene Mills Memorial Scholarship. While Mills looks forward to seeing what the Marlene A. Mills Foundation will accomplish, he is taking the foundation's motto, "Never give up, always give back," to heart. /

Support the Troops

Lincoln Laboratory runs an ongoing campaign of support for deployed U.S. troops. Donations of food, books, games, and toiletries are collected daily, boxed by volunteers, and mailed monthly to military personnel serving in Iraq and Afghanistan. Each year, hundreds of care packages are sent to troops overseas. Lincoln Laboratory Troop Support also sends special care packages each December filled with seasonal items and holiday cards signed by Laboratory employees.

In November, the Laboratory community donated Halloween candy to send 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." Troop Support hosts several packing parties throughout the year to ensure that there are plenty of boxes ready to send overseas. /

Both the two-legged and four-legged participants of the 5K Fun Run for Service Dogs enjoyed the first run sponsored by Recent College Graduates.

5K Fun Run for Service Dogs

Lincoln Laboratory's Recent College Graduates (RCG) employee resource group hosted a 5K in April along the historic Battle Road Trail in Minuteman Park in Lexington, Massachusetts. The $2,145 in proceeds benefit the Troops First Foundation's 24-7 Battle Buddies program, which matches service dogs with wounded veterans. Eighty-five registered runners, a dozen volunteers, and seven dogs joined the event for some exercise while supporting veterans. Emily Clemons and Christopher Flood, coordinators of the race, agreed, "The Laboratory community is unbelievably generous when it comes to veterans." /

Operation Delta Dog

In December, Trang Nguyen and Michelle Lloyd led the Lincoln Employees with Disabilities (LED) employee resource group in sponsoring a service dog for a veteran suffering from traumatic brain injury or post-traumatic stress disorder. Raising more than $1,500, a bake sale held by LED collected funds toward covering the cost of a service dog from Operation Delta Dog, an organization that rescues homeless dogs and trains them to work with veterans. Since a full sponsorship of a trauma-assistance dog requires $20,000, LED is coordinating with three other employee resource groups—Recent College Graduates, Lincoln Laboratory Veterans Network, and the Lincoln Laboratory Hispanic/Latino Network—to raise funds to fully sponsor a dog for a veteran. /

Toys for Tots

The MIT Federal Credit Union at Lincoln Laboratory serves as a donation location for the Toys for Tots holiday toy drive, a long-running charitable event that provides toys for needy children. Each December, more than 300 toys are donated by Laboratory employees. The Laboratory is proud to support the U.S. Marine Corps in their effort to distribute new toys, books, and other gifts to less fortunate children in our community and throughout the country. More than 97 percent of monetary donations to Toys for Tots goes to its mission of giving. Less than three percent is spent on fundraising and overhead. /

The MIT Federal Credit Union branch in Lincoln Laboratory has managed a Toys for Tots drive annually for the past 20 years.

Giving Tree

For the past 11 years, Paula Mason has organized a giving tree to address specific holiday wishes from local families in need. The program is paired with a food drive, so that each family receives requested gifts and holiday food items. The Laboratory anticipates the giving tree each year and responds with generosity, donating both large and small gifts in an effort to make holiday wishes come true for local needy families. Donations are given to the Somebody Cares charity, which delivers multiple bags of gifts to thankful recipients. /

Paula Mason, once a recipient of a Giving Tree gift many years ago, now plans the Laboratory's collection of presents.

A variety of gifts were collected at the Colorado field site and delivered to a local soldier and his family.

Colorado Field Site Giving Tree

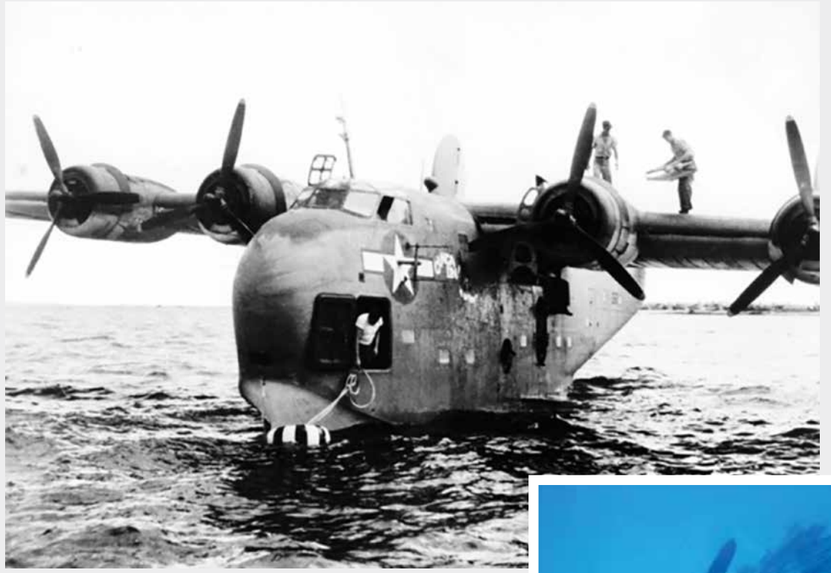
The Lincoln Laboratory field site in Colorado Springs, Colorado, continued their annual tradition of sponsoring a soldier and his family who are experiencing financial setbacks. The field site staff collected clothing, jackets, pajamas, books, bikes, games, dolls, and sports balls. Gifts for the parents were also collected and included movie tickets, a restaurant card, and gift cards. The staff at the field site took great pleasure in providing a Christmas tree, decorations, candy, and stocking stuffers to complete the holiday for this family of four, soon to be five. Food for a holiday meal was also donated. Jo Wilson, who coordinates this effort, said, "We feel privileged to give something back to a soldier who supports our country." /

Santa for Seniors

The police department in Cambridge, Massachusetts, calls on the MIT community, including Lincoln Laboratory, to donate slippers, puzzles, gloves, and tea for senior citizens who may not have friends or relatives with whom to celebrate the holidays. The police deliver bags filled with all kinds of items for entertainment or comfort. Traci Swartz, program coordinator for Community Giving at MIT, described the outreach effort as very successful. "The elderly welcome the interaction with the volunteers and appreciate not only the gift, but also the fact that they are not forgotten!" said Swartz. /

Spotlight:

Kwajalein MIA Project



(Left) The PB2Y-3 Coronado Gunga Din is pictured prior to sinking in the Kwajalein Lagoon in 1944. (Photo credit: Bill Remick) **(Below)** The damaged nose section of the Gunga Din found in 2017. (Photo credit: Todd Emmons)

> “It was a great day when we were able to share that the nose section was finally found.”
>
> —JESSICA HOLLAND, LINCOLN LABORATORY STAFF MEMBER

The purpose of the Kwajalein MIA Project (KMP) is to locate the sites of eight aircraft crashes and amphibious vehicle losses within the Kwajalein Atoll lagoon that are believed to contain the remains of American servicemen who have been listed as missing in action from World War II. The KMP is a nonprofit organization of volunteers who work on Kwajalein and have backgrounds spanning engineering, aviation, diving, archeology, and more. The team plans and conducts searches solely on their own time.

Jessica Holland, who works at the Kwajalein field site as a systems engineer and scuba dives in her spare time, joined the KMP as a way to use her dive skills toward a higher purpose. She has since learned how to operate the sonar that the team uses to search the lagoon. The lagoon is up to 200 feet deep, and the ocean side of the atoll drops off sharply to 10,000 feet.

This search process is conducted in 4-hour stretches, and it can take many trips before a target is found. “There is always anticipation that we will find a target for follow-up dives,” Holland said. “But largely, it is just hours on the water, waiting for something interesting to appear on the laptop screen.”

Finally, in August, something interesting did appear. Holland was driving the boat over a narrowed search area that seemed likely to contain the front section of the Gunga Din, a seaplane that crashed in the lagoon in September 1944 while practicing touch-and-go landings. After reviewing sonar images, the team was convinced that the target warranted a dive to confirm if it was the missing Gunga Din. Four days later, Holland was diving at the site of the target. At a depth of around 90 feet, a large metal object started to come into view: the front section of the Gunga Din—wing, engines, and nose—lay before her. The Gunga Din is the fourth wreck located so far through the KMP.

“It was exciting but sobering to make this discovery. We were the first people to lay eyes on the wreck since it sank during WWII,” Holland said. “We were diving on the grave of a young American naval serviceman who was killed in the service of his country and remained missing for 73 years.” The Defense POW/MIA Accounting Agency was notified of the find and provided with the video footage of the wreck so that they can recover any remains.

More collaboration between the KMP and the Laboratory is expected. A new project will begin high-resolution mapping of the Kwajalein lagoon, about 850 square miles, using unmanned underwater vehicles. The mapping is planned to be complete in three years, with the goal of quantifying the scalability of the concept to larger areas and, ultimately, the whole ocean floor. When the lagoon mapping project gets underway, the Laboratory will partner with the KMP to share data on potential targets that could be the other MIA-related wrecks and to ensure that the known locations, which are WWII graves, continue to be protected and undisturbed.

Despite the tedious hours spent scanning the lagoon this summer, Holland is grateful to be a part of the experience. “I recall feeling elated and emotional as we finished the dives,” Holland said. The KMP has more wrecks ahead of them to find. But, for now, they can revel in the closure of the Gunga Din. /

(Above) An energetic team of Lincoln Laboratory employees enjoyed the camaraderie of participating in the Mount Washington Road Race.
(Below) Laboratory employees contribute annually to food drives for local food pantries, like the Merrimack Valley Food Bank's No Hunger Summer event.

Mount Washington Road Race

This historic all-uphill run draws thousands of runners from across the world to race to the summit of the highest peak in the Northeast, Mount Washington in New Hampshire. Now in its 57th year, this challenging event is run by the private organization that owns the ultra-steep 7.6-mile road where the race is held. Several Laboratory employees have participated separately in this event, but this year was the first time they have done so together. /

Rainbow Compass

Three members of the Lincoln Laboratory Out Professional Employee Network (OPEN) volunteered as mentors in MIT's Rainbow Compass program on campus. This mentoring program matches LGBTQ-identified MIT graduate and undergraduate students with LGBTQ faculty, staff, and alumni to form supportive, businesslike connections. The goal of the program is to create a structured and trusting relationship in which mentors provide guidance and resources while supporting the personal and professional development of the mentees through various methods of work-life balance. /

Food Drives

Lincoln Laboratory Community Outreach promotes food donation drives to support local food pantries, responding to local hunger by distributing nonperishable items to the emergency food system. Each year, Laboratory employee resource groups volunteer at a local food bank. This year, efforts were concentrated in collecting nonperishables and sending them to areas affected by natural disasters. /

Other Community Outreach Events

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

American Diabetes Association's Tour de Cure
American Red Cross
Avon Walk for Breast Cancer
AFCEA Golf Tournament
Bedford Special Education Parents Advisory Council 5K Fun Run
Claddagh Fund
Cradles to Crayons
Emily Letourneau Memorial Volleyball Tournament
Epilepsy Foundation
Jimmy Fund
St. Baldrick's Foundation
Walk for Hunger

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.

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

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.

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