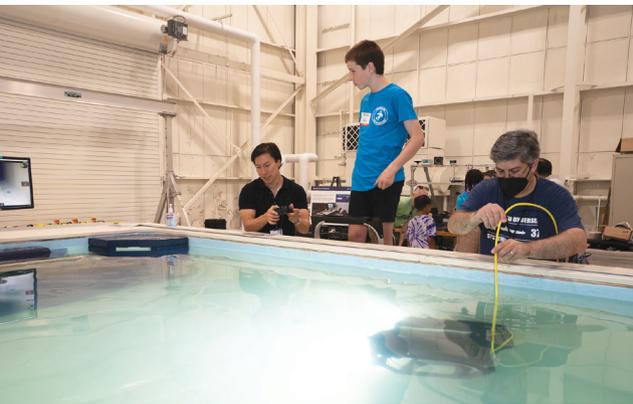




MIT LINCOLN LABORATORY

2022 COMMUNITY INVOLVEMENT REPORT





Lincoln Laboratory resumed hosting in-person educational outreach events where circumstances have allowed. The Laboratory's STEM outreach, whether virtual or in person, implements practical ideas to inspire a younger generation of budding scientists.

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Eric Evans meets students from the Beaver Works Summer Institute at MIT.

A Message

From the Director

Lincoln Laboratory has built a strong portfolio of educational outreach programs that encourage students to explore science, technology, engineering, and mathematics (STEM). These programs foster an interest in STEM among young people and help them gain confidence in their ability to tackle technical challenges. We see this outreach as vital to our nation's technological future. In 2022, we continued our extensive offering of STEM outreach programs, in person and virtually.

Three of our most successful project-based summer programs—the Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE), Beaver Works Summer Institute (BWSI), and Lincoln Laboratory Cipher (LLCipher)—engaged hundreds of students in hands-on experiential learning. The two-week LLRISE workshop celebrated a decade of annually immersing up to 35 students in building and operating small radar systems. In 2022, the four-week online BWSI program offered 350 students from nearly 30 states the chance to take one of 13 courses covering a variety of topics, from programming robotic cars and building small satellites to transforming remote-sensing data into actionable intelligence for disaster or humanitarian response. During an intensive week of classes, LLCipher introduced high school students to cryptography for secure computing. This year, the Laboratory also launched two new programs: Lincoln Laboratory Courses for Accessible, Technical Education (LL EduCATE), which offers prebuilt lesson plans and experiments for STEM outreach, and six-week summer internships for high schoolers to explore STEM careers. The LL EduCATE team has tested lesson plans for three scientific topics and is eager to have Laboratory volunteers share their presentations with local school districts.

I encourage you to look through this booklet to learn more about the many programs we offer to students at every level of education and the various charitable projects we support, including LabAid, a new initiative facilitating charitable giving within the Laboratory community. All these efforts are part of our commitment to serve the nation and our local communities.

Eric D. Evans
Director

01 EDUCATIONAL OUTREACH

The Communications and Community Outreach Office develops relationships with community organizations and members, specifically lower-income districts with a focus on engaging students in K-12 STEM Outreach. Any Laboratory staff member is welcome to propose a topic for a STEM workshop; volunteers are recruited to help develop the material. Over the past few years, we have adapted many of our educational programs into virtual events. In 2022, we resumed in-person formats as circumstances have allowed.

- K-12 STEM Outreach
- Partnerships with MIT
- Community Engagement

LL EduCATE

A new outreach program, Lincoln Laboratory Courses for Accessible, Technical Education (LL EduCATE) introduces students to core STEM skills helpful across many engineering disciplines. The goal of LL EduCATE is to provide affordable and hands-on opportunities for underserved students to see how STEM topics apply to their own lives. Juliana Furgala, Adam Kern, David Maurer, Bich Vu, Maxsimo Salazar, and Jennifer Swanson designed the material to be accessible for students whether they are participating in school or through an online program.

In March, middle and high school students in Stoneham, Massachusetts, participated in the pilot program. Team members selected a filtration project that represents the varied applications of engineering. In this lesson, partly inspired by a Laboratory-led study on the spread of COVID-19 in New York's public transportation system, the students were challenged to develop a filtration system to eliminate as much "mud" (coffee grounds) as possible from a water sample. "It was great to see the students so engaged as we ran the trial experiments at Stoneham High School," Kern said. "Their engagement was particularly striking on our first run, when we did our filtration experiment with high schoolers. They were so excited that they suggested adding more time during the next trial."

A second course, Clausewitzian chess, was tested later in March with the same set of students. Clausewitzian chess, which explores the fundamentals of decision making, is named after Carl Clausewitz, a military theorist who spoke on military decisions and the difference between tactics and strategy. This chess variant is designed to demonstrate the possibility of



Students from Stoneham High School test their two handmade designs for water filtration as they learn about the engineering design process, fabrication, and testing during LL EduCATE.

modeling complex cognitive concepts. The students involved in this workshop learned how to best make decisions with limited information based on the actions of their opponents.

The team also created course content to help students understand Bluetooth technology, which, along with a reprise of the two initial courses, was rolled out at Stoneham Middle School in April and repeated in May. These premade courses are aligned with formal educational standards and easily adaptable for remote learning. Further plans are underway to expand the program to other schools in Massachusetts. /

LL EduCATE - Texas

Esmeralda Hernandez, a 2022 teacher participant in Lincoln Laboratory Radar Introduction for Student Engineers, learned about LL EduCATE in July and was immediately interested in installing this outreach program in her school, Jubilee Brownsville High School in Brownsville, Texas, for its new engineering initiative. By October, David Maurer, Juliana Furgala, Adam Kern, and Jennifer Swanson began the first LL EduCATE course for a group of 22 students. The LL EduCATE team repeated the course on filtration, using the initial trial of the course in Stoneham, Massachusetts, as

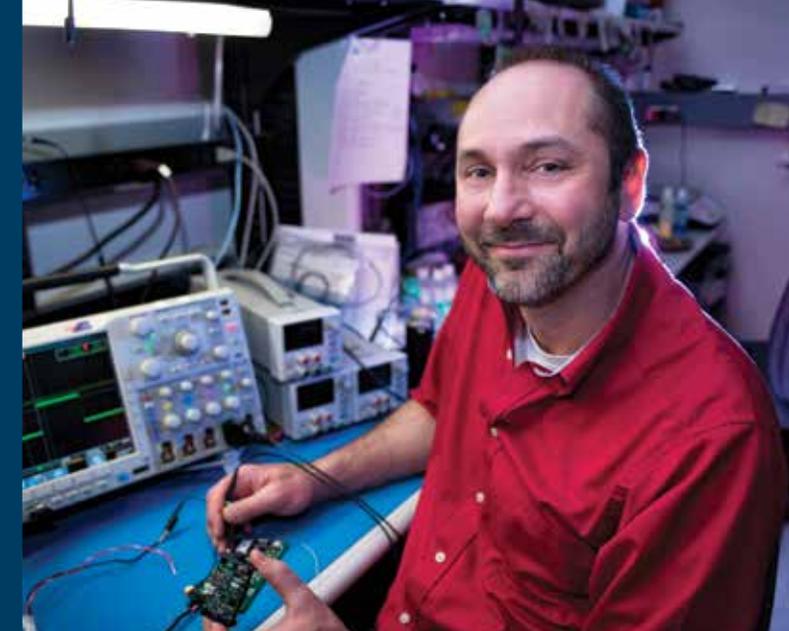
a guide. The hands-on experiment provided an opportunity for students to try out engineering by developing a filtration system to produce clean water. The students were enthusiastic, prompting Hernandez to schedule a course on Clausewitzian chess and a course on Bluetooth technology. Using the LL EduCATE program at Jubilee Brownsville High School has left Hernandez and her students pleased and ready to request the LL EduCATE team to offer more courses in the future. /



Students in Brownsville, Texas, gather in class to follow the LL EduCATE course material on filtration for the debut of the school's engineering initiative.

DAVID MAURER

EMPLOYEE SPOTLIGHT



Which STEM outreach activities have you been a part of?

I've been part of LLRISE [Lincoln Laboratory Radar Introduction for Student Engineers] for about five years and LL EduCATE since its beginning. With LLRISE, I started by helping out with assembly of the radar units and then moved into teaching the electronics portion, rewriting some of the lessons and redesigning the electronics. With LL EduCATE, I worked on the team who developed the curriculum from concept through beta site testing the lessons.

What one thing has surprised you about mentoring students?

Today's generation of kids is so much further along with their education than I was when I was their age. The questions they ask are very well thought out.

Why should other people consider engaging in volunteerism and STEM outreach?

The list of reasons why is very long, but perhaps the simplest answer is that we can make the nation better one volunteer opportunity at a time. At Lincoln Laboratory, we are all extremely fortunate in so many ways. It is surprisingly easy to discount this advantage when everyday life gets in the way. Everyone has something to teach, and everyone has something to learn. You often do both by volunteering.

Why did you decide to start volunteering?

I am a serial volunteer. I grew up participating in 4-H, which has similar philosophies of duty to community as Boy Scouts and Girl Scouts. I feel very fortunate to have had the educational opportunities I've had, and I believe my duty is to pay it forward as much as I can. Besides, it's a lot of fun.

Is there a specific STEM activity that resonates with you? Why?

One of the areas I find particularly interesting is energy generation and harvesting. It is a very relevant problem with no one-size-fits-all solution. The topic requires examination from every aspect of science to inform solid policy and technology for the future.

Has there been a particular student reaction to your mentoring that you are proud of?

I really enjoy it when a student understands something that had not made sense before. There is a big difference between the person explaining and the listener understanding. My goal is always to have a discussion that, in the end, leads to the listener understanding. If that doesn't happen, I didn't do a good job explaining.



Johnny Worthy (center) helps two Brockton High School students prepare their drone for the New England Aerospace Robotics Competition.

The competition had two phases—an autonomous and a semiautonomous phase. The Brockton team was the only team at the competition able to complete the autonomous section. “It was pretty magical seeing their drone take off and start traveling to the defined waypoints on its own!” said Worthy. “We are extremely proud of the teams, the progress that they made, and how they demonstrated their newfound knowledge at the competition.”

One student on the team said that the process of learning, designing, building, and programming competition drones has been equal parts fun and frustrating. He added that there aren’t many opportunities to learn in-demand programming languages like Python in school—at least not in ways that are as fun as programming a drone.

“The students had never touched drones or programmed anything before, but they had such a fantastic performance due to their work ethic and helpful mentoring from Laboratory staff,” Worthy said.

Worthy and Kava are holding a few sessions with the Brockton High School students over the summer to keep them engaged in STEM activities and give them a place to keep working with their drones. “The plan is to continue mentoring next year and compete in ARC again, possibly coming in first now that they know what to expect!” Kava said. /

Rockets

Lincoln Laboratory Community Outreach collaborates with Empower Yourself, an organization that provides year-round interactive educational programs for low- to middle-income

families and underrepresented students. For the past year, two Laboratory staff members, Kava and Worthy, have mentored students in Brockton High School’s ARC team, mentoring the students in designing, building, and improving rockets. Kava, a Brockton High School alumna, now hopes to inspire minority students to tackle careers in science: “It is important that students have an opportunity to see engineers who look like them, grew up in the same neighborhood as them, and speak the same language as they do.”

Empower Yourself is the driving force behind the rocket competition, but volunteers from Lincoln Laboratory and Worcester Polytechnic Institute help provide engineering expertise to direct the teens. Last year, the students built and tested drones; this year, the focus was on designing rockets and payloads for a “mission” in space, requiring the kind of calculations and computer coding that carry STEM education from the classroom into the real world.

To celebrate the students’ hard work, Empower Yourself hosted a Science Fair in October titled “The Science of Space.” The 100-person event culminated with a rocket launch competition between six high school teams. Lincoln Laboratory supported the event in several activities: Kava and Worthy served as rocket launch coaches, while Chiamaka Agbasi-Porter and Alfredo Martinez served as judges for the competition. Daphne Vessiroopoulos and Bich Vu guided students in making a circuit as they built a do-it-yourself lightsaber. Yari Golden-Castano and Jessica Johnson helped participants understand the propulsion, inertia, and motion principles of spacecraft dynamics. “I appreciated the opportunity to give students advice about their college plans and career paths. I hope that these connections might guide these students into STEAM [science, technology, engineering, art, and mathematics] careers,” Worthy said. /



Members of the Brockton Aerospace Robotics team proudly show the components of their rocket.

Aerospace Robotics

Drones

A Brockton High School Aerospace Robotics Competition (ARC) team mentored by Johnny Worthy and Donato Kava came in second place at the New England ARC finals, which took place in April. For this year’s competition, teams prepared uncrewed aerial vehicles (UAVs) that could operate autonomously and complete a “disaster management” scenario, performing tasks like flying to specific areas, counting how many people need assistance, and assessing building damage.

Over the past year, Worthy has helped the students solve the engineering challenges of building a UAV, such as aerodynamics and size, weight, and power constraints. Meanwhile, Kava taught the students how to program the UAVs to fly autonomously.

Kwajalein Robotics Club

In 2021, Karyn Lundberg of Lincoln Laboratory’s Kwajalein Field Site started the Kwajalein Robotics Club for all of the fifth and sixth graders attending George Seitz Elementary School. Fifth-grade teacher Misti French co-led each club meeting, hosted in the school’s STEM Lab. In the spring, Laboratory staff member Stephanie Fried transferred to the site and started supporting the club too. Five teams of six children each comprised the entirety of the fifth- and the sixth-grade classes, so every student was included and involved.

With the help of their mentors, the students learned how to build a LEGO robot and iteratively improve on its design. Then, they focused on computer programming and gained coding skills to enable their robots to navigate tasks autonomously. At each club meeting, the teams were assigned a specific programming challenge.

After months of practice building and coding, the students began to combine prior programming challenges so that their robot could leave a set point, follow a line, arrive at a secondary point, and perform a new task such as depositing a “cargo” block at a LEGO cargo plane. The Robotics Club, which has been meeting for two hours per week throughout the entire school year, had several smaller competitions, as well as a robotics expo for parents and the school community. “They are really understanding how to work together and leverage their team communication skills along with their coding and programming skills,” French said. The students will share their work in poster sessions at the end of the school year.

When asked about future plans for the Robotics Club, Lundberg said, “We are expanding to eight teams this year and purchasing six more kits to start a club at the public school on Ebeye. We hope to have friendly competitions between the Kwajalein and Ebeye teams in a matter of months.” /



Left: Students in the Kwajalein Robotics Club design and build a robot from a kit of LEGO parts. **Below:** Karyn Lundberg (back left) and teacher Misti French (far right) stand with the fifth-grade class of makers who have learned how to program a robot to perform tasks and challenges.



“We share the same passion and mission of LLRISE, which is to inspire, cultivate, and develop the next generation of diverse and exceptional STEM talent for the nation.”

— LOUIE LOPEZ, DEPARTMENT OF DEFENSE STEM DIRECTOR AND LLRISE PARTNER

Participants in LLRISE work together to measure an antenna frame while designing their antenna using software in the Technology Office Innovation Laboratory.

Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE)

The Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE) is a two-week summer program in July that brings high-achieving students to the Laboratory to learn about the fundamentals of radar and build a small radar system. In 2022, the program returned to an in-person format with 23 students, two high school teachers in teacher training, and eight instructors. Participants attended three career seminars, three facility tours, and a wellness seminar on mental health for students.

In the initial days of the program, students learned about the basics and history of radar, electromagnetic signal processing, and modular radio frequency, and received an introduction to Python and computer-aided design (CAD) software. They also soldered the radar antennas, populated the circuit boards, and assembled their own radar. After assembling their own radar, students learned three signal processing techniques: Doppler, synthetic aperture radar, and pulse compression and ranging. They worked in groups to design

their own experiments and presented their data to Laboratory staff. In addition to the technical material taught by eight instructors, the program included career panels, seminars about college and workplace preparedness, and Laboratory facility tours.

Former instructor Beverly Wong said, “Every part of the lectures reflects experiences that you would have in the real world. Students take their radars out, collect data with them, and test Doppler theory. This comparison between theory and experimentation is something that we do almost every day at the Laboratory.”

The successful two-week program has spun off a variety of programs—a one-day workshop, LLRISE for Teachers, LLRISE for Middle School, and LLRISE Spring Break—and has traveled to the Marshall Islands, Puerto Rico, Rhode Island, Texas, and New Mexico. /



In **10** years, **234** students have graduated from LLRISE. Of these graduates, **98%** are currently majoring or working in a STEM field, including nearly all of the program's first-generation college students. More than **70%** of LLRISE alumni are women.

Left and below: Alumni from the first 10 years of the LLRISE program reconnect at a special anniversary symposium, where they reflected on how LLRISE affected their educational and career paths.



LLRISE 10-Year Symposium

This year marked the 10th anniversary of the LLRISE program. Students, instructors, and teaching assistants (TAs) reunited to celebrate the milestone and reflect on Lincoln Laboratory's radar-focused educational program. LLRISE was the brainchild of K-12 STEM outreach program manager Chiamaka Agbasi-Porter, who still leads LLRISE today. Back in 2012, she worked with Laboratory engineers to adapt an MIT undergraduate course on radar into a two-week curriculum for high schoolers.

"It's rigorous, transformational, and a lot of fun. I am humbled by and appreciative of all the work that so many people have put into the program," Agbasi-Porter said. "LLRISE represents a legacy founded on a commitment to engineering education, underrepresented students, and the community."

During the two-day reunion, former students, TAs, and instructors shared their stories of success and reflected on the influence LLRISE has had on their lives.

"LLRISE set me on a path that I did not expect," said Annalesia Law, an alumna who credits LLRISE with making her consider a future in engineering. In 2022, she graduated from Howard University with a bachelor's degree in mechanical engineering. During her presentation to the current class of LLRISE, McKenzie Ferrari, an alumna and two-time TA, remembered a feeling of acceptance. "Before LLRISE, I didn't have good support to help me get the career that I wanted." Today, she is a dual major in secondary education and physics, studying supernovae. Ferrari encouraged the current LLRISE class to move forward with confidence. "You might think that you don't belong, but you do!" This sentiment has inspired many instructors and students alike to be part of LLRISE.

The LLRISE 10-Year Symposium was preceded by individual reunions for the alumni of each LLRISE class year. The reunions were held virtually, making the 10-Year Symposium even more special, as they could see their former classmates in person. /



Students proudly display the radars used for their personally designed radar experiments during their spring break.

LLRISE Spring Break

In 2021, the two-week LLRISE program was condensed to a one-week course coverable during a high school spring break. This program debuted with the Texas Alliance for Minorities in Engineering, and its huge success led to a repeat offering in March 2022. Twenty-five students and one teacher participated in the program this year. The spring break program remained virtual, using Zoom and the edX platform.

The course was taught by Lincoln Laboratory staff members Ryan Bohler, Aryk Ledet, David Maurer, and David Brigada. Juliana Furgala also assisted students with troubleshooting the radar software. Typically, the full summer program guides the students in building a small radar. However, to limit complexity in the virtual setting, students were sent a preassembled radar. Students designed their own experiments using pulse compression and ranging, a signal processing technique used to measure the distance of objects from a radar.

Four of the LLRISE Spring Break students and one teacher applied to and were accepted into the full-length LLRISE program held in the summer. /

QIANA CURCURU

EMPLOYEE SPOTLIGHT



Do you recommend any particular outreach activity/program to others who are considering volunteering?

I recommend volunteering for LLRISE. It's a great program that helps students from underrepresented communities and not only gets them excited about STEM but also shows them that they can succeed with outstanding results. This mission really resonates with me. My involvement in LLRISE had a profound impact on my life; it taught me a lot about myself and what a person can achieve.

What motivates you to participate year after year?

In my first year as an LLRISE teaching assistant, I recognized aspects of myself in each of the students. They were eager to learn and wanted a space where they could explore their interests. Often, LLRISE is the first time where students are in a community of like-minded thinkers, and this environment allows them to be authentic without social constraints. It is amazing to see the impact on the students as they go to college and eventually have careers of their own.

One reason I am motivated to continue volunteering is that some students are unsure if STEM is right for them and can't see themselves as scientists or engineers without examples around them. I want to

help these students discover their love for science and engineering and provide them with resources that they may not have at home.

How do you manage to make time for volunteering?

I prioritize helping LLRISE every year because it is important to me. I am grateful to all the amazing people who have invested their time to mentor me, so I understand how meaningful good mentorship can be. There are lessons I wish I had known; I hope to pass on these lessons to students to help figure out what career path is right for them. It's important to emphasize to students that being surrounded by other intelligent individuals is something to embrace and that it is okay to not always know the right answer; a culture of asking for help should be fostered.

What would you like other people to know about helping with STEM programs?

I am always looking for ways to make an impact. Volunteering with STEM programs has been one of the most rewarding experiences. STEM outreach has taught me that I can make a difference by encouraging students who may doubt themselves or need some reassurance and self-confidence to succeed on their own.

LLRISE for Teachers

For two weeks in the summer, teachers became students immersed in the 10th annual LLRISE. Though targeting rising seniors, LLRISE also provides an opportunity for high school teachers to be introduced to radar. Daphne Vessiropoulos, K-12 STEM outreach program assistant manager, explained, "We provide teachers with the technical knowledge to bring LLRISE to their schools to extend the program's reach to communities we wouldn't normally have access to."

Radar is seldom part of a high school curriculum, but teachers Esmeralda Hernandez and Liz Raine were looking for ways to engage students in the basics of science and engineering. Esmeralda Hernandez teaches mathematics at Jubilee Brownsville High School in Brownsville, Texas; Liz Raine teaches engineering and physics at the John D. O'Bryant School of Mathematics and Science in Roxbury, Massachusetts.

"Inviting teachers to participate in LLRISE allows us to reach students in areas where access is limited. Teachers can take what

they learned and adapt it to fit their curriculum or use it as an enrichment program," said Chiamaka Agbasi-Porter, K-12 STEM outreach program manager.

Both Hernandez and Raine are excited to take LLRISE back to their schools. "I come from a town that doesn't have many STEM programs," said Hernandez. "I'm going to tell my students about the radars we toured [Millstone Hill and Haystack] and show them how to use the small radar I built."

Raine plans to bring some of the applications of radar back to her biology classroom. One of her ideas is for students to test the speed of sound through air and water mediums containing an object to help students understand echolocation. "I never would have thought about trying to learn about radar in a million years," said Raine. "But I realized you don't need to be an expert to understand how radar works." /



“One takeaway from LLRISE has been networking with Laboratory staff and learning how they engage in both research with real-world impact and educational outreach.”

— LIZ RAINE, LLRISE TEACHER PARTICIPANT

Esmeralda Hernandez (left) and Liz Raine spin a wheel above a small self-built radar system to determine the wheel's speed based on the Doppler effect.

AFCEA Internship Program

Lincoln Laboratory proudly participates in the Armed Forces Communications and Electronics Association (AFCEA) internship program. AFCEA arranges summer internship opportunities for graduating high school seniors who are interested in STEM careers. The Laboratory accepts one to four students as paid interns in a variety of disciplines, such as engineering, chemical and biological defense, optical systems technology, advanced sensor techniques, electro-optical systems, and weather sensing. The interns are invited to tour Laboratory facilities, see the latest research, and learn about different technical career choices.

The AFCEA internship program was on hold in 2020 and 2021 because of the pandemic. In 2022, with safer COVID-19 conditions, AFCEA returned to organizing 22 students in technical internships throughout the Boston area.

At Lincoln Laboratory, AFCEA intern Jessica Chan was sponsored by the Mechanical Engineering Group. “The interdisciplinary nature of the work at Lincoln Laboratory surprised me,” said Chan. “It was fascinating to see people from several different disciplines working together on a project. It broadened my perspective to realize how a variety of scientific fields can help national security in different ways.”

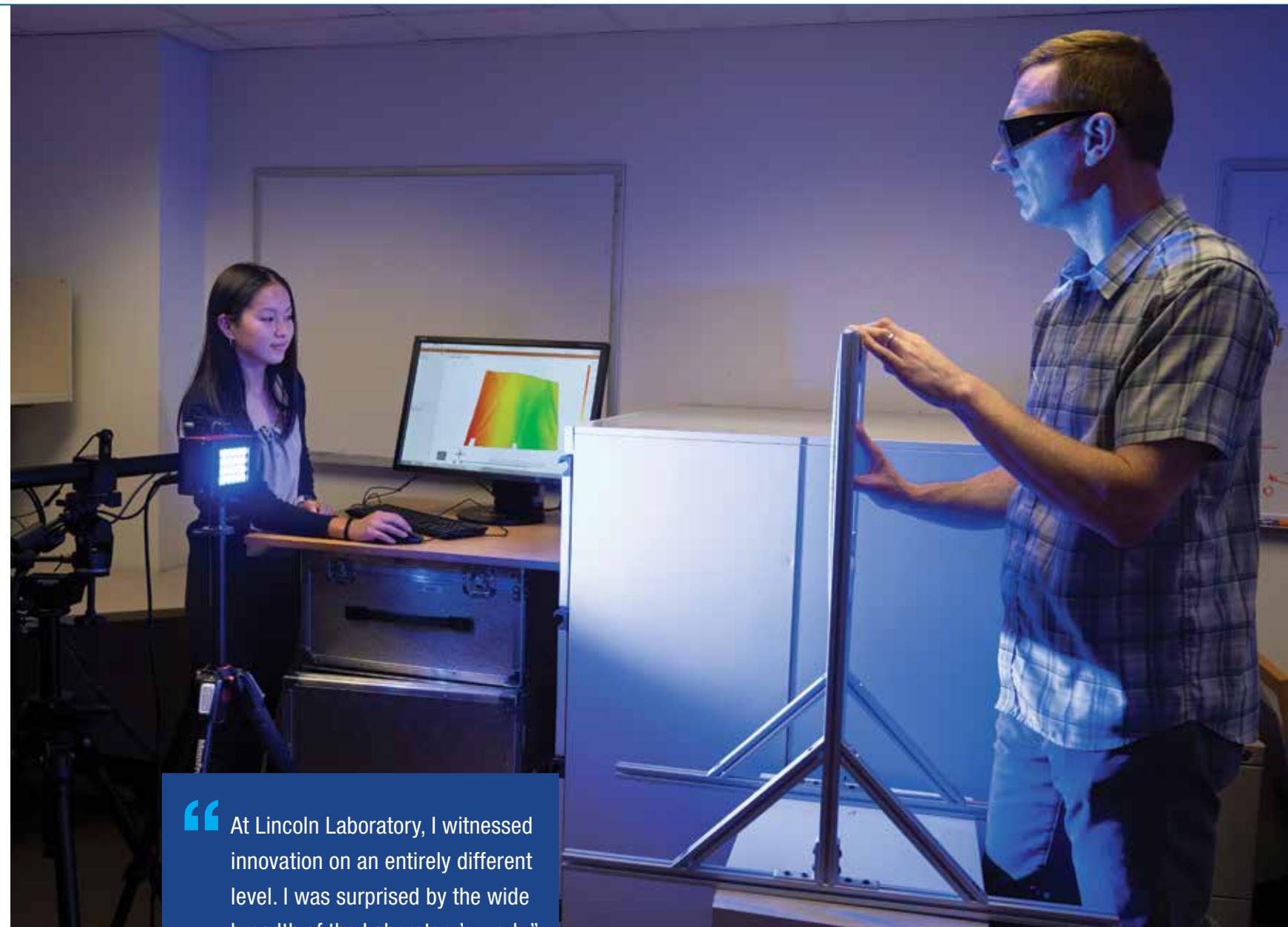
Under the mentorship of Mark Silver and Ryan Little, Chan developed an interactive demonstration using a digital image correlation (DIC) sensor. The measurement technique of DIC uses two cameras to track an object’s position, velocity, acceleration, and strain. Chan learned about DIC and sensor calibration, and became familiar with the Laboratory software used for this technology. She practiced defining a surface component, using point markers for analysis, and evaluating the displacement strain and acceleration of an object. This knowledge was leveraged in creating the group’s demonstration and interactive display for the Laboratory’s Open House in September.

Silver said, “While most of the information was new to Jessica, she was able to come up to speed quickly and apply it to the project in an efficient way.” Her help was beneficial to the entire group; Silver explained, “while we have staff who are familiar with the DIC sensor, we don’t have the time to develop an interactive demonstration.”

Broadening her exposure to hands-on engineering, Chan also assisted with an optical assembly. Chan said, “My mentor made me feel included and supported at the Laboratory. When I had some downtime, he asked me to help with a build he was doing with optics, so I could really get hands on with the tools and equipment. I was granted much more autonomy and independence here than I would have gotten at an internship elsewhere.”

As a firsthand witness of Chan’s skills, Silver said, “Jessica absorbed math and physics concepts very quickly—understanding the concept behind DIC was never a problem for her. She was very willing to learn to set up and use the equipment and work her way through the complicated software of the sensor system.” He advises groups to hire AFCEA interns because the internships “provide an opportunity for young future scientists and engineers to see how science and engineering happens in the real world, before they dive into an academic career. It is important to find the right type of work that can both provide a meaningful experience for the student and useful work for the group or program.”

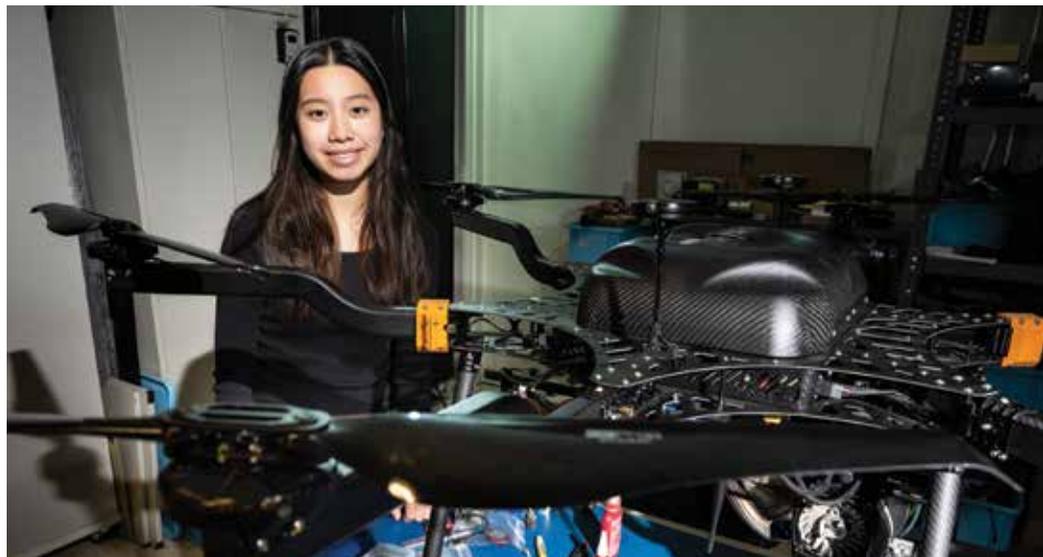
In summarizing her experience at the Laboratory, Chan said, “Through this internship, I have a newfound appreciation for engineering. I plan on taking courses in the engineering school at University of Southern California and getting involved in research opportunities. In the future, I hope I get to return to Lincoln Laboratory.” /



“ At Lincoln Laboratory, I witnessed innovation on an entirely different level. I was surprised by the wide breadth of the Laboratory’s work.”

— JESSICA CHAN, AFCEA INTERN

AFCEA intern Jessica Chan uses a digital image correlation system to measure deformations in the membrane stretched by mentor Mark Silver. The two cameras turn pictures of the membrane into data representing the membrane’s movement.



High school intern Chloe Kindangen assessed the environmental impact of operating drones, like the one seen at left, on wildlife.

High School Interns

This year, the Laboratory’s summer internship program was expanded to offer on-site internships for high schoolers. The internships provide high school students with an opportunity to explore STEM careers before they choose an area of study in college. Laboratory staff selected four interns for the inaugural six-week program, which ran from July to August.

Intern Chloe Kindangen worked in the Advanced Sensor Systems and Test Beds Group to assess the environmental impacts of drones operating at a field site. She researched impacts to wildlife and considered how to mitigate risks posed by light and noise.

Mya Gordon assisted the Tactical Networks Group to structure and program a receiver for a wireless communications-based Battleship-like game, which the group demonstrated at the Laboratory’s Open House event in September. “The Laboratory’s internship program allowed me to apply robotics and programming to real projects and be exposed to different applications of electrical engineering,” Gordon said.

As an intern within the Interceptor and Sensor Technology Group, Ryan Wempen simulated the physics of hypersonic vehicle flight. He applied physics and math laws to real-world scenarios relevant to this expanding field with lots of unanswered science questions.

Veronica Cheng, an intern in the Advanced Concepts and Technologies Group, performed calculations needed to test the range of a thumb-sized car radar. “I had to figure out the dimensions of the reflector that would be compatible with the radar and interpret my results. I really like math and figuring out how things work based on calculations,” Cheng explained.

Students as well as mentors benefited from the internships. Mentors noted that passion for their work was reignited and that questions from young interns helped them consider problems from new perspectives. In future years, the Laboratory hopes to expand the program and recruit more mentors across the Laboratory. /

Girls Innovation Research Laboratory (G.I.R.L.)

Lincoln Laboratory’s G.I.R.L. program provides hands-on engineering workshops primarily for middle and high school girls. Over the past two years, G.I.R.L. workshops have been offered at different schools and organizations in the larger Boston area: Hanscom Middle School, Brookview House, and Girls Inc. While G.I.R.L. prioritizes serving a female demographic and representing women in STEM through a female-heavy staff presence at events, the program also holds co-ed events serving all underrepresented populations. G.I.R.L. workshops were held at Brookview House for the students who live there. Brookview House, in Dorchester, Massachusetts, provides affordable housing and support services for women and children experiencing homelessness. They strive to provide the resident children with hands-on educational support. The three G.I.R.L. workshops at Brookview House used G.I.R.L. curricula taught by Laboratory staff. /

Introduction to STEM

In this March workshop, Laboratory outreach coordinators and teen volunteers from Kiddo Byte supported various Laboratory staff members in introducing 20 elementary and middle school students to STEM. Students engaged in STEM through a hands-on activity, led by Daphne Vessiropoulos, in which they combined baking soda with vinegar to observe a chemical reaction (science); a robotics activity, led by Jeffrey Arena and Bich Vu, in which they learned how to program a robotic mouse to navigate through a maze (technology); a building segment, in which Jennifer Watson encouraged them to explore the concept of structural support when building “skyscrapers” with pipe cleaners (engineering); and a lesson in probability, led by Catherine Lockton, in which they used candy to calculate odds (mathematics). /



Students in the Introduction to STEM workshop at Brookview House program a robotic mouse to move through a maze.

Introduction to High-Performance Computing Clusters

Taught by Julia Mullen of the Lincoln Laboratory Supercomputing Center and assisted by a volunteer from Kiddo Byte, an organization whose mission is to give all kids access to computer science, this workshop introduced students at Brookview House to the idea of high-performance computing by defining supercomputers and their purpose. Mullen explained the basic concepts of distributed computing from remote systems and how data are delivered from companies such as YouTube and Google. To make these concepts more tangible and help outline the benefits and strategies of distributed computing, the workshop included several active-learning simulations designed to build intuition.

Early in the April workshop, to engage the 14 elementary and middle school students and highlight the challenges associated with distributed computing, Mullen asked the students to perform two sorting operations. In the first sort, the students were placed in a single group and sorted themselves by height. In the second sort, the students were randomly assigned to one of two groups and sorted themselves by height, after which the two sorted groups had to combine by moving only one person at a time. Following this activity, they discussed the experiences of the different sorts, what challenges they encountered, and how they might do the process differently a second time.

To provide students with a sense of how parallel algorithms address distributed computing challenges, Mullen had the students act as computing system components to process a task—in this case, completing a 100-piece puzzle. Every student

had a role during the performance of this parallel job. To simulate the leader-worker paradigm, one student, acting out the leader process, gave packets of puzzle pieces to each student (the network). To realize the compute process, students completed their section of the puzzle. Then, each student network walked the packet back to the leader to simulate the receive operation. The leader received the first packet and was involved in both sending more work to the compute processes and assembling the full puzzle. After all of the work was completed, the participants enjoyed the full puzzle and discussed the connection between the work they completed, following instructions, and the concept of an algorithm. /

Introduction to Artificial Intelligence and Machine Learning

In April, 14 elementary and middle school students at Brookview House in Dorchester, Massachusetts, participated in an introduction to artificial intelligence and machine learning (AI/ML)



Olivia Brown, Chiamaka Agbasi-Porter, and Victoria Helus introduce the concept of artificial intelligence and machine learning and help students identify AI technologies.



After learning about artificial intelligence and machine learning, workshop attendees build decision trees by sorting candy.

workshop led by Laboratory staff members Olivia Brown and Victoria Helus. First, participants were introduced to the three parts of AI: data, learning algorithms, and prediction. Brown and Helus walked them through examples of each of these aspects for different applications, such as Netflix’s recommender system. Then, the students played an “AI or not” game in which they were presented with various technologies and asked to identify those that constitute AI. To understand the concept of a particular type of algorithm called a decision tree, the students sorted different candies and decided which characteristics (e.g., wrapper color, ingredients, size), aka the “branches” of the tree, are important for classification.

Brown and Helus also covered the types of mistakes that AI can make, illustrating historical biases that may be present in data, leading the students to discuss AI ethics. At the end of the workshop, students shared how they would use AI for good and were introduced to female engineers and scientists working in the field. “Our goal is to expose students to a new STEM-related topic and show them that there are underrepresented minorities working in this space,” said Brown. Feedback has been positive, with many students asking for follow-on workshops.

This popular workshop was offered again in November, this time at the Charlestown Boys and Girls Club. Helus, Brown, Lindsey McEvoy, and Andrew Schoer supported the event. /

Girls Who Code

From January through May, elementary school girls in third, fourth, and fifth grades at Brookview House participated in Girls Who Code, a program that teaches children how to code in fun, useful, and creative ways. Lincoln Laboratory’s Shamaria Engram assisted volunteers from Kiddo Byte. Together, they taught the girls how to perform programming in Scratch (a drag and drop coding tool) and covered the finer points of “if-then” statements. All lessons led up to the students programming a computer game that lets the user create their own adventure. In addition to teaching technical material, staff members discussed their academic and career pathways to inspire young people to seek STEM careers. Engram enjoys being part of this outreach because she likes being an example to the underserved community. /

Spotlight: Victoria Helus and Olivia Brown

Victoria Helus and Olivia Brown are on a mission to ensure AI literacy for all.

Through the Laboratory's G.I.R.L. program, they have been leading workshops teaching girls and young women about fundamental AI/ML concepts and concerns surrounding safety and ethics. This outreach program inspires girls, many of whom are from underprivileged communities, to pursue careers in STEM. Over the past two years, they have led workshops at different schools and organizations in the larger Boston area: Hanscom Middle School, Brookview House, and Girls Inc. They also participated in a career panel at Pioneer Charter School of Science. The G.I.R.L. program serves primarily females, but also offers co-ed workshops to serve all underrepresented populations.

Previous G.I.R.L. workshops had been offered on related topics like programming and robotics, but Brown and Helus noted a gap. The rising popularity of "code-free coding," in which you

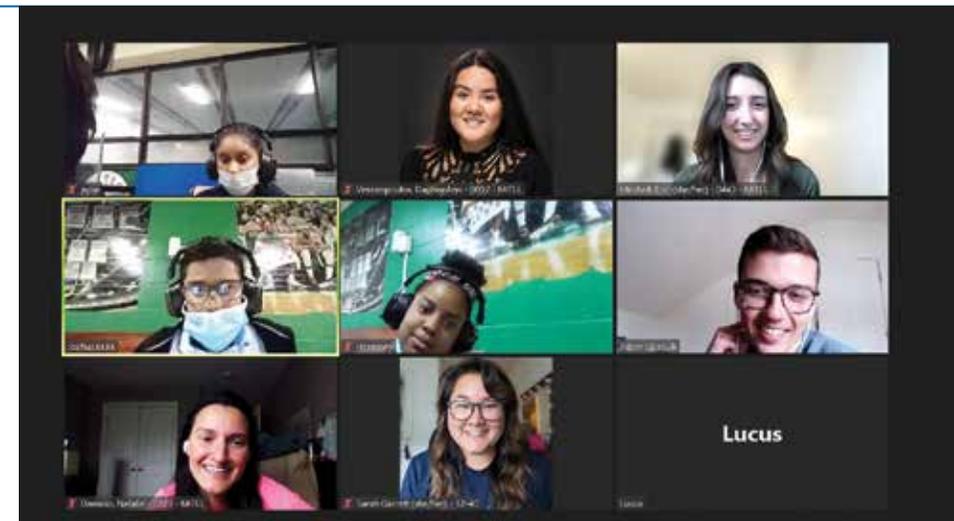
drag and drop boxes according to what you want the code to do, is making people even further disconnected from the math underlying AI/ML systems. That's why these workshops use no screens or computers; instead, Helus and Brown engage students in hands-on activities illustrating high-level concepts and in thoughtful discussion about the benefits and perils of the technology.

Brown and Helus illustrate historical biases that may be present in available data. They refer to instances such as how the first page of results from Googling images of "physicist" shows only men and how translating "She is a doctor; he is a nurse" to a foreign language and then back to English modifies the sentence to "He is a doctor; she is a nurse." These references prepare the students for a group discussion on AI ethics.

"What we really want is AI literacy for everybody," said Helus. "Often, a technology like this harms underserved and marginalized communities the most. For example, facial recognition algorithms are less accurate for people of color. AI literacy should be accessible for all, even if you aren't going into STEM, because the technology is part of our daily lives."

"We want students to be inspired to consider AI as a field they can go into, whether as a computer scientist, mathematician, or lawyer," said Brown. "Representation and diversity in AI are critical to ensuring future technology benefits all people." /

Olivia Brown (left) and Victoria Helus assemble kits for their artificial intelligence and machine learning workshops, offered through the Laboratory's G.I.R.L. educational outreach program.



Members of RCG meet virtually with the students from the Boys and Girls Clubs to explain the basics of coding.

Boys and Girls Clubs

Lincoln Coders

Throughout April and May, technical staff in the Recent College Graduates (RCG) employee resource group volunteered to serve as mentors in Lincoln Coders, a program that teaches students in grades 4–6 the basic concepts of computer science in a fun environment that encourages creativity and collaboration. Developed by RCG and rolled out in 2021, Lincoln Coders features the use of Scratch, a visual drag-and-drop programming language, to make short games, chatbots, and animations. In 2022, Lincoln Coders partnered with the Boys and Girls Clubs of Boston and of Lowell. The RCG volunteers mentored students in basic coding twice a week for eight weeks. Sarah Garrett and Erin Mitchell of the Laboratory led the effort in March to match eight mentors with three to four students, enabling an almost one-on-one mentorship ratio. Laboratory volunteers Kara Breeden, Arthur Chu, Natalie Damaso, Chelsea Lennartz, Michael Perkins, Lydia Zuehsow, and Adam Gjersvik taught the students the basics of Scratch coding via Zoom meetings. When reflecting on teaching coding virtually to a classroom of students, Erin Mitchell said, "My favorite moments

were when a concept would click with one student, who would go around to the other students in the room to explain and help them find the right buttons on their screens—they helped teach each other in a way that we couldn't because we were virtual."

Leaders of the course reported that Scratch programming is great at making learning feel like a game, noting that the students were engaged with the material and excited to learn. They also pointed to the statistic that 100% of the Lincoln Coders mentored in 2021 indicated they planned to continue coding in the future, arguably the main goal of coding outreach.

"An early education in programming is incredibly beneficial," Mitchell said. "It helps students foster an interest in STEM and equips them to pursue careers in fields like programming, robotics, and web design." "I wish I had been able to take part in a program like this when I was growing up," Garrett said, to which Mitchell added, "And I love being able to host one now!" /



Participants in the first Light, Vision, and Spectra workshop build their own light crystals using a do-it-yourself kit from KiwiCo.

of color perception. George closed the workshop by leading an activity in which students practiced building a color-mixing light-emitting diode (LED) crystal, with the goal of using the crystal to assess whether mixing colors of light works the same as mixing colors of paint. The activity allowed students to learn about simple circuitry and exercise tactile skills.

“We were all happily surprised by how bright and willing to engage the students were,” Martell said. “They were full of curiosity and bright questions right out of the gate.” When asked about a repeat performance, Martell said, “The students were so enthusiastically engaging with the material that we weren’t able to cover it all! We plan to schedule a second event, focusing on animal vision, imaging with different types of light, and an interactive activity using diffraction glasses.” /

Light, Vision, and Spectra

In early 2020, Bethany Huffman, Michelle George, and Riley Martell developed a new STEM outreach workshop on the topic of light and vision. Once the pandemic hit, there was no opportunity to host the event in person because of the workshop’s hands-on component. But in November 2022, the workshop took place at the Boys and Girls Clubs of Boston for an audience of middle school boys and girls.

Huffman began by introducing light spectra, light reflection, and what makes color. Martell then described how the human eye interacts with light and how we perceive color, and showed images of color illusions highlighting the intricacies

Artificial Intelligence/Machine Learning

Children of all ages at the Charlestown Boys and Girls Club participated in a workshop discussing the concept of AI and ML in November. The format was the same as that of the workshop Victoria Helus and Olivia Brown presented at Brookview House under the G.I.R.L. program. Lindsey McEvoy and Andrew Schoer assisted in explaining what AI is and isn’t, discussed ways that AI can fail, and illustrated how best to program ethically. Students were taught to identify AI and used candy to explore an algorithm design sorting technique called a decision tree.



Participants in the Artificial Intelligence/Machine Learning workshop play a game of “AI or Not.” By way of a ping pong paddle marked “AI” on one side and “Not AI” on the other, the students identify different technologies, ranging from a toaster to a self-driving car, that constitute AI.

At the end of the workshop, students were asked how they would use AI for good and were introduced to some female and underrepresented minorities working in the field. /

Student-Industry Connects

For one week in April, Mass STEM Hub hosted Student-Industry Connects, a new breed of science fair program that provides a transformative learning experience for K–12 students across the United States. Mass STEM Hub is an educational administration organization that works alongside K–12 schools to provide applied learning and STEM programs developing students’ critical thinking, complex problem solving, and collaboration skills, which are crucial to their college and career success in a rapidly changing world.

In Student-Industry Connects, middle and high school students submit a computer science, engineering, or biomedical science project that solves a problem. They share their ideas with industry mentors, who submit constructive feedback for improvement and reinforce in-class learning, offering a glimpse of how industry solves real-world problems. Student-Industry Connects provides an easy way for students to show off their hard work to an authentic industry audience—a connection that helps make coursework more motivating, engaging, and meaningful.

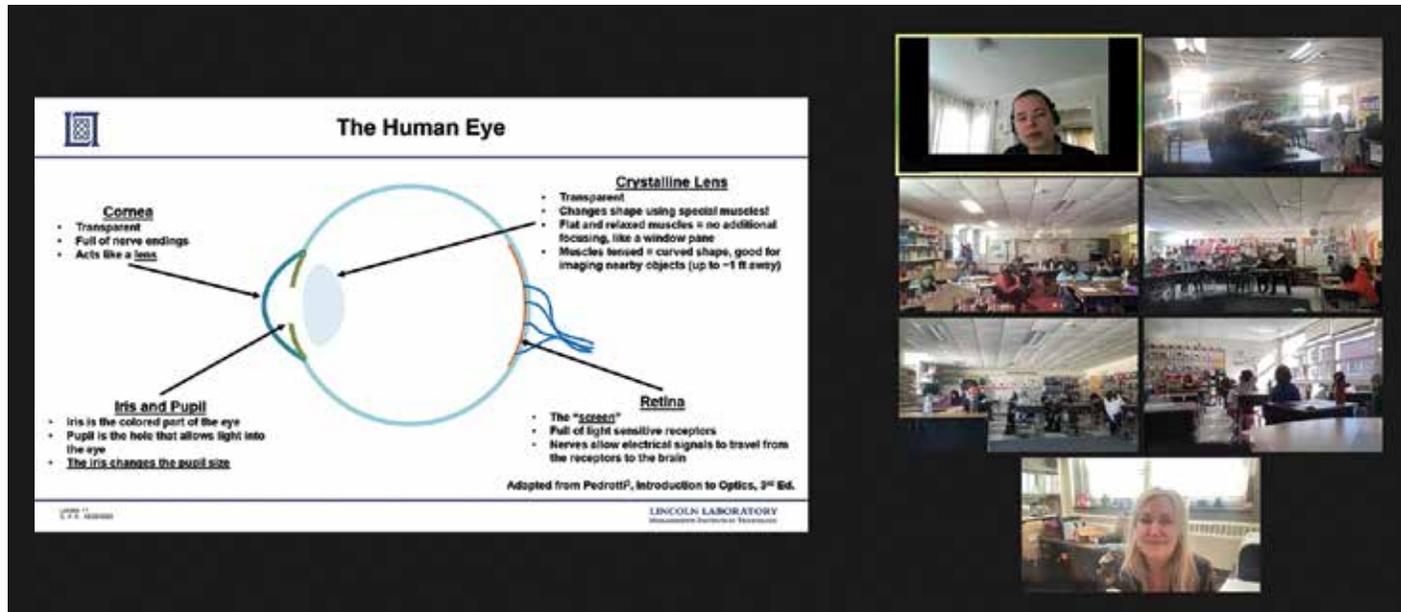
Lincoln Laboratory staff volunteered to work with local classes to review proposed projects through an online portal. To share insights about their career path and profession, mentors can choose to connect with the students virtually. Laboratory mentors included Matthew Truch, Charlotte Shabarekh, Dominick Pipitone, and Philip Tomezsko. /

STEAM Discovery Night and Science Fair

Before 2020, no STEM-based activities were offered at the elementary school level in Wayland, Massachusetts. During the 2019–2020 school year, Laboratory staff members Janice Crager and Ekaterina Sergan formed a parent/teacher organization-led STEAM (science, technology, engineering, arts, and mathematics) committee that planned and hosted Wayland Public School’s first-ever STEAM Discovery Night and Science Fair.

For the premiere STEAM Discovery Night in February 2020, students created their own science projects and posters to share at the Science Fair. Local organizations—including the Discovery Museum, Girls Who Code, and iRobot—hosted information booths about their STEAM programs. Lincoln

Laboratory was proud to be part of this school’s successful STEAM program debut, with former Laboratory staff member John Yirrell leading an interactive radar demonstration and Chiamaka Agbasi-Porter creating an interactive planetary surface station for children to explore. At another station, participants built a mini light saber while learning about circuits and used Ozobots to practice programming robots to follow a drawn line. In January 2021, Brice MacLaren and Megan Richardson gave a Zoom presentation, “Water Resiliency in Puerto Rico.” In January 2022, the STEAM Discovery Night theme was “Lights! Sound! Action!” Nicolas Malyska presented “Hearing Sound Direction,” during which children wore headphones and learned how slight time shifts change how sound direction is perceived. /



Ekaterina Sergan shows third-, fourth-, and fifth-grade students at Claypit Hill Elementary School how the human eye works and how a lens may affect vision.

CHIAMAKA AGBASI-PORTER

EMPLOYEE SPOTLIGHT



Lincoln Laboratory’s K–12 STEM outreach program manager, Chiamaka Agbasi-Porter, loved math and science in high school and yearned to improve her skills. But she was shy and struggled to ask teachers for extra ways to learn. “I didn’t know how to find opportunities,” said Porter, who went on to earn degrees in chemistry. “As I entered my field, I thought about all the students who don’t know where to start.” Reaching these students has become her life’s passion.

Over more than a decade at the Laboratory, Porter has cultivated an educational ecosystem that impacts hundreds of students every year. Her programs open possibilities for kids who may not otherwise have the resources to pursue STEM interests.

The more than 20 programs that Porter coordinates transform lessons into fun, hands-on challenges. Students hack code, program mini autonomous cars, build circuits, and engineer tiny satellites. She strives to be what she once looked for as a young student: an advocate for underserved kids, a kind and passionate educator, and a selfless mentor.

However, the end of the program is often the start of her mentorship in earnest. She connects students to internships, writes college recommendations, and helps them look for employment. “The main goal is to enable students to pursue STEM careers,” Porter said, adding that a major part of that is helping minority students persist through college.

For Porter’s many contributions to STEM learning, MIT honored her with a 2022 Dr. Martin Luther King Jr. Leadership Award, which recognizes MIT members who embody the “spirit of community” and Dr. King’s work.

As for the future of STEM education, Porter is focusing on how to reach other demographics who may not have access to STEM opportunities. She is deeply committed to creating new programs that enhance STEM education for our next generation.



Curiosity consumes attendees of the “Undersea Technologies” Science on Saturday as they watch an underwater autonomous vehicle track the bottom of the tank floor and prepare to share video results of its discoveries.

Science on Saturday

Each school year, more than 2,000 local K–12 students, parents, and teachers attend Science on Saturday demonstrations hosted by Laboratory technical staff volunteers. Since the program’s origin in 2006, attendees have enjoyed watching and participating in demonstrations on rockets, robotics, computers, acoustics, lasers, sound, sight, and weather. Over the past year, Lincoln Laboratory’s Science on Saturday returned to an in-person format when possible. Science on Saturday demonstrations in 2022 spanned topics from the ocean to outer space.

In October, Andrew March, David Whelihan, and Carrie Seiberling hosted “Undersea Technologies” and described the different ways that sound and robots are used to explore the ocean. To illustrate how sound travels in water, March and Ben Evans played music via a hydrophone in a fish tank (filled with water but no fish). This event used a real underwater test tank to show participants how an autonomous underwater vehicle can explore an environment by itself. Whelihan, Jared Monnin, and Richard Czerwinski explained that the remote vehicle was programmed to drop to

the bottom of the tank and report what it saw. Once the vehicle returned to the surface, the video feed from the vehicle showed the interesting objects found underwater, including SpongeBob’s pineapple house and LEGO Stormtroopers. Participants visited a second station hosted by Riley Martell and Carrie Seiberling to learn about buoyancy and a third station helmed by Byung Gu Cho and Daphne Vessiropoulos, who explained how to build a remotely operated vehicle at home and how to create a two-switch circuit from a single-power source.

In December, Sarah Willis, a staff member working at the Laboratory’s field site on Kwajalein Atoll, hosted “Water Worlds: The Search for Life in Space.” The show, streamed live from Kwajalein, was supported by stateside staff, who presented in-person demonstrations for those local to the Greater Boston area. Willis explained how water and life are interconnected, and why the search for life in other galaxies has to begin with the search for water. She discussed where we might find worlds capable of supporting life elsewhere in the galaxy.

Laboratory staff members in Lexington, Massachusetts, Jordan Wynn and Marina Furbush, then gave participants a closer look at some of the tiny life forms found in water on Earth. They also demonstrated the basic principles of transit photometry. /



In the “Water Worlds: The Search for Life in Space” Science on Saturday show, an attendee gets an up-close look at micro-organisms found in pond water.

Beaver Works Summer Institute

Building a 3D-printed prosthetic hand, designing a virtual grocery shopping assistant, and using machine learning to detect COVID-19 from the sound of a cough—these are just a few of the projects students worked on during the Beaver Works Summer Institute (BWSI). This annual four-week program for rising high school seniors offers hands-on, project-based learning experiences for students to engage in STEM.

The program was conducted virtually in 2021 but also included in-person programs at the Laboratory's field site on Kwajalein Atoll in the Marshall Islands. More than 350 students from nearly 30 states participated, and the program ended with a live, webcast final event, which included student project demonstrations and competitions.

"The students learned a lot in a short span of time and demonstrated their new skills successfully," said Sertac Karaman, an academic director of BWSI. "The programs that they are enrolled in are inspired by our courses and research at MIT. The subjects are very deep and exciting."

Since starting in 2016 with just two courses, BWSI, now in its sixth year, expanded that selection to 13 courses: Autonomous RACECAR Grand Prix, Autonomous Cognitive Assistant (Cog*Works), Autonomous Air Vehicle Racing, Autonomous Underwater Vehicles Challenge, Build a CubeSat, Unmanned Air System—Synthetic Aperture Radar, Data Science for Health and Medicine, Remote Sensing for Disaster Response, Serious Game Design and Development with Artificial Intelligence,



Students in the RACECAR course learn how to train an autonomous vehicle to follow colored lines using color priority swapping through a queue. The racecar is able to automatically turn to follow a colored line on the ground and can be directed to drive toward multiple final destinations given the state of the car.

Assistive Technology, Embedded Security and Hardware Hacking, Cyber Security in Software Intensive Systems (CSIS), and Quantum Software.

One of the newest additions to BWSI was the CSIS course, which taught students the basics of hacking and web security while emphasizing ethics and allowing them to perform hands-on security assessments of web services. Many of the students had never used a terminal prior to the course, but by the end of the month, they had scanned through services hosted on a virtual private cloud on Amazon Web Services and demonstrated their hacking abilities in a capture-the-flag exercise.

"The core takeaway of the course is the idea that all it takes fundamentally to do this kind of work is optimism and persistence to try a bunch of stuff and believe that you can read the documentation and figure out what you are supposed to do next," said CSIS lead instructor Noah Luther.

The students praised BWSI's handling of the virtual format. "From the daily speaker seminars to our individual courses, this summer

was one of the most intellectually stimulating summers of my life," said one student. "Even though the program was virtual, I still felt the effort put into making the program engaging and stimulating, especially for a program that was free."

Some students liked their BWSI courses so much that they brought what they learned back to their own communities. One student, who designed a stool to help people with a disability reach the upper shelves in their kitchen, was inspired to establish an after-school program and online community based on BWSI's Assistive Technology course for her local high school and surrounding schools.

Another student pointed out the benefit of the daily seminars from business leaders, and, in doing so, highlighted a main goal of BWSI: "Listening to speakers from a multitude of fields opened my eyes to the range of possibilities for my future career." /



Hundreds of students from the 2022 Beaver Works Summer Institute gather virtually to explore engineering and technology.



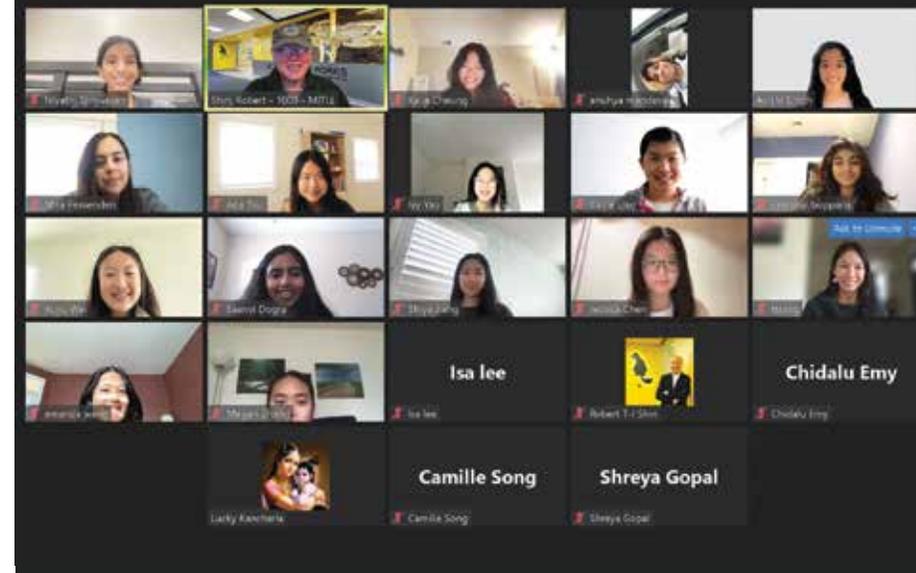
Above: Students from Kwajalein and Ebeye participate in Lincoln Laboratory's BWSI program. **Left:** Kwajalein students in the BWSI program "test drive" their robots to determine if the code that tells the robot how to follow a specified path needs adjustment. Photo: Stephanie McCutcheon



BWSI – Kwajalein Atoll

On Kwajalein Atoll, the BWSI program has enjoyed its third summer of offering high school rising seniors the opportunity to perform the hands-on work of engineers and programmers. The two-week program, which mimics the one offered in Massachusetts, provides a unique opportunity for students in an extremely remote Pacific Island environment to explore project-based STEM learning using a modified version of the BWSI Autonomous RACECAR curriculum. American students from the U.S. Army Garrison Kwajalein Atoll and the host nation

of the Republic of the Marshall Islands collaborate on international teams to learn how to code in Python and program self-driving mini racecars. The students build collaboration and leadership skills, gain deep exposure to career opportunities across STEM fields, and learn valuable course-specific skills related to coding and robotics. The program finale featured autonomous vehicle races and was attended by the larger community of islanders, Lincoln Laboratory staff members, and Army personnel. /



Participants in the Girls Who Code program meet with Robert Shin, director of Beaver Works and creator of the BWSI program.

“BWSI gave me the confidence and foundation to continue pursuing engineering in college and possibly as a future career.”
— BWSI STUDENT

BWSI Girls Who Can and Yes! You Can!

Beaver Works Summer Institute offered beginner courses to engage students in a variety of subjects, encouraging beginners to build, make, and learn. No prior experience is required, and the courses are set up in a fun, low-stress environment. The courses, which take place virtually over eight weeks, are offered as a spring program, “Yes! You Can!” for students in grades 9–10, and as a fall program, “Girls Who Can,” for 11th-grade girls.

Students select from among six BWSI-inspired courses that let them try their hand at STEM-related activities:

Program Autonomous Cars. Students are introduced to Python programming, machine vision, and control algorithms to code an autonomous model car.

Design, Build, and Fly Model Aircraft. Students interested in aerospace and aeronautics are introduced to aerospace engineering. Model airplanes and wind tunnels are used to demonstrate concepts.

Learn Many Interesting Things (From Transistors to Data Science). Students cover technologies that shape our world, including computer architectures, coding, machine learning, and computer vision.

Program Cognitive Assistants. Students in this artificial intelligence course are introduced to coding in Python, natural language processing, and machine learning. Students then use these concepts to build an autonomous cognitive assistant.

Analyze the Building Blocks of Life. Students learn about genomics, programming, data visualization, and digital biosecurity. This course mimics BWSI's Computational Biology course and the Microbiome course co-developed by MITRE and Lincoln Laboratory. /

BWSI – Build a CubeSat Challenge

In the spring and fall, BWSI hosted a Build a CubeSat Challenge, partnering with several networking organizations: the Society of Women Engineers, the National Society of Black Engineers, and the American Institute of Aeronautics and Astronautics. High school students on teams of five were led by teachers and mentors to build, learn, and demonstrate the operation of a CubeSat. Over 15 weeks, participants attended self-paced online courses to learn how to design, build, and test a satellite prototype. After completing modules on orbital dynamics; the space environment; systems engineering; and satellite development tools, including Python programming, the students engaged in a series of hands-on projects, culminating in a final presentation.

Each team began developing their hardware skills by building a FlatSat (a large motherboard where satellite avionics modules can be installed and connected as if they were inside a real satellite) and taking a picture of their team with a Raspberry Pi camera. They used the FlatSat to learn about the parts of the satellite through subsystem labs. During their final project, the students

applied everything they learned about satellites, space, and engineering to design their very own prototype CubeSat (a 1U category satellite, measuring 10 cm on each side and weighing 1.33 kg) for a real science mission. This year, the organizers worked with Collin Ward and Paul Fucile from Woods Hole Oceanographic Institution to look at using CubeSats with an imaging sensor to detect plastics in the ocean. Rebecca Keenan of Lincoln Laboratory served as the lead instructor. Each team submitted a design review video to get feedback from judges. Applying feedback from judges and mentors, the students implemented their design and built a mini satellite capable of detecting colored pieces of plastic in the ocean. They submitted a video demonstrating their CubeSat’s performance, which was shared with the public on the BWSI YouTube channel. MIT professor and Build a CubeSat Challenge instructor Kerri Cahoy shares her love of CubeSats on an annual basis: “It’s fun to encourage students to be creative and take risks and see what they come up with. But really, it’s a mutual discovery. That’s the best part of the job.” /



Professor Kerri Cahoy, Build a CubeSat Challenge instructor, shares insight on MIT’s Space Telecommunications, Astronomy, and Radiation Laboratory during the 2022 workshop.



The 24 students participating in Lincoln Laboratory CIPHER—held at the Beaver Works Center in Cambridge, Massachusetts—gather outside. Laboratory instructors David Wilson and Ariel Hamlin are in the front middle.

Lincoln Laboratory CIPHER

Twenty-four students in grades 8 through 11 spent a week in August at the Beaver Works Center in Cambridge, Massachusetts, to learn about modern theoretical cryptography in this year’s Lincoln Laboratory CIPHER (LLCIPHER) workshop. Students not only learned about the importance of modern cryptography and encryption methods but also explored more complex topics such as pseudorandom number generators, zero-knowledge proofs, and blockchains. On the final day, they studied multiparty computation, a method that can reveal the results of a

computation without revealing the data that were used to do the computing. Using dice, students added up how many stuffed animals they owned as a group without revealing their individual counts. The program also included a short seminar about the college admissions process at MIT.

Laboratory staff member Ariel Hamlin led this year’s workshop. She helped with the workshop in prior years and took it over from David Wilson, who led the program for the past few years. Joining Hamlin and Wilson as instructors were Laboratory staff

members Noah Luther, R. Nicholas Cunningham, J. Parker Diamond, Dhir Patel, and Hanson Duan.

“Every day there were new surprises,” said Lakshya Jain, a high school student from Wrentham, Massachusetts. Jain was surprised at how in depth the program was in terms of subject matter: “I think the most interesting thing we learned was zero-knowledge proofs and how you can prove something without giving any knowledge away.”

Hamlin said she couldn’t pass up the opportunity to continue bringing cryptography to young minds. “Classes like these show kids that they can learn things beyond the core subjects in high school. I hope that even if they don’t pursue cryptography, they go forward and find their own passion.” /

Mentoring Beyond LLCipher – Benjamin Zelnick

When Benjamin Zelnick, an alumnus of the 2021 LLCipher program, needed a mentor for a science fair at his school, he didn’t need to look very far. He already knew how eager scientists at Lincoln Laboratory were to help a budding engineer. He inquired about a mentorship possibility and was paired with Uri Blumenthal, who met virtually and via email with Zelnick from March to May. Blumenthal volunteered to help Zelnick choose and develop an idea for a paper or project. Zelnick’s original goal was to specify how wireless local networking could allow access to cached resources in remote areas without reception or significant infrastructure. He wanted to expand on the idea of an ad-hoc mesh network where nodes discover each other, share their knowledge, and



The LLCipher program, which began eight years ago, prioritizes small classes for increased teacher-student interaction and mentorship.

dynamically update their status, using at-hand communications like Bluetooth, Wi-Fi, and high-frequency and very high-frequency radio. Blumenthal not only helped his mentee better understand networking protocols and the finer points of designing a new Internet Protocol (IP) but also guided him in seeking resource material. As Zelnick acquired more content, Blumenthal started conducting regularly scheduled Zoom meetings and weekly mentorship. Now, Zelnick is focused on writing and publishing a formal paper on his project, with a long-term stretch goal of developing a prototype. “Mentoring was a very positive experience,” said Blumenthal. “It’s a great opportunity to guide and teach bright young people, with the possibility of them joining the Laboratory in several years.” /

Robotics

Over the past 12 years, Lincoln Laboratory has led a strong robotics outreach program. Several staff volunteers have served as coaches and mentors to students from kindergarten through 12th grade to build and program LEGO robots to compete in the FIRST (For Inspiration and Recognition of Science and Technology) Robotics Competition. While Lincoln Laboratory robotics outreach took a hiatus due to the pandemic, Vitaliy Gleyzer mentored a team (The Gummy Bears) on his own with great success.

The Gummy Bears competed in the FIRST Lego League (FLL) Challenge, a global event encouraging young students to explore STEM through LEGO-based robot competitions. Each year, FLL teams receive a map and ping pong-sized table full of LEGO pieces, with which the teams design and program a robot to complete specific map-based tasks set forth by FLL according to a theme related to a real-world problem. The research theme for the 2021–2022 FLL season urged participants to design ways to deliver cargo in a way that addresses efficiency issues and environmental impacts.

The team of sixth and seventh graders quickly learned how to program their robot to complete several specific challenges and practiced making their robot more efficient at each task. In December 2021, the team’s robot design won the Champion’s Award (first place) at the FLL state tournament, and the team’s project, “Aerial Package Delivery for Cluster Communities,” won second place (semifinalist) in the FIRST Global Innovation Competition. These awards propelled the team to the international-level competition at the FLL World Festival in Houston, Texas—a trip sponsored by Lincoln Laboratory. The team of budding engineers and programmers were recognized with a Robot Design Finalist Award at the World Festival, where they presented their robot to people from around the world and exchanged ideas on how to improve robots.



The Gummy Bears robotics team, mentored by Vitaliy Gleyzer, won the Massachusetts State Championship and the Robot Design Finalist Award at the World Festival during the 2021–2022 FIRST Lego League season. The team is shown here practicing for the Championship event.

Gleyzer said, “What I enjoyed the most about working with this team were the endless aha moments when the kids learned a new concept that was so complicated and foreign to them just a moment before but became obvious in hindsight.”

The team also developed an outreach plan to get more kids interested in robotics. A self-produced video about the FIRST program was sent to local schools, and the team still actively seeks new opportunities to share their experience. /

Spotlight: Coding for Kids, By (Older) Kids

Excerpt from *The Boston Globe*, February 21, 2022

On a snowy Saturday morning in early February, a group of kids piles into the classrooms at Brookview House in Dorchester, ready to learn computer science with the help of 17-year-old Robbie Khazan and the Kiddo Byte team.

Inside the classrooms, brainstorming begins. A group of girls shouts out ideas for games they can create on Scratch, an introductory programming language for kids. Two volunteer instructors record the various game designs that pop up. The girls pick a choose-your-own adventure game. Down the hall, the boys ultimately decide on recreating a popular app they already play, called Geometry Dash.

All the while Kiddo Byte founder Khazan is ducking between classrooms, helping teach the eager students, who range in age from 8 to 13. The Arlington High School senior harbored a love for coding from an early age, and began his nonprofit, offering free computer science courses for kids, in the fall of 2020 after seeing the enthusiasm of his younger sister and her friends as he taught them how to code. Khazan soon expanded Kiddo Byte's services to the children who need it most: those who don't have access to coding classes. "I wanted to make the biggest impact I could with Kiddo Byte, as an opportunity to do something more meaningful than just teaching programming to kids who could pay for it," said Khazan.



Kiddo Bytes helps children at Brookview House practice coding in a big screen format so the whole class can learn by watching and then by doing. Together, they test the code to see if it works as planned.

Spotlight (continued)

Arlington High School student Robbie Khazan leads a Zoom class for his online coding academy for young students, Kiddo Byte. Photo: WickedLocal.com



Khazan found a match in Brookview House, a nonprofit that serves women and children experiencing homelessness. Brookview already offers youth programming, including a Girls Who Code class that Kiddo Byte recently took over, and was looking for someone to lead a boy's computer science program. Kiddo Byte now offers two-hour classes twice a month at Brookview.

Even though it's run by teenagers, Kiddo Byte has some serious supporters. Last year, it won grants from the Akamai Foundation and Whole Foods, and current partners include MIT's Lincoln Laboratory as well as the university's Office of Government and Community Relations. When Lincoln Laboratory heard who Kiddo Byte serviced, it agreed to provide monetary support. Last June, the Laboratory helped Kiddo Byte donate nine Chromebooks to Brookview kids,

which Khazan said was "incredible." Lincoln Laboratory employees have since joined Kiddo Byte classes as instructors, giving the kids access to wisdom of professional programmers.

Still, most volunteers at Kiddo Byte are high school students, 39 in all, who teach classes, work on marketing and fundraising, and onboard new volunteers.

"We're able to help kids even if they're not going to become a computer scientist by giving them access to a tool to express their creativity, and something tangible to point to and say, 'I made that'" said Khazan. "I think every single kid, no matter where they're from, that's going to affect their life trajectory because it gives them something to create and be proud of." /



Thomas Sebastian shares engineering tips to help kids design a 3D-printed airplane.

Design Your Own Airplane

Reuben Hoar Library in Littleton, Massachusetts, underwent significant changes in the past year, including a new building, new staff, and a new focus on providing STEM outreach activities. The first such activity focused on engineering design and 3D printing. Laboratory staff member Thomas Sebastian volunteered to teach a half-day class at the library for 11- to 14-year-olds interested in learning how to use a 3D printer. The students learned the basics of flight and airplane design concepts and how the 3D printer could incorporate a design into a “working” model, namely, one that could fly or glide better than a paper airplane. Sebastian has shared his knowledge of 3D printing with several other groups of varying ages, always with very good results. The participants were attentive and had a lot of fun trying to get their airplanes to fly.

The senior librarian for young adult services, Catherine Sebastian, received positive feedback from parents and participants: “One parent described how she had been trying to explain to her son that 3D printing wasn’t just for making cute toys but also for enabling engineering design to move forward in new ways, and this program hit that nail on the head.” She added that the library is “definitely interested in incorporating more STEM programming generally—and 3D printing specifically—into our young adult services going forward, and this event was a great way to start!” /



Lisa Kelley and Joel Grimm attend the Massachusetts Manufacturing Mash-Up to increase awareness about the Laboratory’s STEM outreach.

Massachusetts Manufacturing Mash-Up

Laboratory outreach managers Chiamaka Agbasi-Porter and Daphne Vessiroopoulos, and Beaver Works managers Lisa Kelley and Joel Grimm connected with people attending the second annual Massachusetts Manufacturing Mash-Up, a conference that draws people and manufacturing businesses together to solve challenges impacting the manufacturing industry. Organized by the Center for Advanced Manufacturing at the MassTech Collaborative, the Commonwealth of Massachusetts, MassHire, MassRobotics, FORGE, Massachusetts Manufacturing Extension Partnership, and Worcester Polytechnic Institute, the conference includes

sessions related to cybersecurity, robotics, workforce development, and working with the Department of Defense. While attending the conference, Lincoln Laboratory staff networked with some of the more than 700 attendees, mostly teachers and students, and shared information about the Laboratory’s various STEM programs to help students gain hands-on experience with engineering, manufacturing, and innovating. The outreach staff helped parents and students understand the Laboratory’s most popular STEM programs—like LLRISE, LLCipher, G.I.R.L., and BWSI—in hope of attracting more students from the Worcester area. /

“ Studying STEM creates endless opportunities, and we hope more students can see themselves in STEM.”

— KIM DRISCOLL, MASSACHUSETTS LT. GOVERNOR, CO-CHAIR OF THE STEM ADVISORY COUNCIL

Massachusetts STEM Week

Massachusetts STEM Week takes place during the third week in October and is organized by the Executive Office of Education and the STEM Advisory Council in partnership with the state’s nine Regional STEM Networks, of which Lexington falls into the Metro West Network. STEM Week is a statewide effort to boost the interest, awareness, and ability of all students to see themselves in STEM opportunities. Young women, students of color, English language learners, and students with disabilities continue to be underrepresented in STEM fields, yet they make up a large percentage of the overall workforce.

STEM Week offers both in-person and virtual events across the Commonwealth. Schools, nonprofit organizations, colleges, museums, and businesses all participate to host and organize STEM Week events for students in preschool through college. Lincoln Laboratory Community Outreach attended three events during Massachusetts STEM Week in 2022: Framingham State University’s Open House, Mass STEM Hub’s Challenge Showcase, and Pioneer Charter School of Science’s Career Panel. /

Framingham State University’s Open House

On October 14, Laboratory staff hosted a table at Framingham State University’s STEM Week Open House at the McAuliffe Center. The goal was to promote interest in integrated STEM learning. At this festival-style event, staff had the opportunity to explain a few of the Laboratory’s STEM outreach programs and increase awareness among families with children at the middle and elementary school level. The Lincoln Laboratory booth featured two activities: programming and wiring gumdrops to function as a keyboard, and using a computer to play piano in a preprogrammed Scratch application. Laboratory volunteers Chiamaka Agbasi-Porter, Daphne Vessiropoulos, and Yari Golden-Castano talked with families about electric circuits while children were busy with the demonstration. /

Mass STEM Hub’s Challenge Showcase

On October 21, Laboratory volunteers traveled to the Reggie Lewis Center in Boston, Massachusetts, to attend the Mass STEM Hub event, created to facilitate interactions between industry representatives and the Metro West community to help students discover STEM careers. The staff showcased the Laboratory’s outreach programs—emphasizing the hands-on engineering basics students are exposed to—to families with elementary and middle school students. The event included the Challenge Showcase, a competition that is part science fair and part career research. More than 150 schools participated, guiding students to research STEM careers while building confidence and presentation skills. Thomas Sebastian and Phillip Daniel from Lincoln Laboratory volunteered to evaluate several projects in which student teams presented pitches about engineering careers in high demand. The judges were tasked to authentically connect the dots between coursework and careers while interacting with students, offering suggestions, and sharing details about their own careers. /

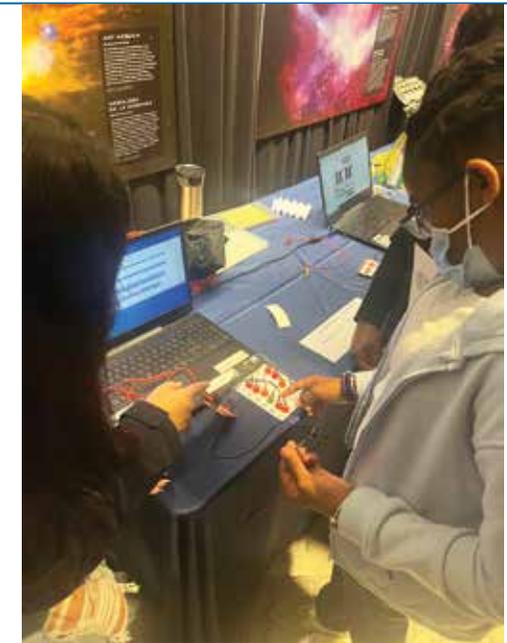
Pioneer Charter School of Science’s Career Panel

Lincoln Laboratory and the Pioneer Charter School of Science in Everett, Massachusetts, have an evolving collaboration to inspire students in grades 9–12 and help them picture themselves in STEM careers. The school celebrated Massachusetts STEM Week on October 20 by hosting a career panel with scientists from several prominent companies. Lincoln Laboratory’s Jessica Johnson volunteered as a guest speaker and delivered a 40-minute talk about manmade objects in space, working in the aerospace industry, and what types of classes students may take as a pathway to such a career. Johnson engaged the children with the thought of going into space and introduced them to all the other aerospace jobs that take place on the ground. She spoke about her work experience at Lincoln Laboratory and SpaceX, and the different launches that she assisted with. Finally, Johnson shared launch videos and mission patches with the children.

Johnson has a history of volunteering in a variety of STEM outreach programs. “I know what kind of impact events like these can have on kids’ futures,” said Johnson. “I got into STEM because of a single passing comment a teacher made in high school about the world needing more female mathematicians, so being able to stand in front of a group of young folks and help them see STEM fields as accessible and exciting feels really valuable to me.”

Johnson added that the question-and-answer session after her talk was the best part: “The students had great questions about space debris, space sustainability, and what kinds of coding and engineering fields may be helpful for their futures in this type of career. I enjoyed volunteering and will definitely do it again!”

Reflecting on STEM Week, Daphne Vessiropoulos, the K–12 STEM outreach program assistant manager, felt it was a great way to inspire the next generation of STEM professionals and help students connect their classroom learning with future opportunities. /



Daphne Vessiropoulos (left) helps a participant understand how an electric current works as they use a Makey Makey kit to program gumdrops to serve as a keyboard.



Jessica Johnson tells students of Pioneer Charter School of Science what to expect from a career in the space industry.

Spotlight: Lincoln Laboratory Open House

On September 10, attendees lined up to enter the Laboratory’s Open House event—the first held since 2016. The Open House offered 7,400 registered visitors the opportunity to tour many of the Laboratory’s local facilities, including main buildings, the Flight Test Facility, 3 Forbes Road, the Sensorimotor Technology Realization in Immersive Virtual Environments (STRIVE) Center, and the Lincoln Space Surveillance Complex.

“My favorite part was walking down the corridors and seeing smiling families and the enthusiasm of the staff providing demonstrations,” said James Kuchar, co-chair of the Open

House Committee. “You can tell when people are proud of their work and their workplace.”

Curious attendees had access to nearly 100 demonstrations and activities hosted across Laboratory facilities and organized by staff from every corner of the Laboratory. Many demonstrations, like the egg drop, were hands on, while others simply exhibited Laboratory work.

“My favorite part of the event was watching kids of all ages pick up the Artificial Intelligence–Guided Ultrasound Intervention Device (AI-GUIDE) and move it to a target

Participants try aiming a phased array to focus high-power electromagnetic energy into a focused beam, represented by colored lights.



“Open House brings employees and families together to participate in science and technology demonstrations and celebrate the Laboratory’s extraordinary heritage.”

— DAVID GRANCHELLI, CO-CHAIR OF THE OPEN HOUSE COMMITTEE

Spotlight (continued)



The Autonomous Systems Development Facility on Hanscom Air Force Base featured many demonstrations, including a swarm of uncrewed aerial vehicles, an artificial intelligence–driven racecar, and a life-sized virtual pong game.

location by following a gamified display. It was rewarding to see their excitement after they tried out a demo, and I see a new generation of engineers and scientists in the making,” said Laura Brattain, one of many staff demonstrating a Laboratory technology. “I was pleasantly surprised by how many people with medical backgrounds stopped by the demo and shared insightful comments and enthusiasm.”

For many Laboratory employees, this event was the first opportunity for their families and friends to see what they do in person. “My kids enjoyed the activities, seeing my office, and learning more about the work we do at the Laboratory. In particular, they enjoyed the Autonomous Systems Development Facility,” said Navid Yazdani. “I really appreciate the Laboratory holding this event; my kids left with an increased interest to pursue STEM fields and do well in school.” Opening other places like the machine shop, cleanrooms, and Microelectronics Laboratory helped visitors and employees understand the wide array of technical areas covered at the Laboratory.

The Open House is typically held every five years, and this event was originally meant to coincide with the Laboratory’s 70th Anniversary but was delayed due to the pandemic. “While walking around the event, I heard one young attendee say ‘I wish this was every weekend!’” said James Caruso, who helped organize the event. “Open House took a lot of planning, but we know how much employees and their families value this event, so it is well worth it.” /

A Laboratory staff member helps an attendee learn about the sound cues humans use to maintain situational awareness while wearing helmets, headphones, or other items that cover the ears.



Massachusetts Science and Engineering Fair

The Massachusetts Science and Engineering Fair has rebuilt itself during the last two years to be an event that can function virtually if necessary. Part of this redevelopment included hosting speakers from technical organizations, like Lincoln Laboratory, to present talks about what motivated them to follow a technical career path. Thomas Washington, a test pilot who works at the Laboratory's Flight Test Facility, was happy to talk to high school students about what sparked his decision to become a test pilot. As a child, Washington was already obsessed with military aircraft, good at math and science, and mechanically inclined. But, in Washington's case, inspiration came from the big screen. In 1983, when the movie "The Right Stuff" was released, Washington was introduced to the concept of a test pilot and learned how being a pilot and an engineer could intersect. When asked why he chose to volunteer, Washington said, "I think it's important to provide kids interested in STEM a roadmap for how to get from where they are to where they want to be—particularly for kids from traditionally underrepresented demographics. If they can see that a path exists, they are more likely to believe that they can do it, too." /



Thomas Washington inspired students at the Massachusetts Science and Engineering Fair by sharing how and why he chose to be a test pilot for Lincoln Laboratory.

Science Fair Judges

The Pioneer Charter School of Science sought volunteers to judge their virtual Science Fair for grades 9–12 and 6–8, held on January 27 and 28, respectively. This volunteer opportunity could require as little as a two-hour commitment or last the entirety of the two-day event. Richard Kingsborough, Sandi Glynn, and Charlotte Shabarekh answered the call for volunteers and generously offered their time to review science projects over Zoom.

Project topics ranged from computer science to electrical engineering. Judges used a rubric to grade student projects, with an emphasis on providing constructive feedback. Shabarekh was

impressed by the breadth and depth of students' knowledge and analytical reasoning skills. She said, "Even though the format was virtual, we were able to see the amount of work that students invested in their projects."

Reflecting on his first time serving as a science fair judge for this school, Kingsborough said, "I enjoyed the experience. The projects were all quite interesting, and the kids were engaging and enthusiastic during their presentations, even over Zoom." Both Kingsborough and Shabarekh plan to volunteer next year and look forward to in-person judging. /



Students at Excel Academy Charter High School meet with Lincoln Laboratory Community Outreach staff to learn about the many STEM programs available throughout the year.

Excel Academy Job Fair

Lincoln Laboratory Community Outreach publicized its offerings at the Summer Opportunities Fair at Excel Academy Charter High School in East Boston in March. Approximately 500 students in grades 9–11 heard information about the Laboratory and its mission. In an attempt to recruit Excel Academy students for Lincoln Laboratory STEM programs, Laboratory outreach managers Chiamaka Agbasi-Porter and Daphne Vessiropoulos described the Laboratory's new high school internships and various summer and extracurricular opportunities—like Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE), Lincoln Laboratory Cipher, Girls Who Code, and Lincoln

Coders—that help students "try on" technical careers. For example, students saw a "homemade" radar to understand what students build on their own during the LLRISE summer program. The ultimate goal of the Laboratory's presence at fairs such as this one is to have more students from these particular schools participate in the Laboratory's STEM programs. /

Junior Achievement of Greater Boston

On December 9, the Laboratory's outreach staff attended a new event from Junior Achievement (JA) of Greater Boston: the JA Inspire Virtual Career Expo. This inaugural expo was held to introduce Inspire, a hands-on career readiness program and exploration fair for eighth-grade students in Greater Boston. JA Inspire encourages students to start exploring career options early through dynamic interactions, activities, and booth presentations. The 13 Boston-area schools that attended learned about several Lincoln Laboratory STEM programs, including LLRISE; Lincoln Coders; and Lincoln Laboratory Courses for Accessible, Technical Education (LL EduCATE).

The Lincoln Laboratory booth featured two activities. Daphne Vessiropoulos helped students use Makey Makey kits to program gumdrops in Scratch and wire them to function as controllers for Super Mario games. Chiamaka Agbasi-Porter hosted a demonstration of a working radar, built in the Laboratory's LLRISE summer program, so students could track their movements and distance from the radar. Students learned about electric circuits, programming, radar, and the Laboratory's STEM programs. /

02 EDUCATIONAL COLLABORATIONS

Inspired by employee desires to connect with the community and motivate student interest in STEM, our outreach initiatives include:

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



Interns in the 2022 Summer Research Program gather in the Laboratory's lobby for a group photo.

Summer Research Program

Each year, the Laboratory offers undergraduate, graduate, and military students the opportunity to spend their summer at the Laboratory gaining hands-on technology research and development experience through the Summer Research Program. Typically, students contribute to projects that complement their courses of study and have opportunities to interface with national

experts in numerous fields of research, work with the Laboratory's state-of-the-art resources and knowledgeable staff on real-world technical problems, and present the results of their research conclusions at the end of the summer. In 2022, 194 students participated in the Summer Research Program. /



Left: Laboratory summer interns attend the I3C’s final event in the auditorium. **Above:** Members of the first-place-winning MILDFIRE team present their project at the I3C “Interns vs. Sharks” competition.

Intern Innovative Idea Challenge

The Intern Innovative Idea Challenge (I3C) is an engineering challenge offered to interns every year as part of the Laboratory’s Summer Research Program. However, because of the worldwide COVID-19 pandemic, the event was put on hiatus for two years. For the first time since 2019, the I3C was held again in summer 2022 and saw a record number of participants—more than 100 interns attended the kickoff in June, and 37 teams were formed, the greatest number of teams in I3C’s six years of existence.

The I3C helps students get hands-on engineering experience in a competitive yet cooperative and enriching environment in which they apply what they learned during their internships to solve real-world problems. Interns form teams, come up with a specific challenge they want to solve, and apply their knowledge of science and engineering to propose a technology design that could address this problem.

Six teams advanced to the final “Interns vs. Sharks” event in August, which is inspired by the business reality television show “Shark Tank.” Each team presented their idea to a panel of judges comprised of Lincoln Laboratory leadership, including the Laboratory’s director, Eric Evans. The Microwave Imager and Laser Device for Fire’s InfraRed Emissions (MILDFIRE) team won first place for their proposed constellation of CubeSats that could monitor wildfires from space. The Rapidly Deployable Private 5G Networks (DiReNet) team came in second place with their idea to provide emergency personnel with voice and data communication using a 5G network that could be brought online within 72 hours after a disaster. The Deorbiting Inactive Satellites in Low-Earth Orbit (DR. CLEANS) team won third place for their inexpensive method of using CubeSats to deorbit defunct satellites. /



The Laboratory’s 2022 GEM fellows gather for a group photo.

University Cooperative Education Program

Technical groups at Lincoln Laboratory employ students from area colleges and universities, such as Northeastern University and Wentworth Institute, under cooperative education agreements. The students work full time with mentors during the summer or work/study semesters and part time during academic terms. Between July 2021 and June 2022, approximately 75 co-op students from area schools were employed in technical divisions and service departments at the Laboratory. /

GEM Fellowship Program

The National Consortium for Graduate Degrees for Minorities in Engineering and Science (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.

GEM fellows work as summer interns while completing their studies and receive financial support—often the deciding factor in their pursuit of graduate education. The internship process also allows companies to access and recruit talented candidates that they may not find otherwise. GEM fellowships at the Laboratory offer the students numerous returns, from networking opportunities to high-level research experience. /

Albert Kodua, a materials engineering student at Virginia Tech, was one of the students who joined the Laboratory this summer as GEM fellow; he worked in the Advanced Materials and Microsystems Group to analyze different materials and determine which of them would be most suitable to use on a space satellite to deflect incoming solar arrays. Kodua also participated in the Intern Innovative Idea Challenge, with his team placing third overall. He described it as “one of the best experiences I have ever had at an internship.” Kodua is the first person in his family to pursue graduate studies and will have his master’s degree completely paid for with the Laboratory’s help.

GEM fellow Sayde King is a computer science and engineering PhD candidate at the University of South Florida. While at the Laboratory, she worked on a project that aims to leverage wearable sensors to predict musculoskeletal injuries before they occur. For her research, she collected data from U.S. Marine recruits as they participated in the final recruitment training challenge known as the Crucible. “Aside from the amazing opportunity to make a significant contribution on a project with so much potential for impact, I would have to say the relationships that I’ve made during my time here are an unmatched takeaway,” King said. During her fellowship, King had the opportunity to connect with her mentor, Shamaria Engram, a Lincoln Laboratory technical staff member and University of South Florida alumna. /



For GEM fellow Albert Kodua, his summer at the Laboratory was his first in-person engineering internship. Kodua dedicated his internship to researching and developing satellite technology.



Sayde King, far left, attends the Crucible event at the Marine Corps Recruit Depot on Parris Island, South Carolina.



Scan here to read more about Albert Kodua's and Sayde King's internships at Lincoln Laboratory.

RYAN BOHLER

EMPLOYEE SPOTLIGHT



What outreach programs have you been involved in?

I’m actively involved in the Lincoln Laboratory Radar Introduction for Student Engineers (LLRISE) and the Intern Innovative Idea Challenge (I3C). I was previously involved in Robotics Outreach at Lincoln Laboratory (ROLL).

For LLRISE, I’ve provided the Introduction to Radar lecture for seven years and the Introduction to Signal Processing lecture for three years, in addition to assisting the students with their building, experimentation, and presentation development for their radar projects. As a mentor for I3C, I’ve helped guide interns in developing their ideas and creating presentation posters for their independent projects (in parallel with their actual internship work). I met with them a few times a month and advised them on poster content and format for optimal presentation in the Poster Challenge. When I was involved with ROLL, I attended regional events to judge competitions of students’ robotics projects.

What motivated you to become involved in these programs?

I wanted to become involved in these programs because they were great opportunities to help form and foster interest in STEM activities among students. LLRISE especially is a good opportunity to help students who are trying to decide on their college and career plans.

What is an outreach opportunity you would like to try out?

I would like to be involved in more of the local outreach opportunities that include younger students interested in exploring STEM. Science on Saturday is a great example of an outreach program that exposes young students to a variety of topics to encourage interest. I would also be interested in volunteering as a mentor for FIRST [For Inspiration and Recognition of Science and Technology] Robotics, helping a local team develop a robot to be used in the FIRST Tech Challenge.

Massachusetts Microelectronics Internship Program

The Massachusetts Microelectronics Internship Program (MMIP) offers a 10-week, full-time internship opportunity in microelectronics and hardware to freshmen and sophomores registered at Massachusetts universities. This summer, in the program's very first season, a cohort of 20 students spent the summer interning at different Massachusetts microelectronics companies. They received personalized mentorship and

participated in a variety of training events and visits to other microelectronics companies such as Raytheon Technologies, MITRE, and Lincoln Laboratory. On these visits, they learned about semiconductor fabrication, entered a cleanroom facility where some of the most advanced chips for satellites are made, and tried to hack modern microelectronics chips. /



Students participating in the Massachusetts Microelectronics Internship Program visited Lincoln Laboratory in summer 2022.



Matthew Alpert, shown in this photo taken at the University of Virginia, is one of five Laboratory Activate fellows who concluded their two-year fellowships this year. Alpert now works as the chief technology officer of RadiantNano, the company he developed during the Activate program. Photo: Activate.

Cybersecurity Mentorship Program

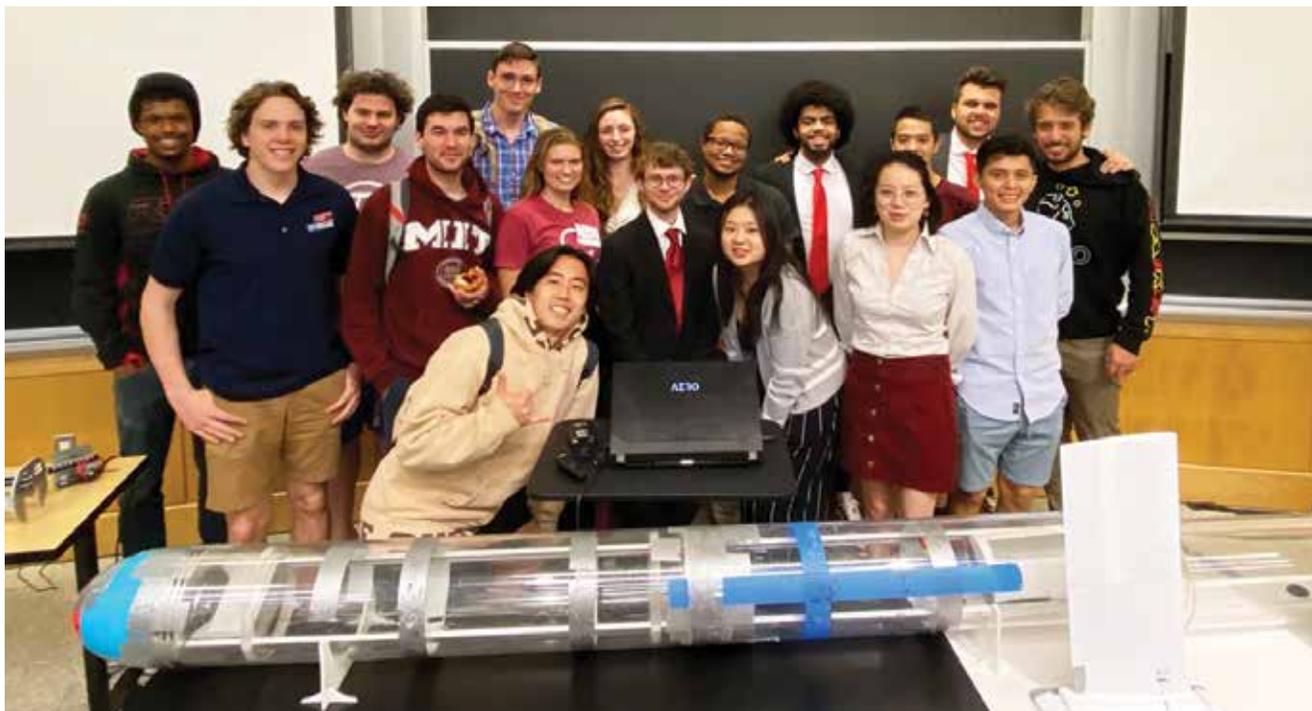
The MassCyberCenter was launched with a vision to enhance opportunities and increase diversity for the Massachusetts cybersecurity ecosystem while strengthening the resiliency of the Commonwealth's public and private communities. This year, the MassCyberCenter at the Massachusetts Technology Collaborative selected 41 students from 18 schools across Massachusetts to participate in the spring Cybersecurity Mentorship Program, offering students an opportunity to work together with industry leaders on real-world cybersecurity projects. Of the 41 selected students, eight worked with Lincoln Laboratory staff members who served as their mentors. /

Activate Fellowship Program

The Activate fellowship is a two-year program that allows science and engineering entrepreneurs to embed with national organizations to learn the fundamentals of building a startup. The fellows are funded by the Defense Advanced Research Projects Agency and are managed by Activate, a nonprofit organization that works with government, philanthropic, and industry partners to support scientists and engineers as they advance hard technologies. Activate fellows embedded at the Laboratory have access to state-of-the-art facilities and equipment, expert staff, and networking opportunities that will help them build their companies. In 2022, five Activate fellows concluded their two-year fellowship period and graduated from the program, while four fellows will continue to work with the Laboratory until 2023. In addition to the current fellows, Activate selected one new fellow to join the Laboratory this year. /



Above is a screenshot from a virtual presentation given by Danesia Patterson, one of the students accepted into the spring 2022 Cybersecurity Mentorship Program. Patterson's mentor was Jeffrey Gottschalk, the assistant head of the Laboratory's Cyber Security and Information Sciences Division.



Students in the spring 2022 Beaver Works capstone course pose for a photo with the underwater glider they developed and tested.

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.

During the spring 2022 session, students in the mechanical engineering capstone course continued to work on a low-cost unmanned underwater glider they had developed the previous year. The glider contains a weight that allows the vehicle to sink to the ocean floor or rise to the surface, depending on the position of the internal weight. The vehicle was fully assembled, and its buoyancy mechanism was successfully tested at the MIT Recreation Center's pool. Possible applications for the technology include monitoring and collecting data on underwater volcanoes, seismic events, plastic waste in the ocean, and climate-related ocean conditions like salinity and temperature. /

BEVERLY WONG

EMPLOYEE SPOTLIGHT

Why did you decide to become a mentor?

Throughout my career, I have been fortunate to have amazing mentors. I started with informal mentorship when I first joined the Lab and then had my first experience in a formal mentoring program through Circle Mentoring, a program led by the Lincoln Laboratory Technical Women's Network (LLTWN). Even today, I receive mentorship from colleagues I've worked with over the years. Finding value in the mentorship I've received, I decided to volunteer and contribute to the formal Laboratory mentoring program. I've also volunteered to mentor high school and college students who have attended our summer programs and internships.

What is the most rewarding part of your experience?

The most rewarding part of mentoring is meeting and getting to know new people. I enjoy hearing about their experiences and learning about their groups' mission and work culture. I've learned many practical career development skills by working with them to create plans to meet their goals or address their current challenges or concerns.

What would you like other people to know about mentoring?

Mentorship is a symbiotic relationship, where knowledge, experiences, and solutions are shared and both parties gain from meeting. Successful mentoring is an optimal way to help a mentee realize their potential.





Laboratory staff regularly teach courses related to science and technology through the MIT Professional Education Short Programs.

MIT Professional Education

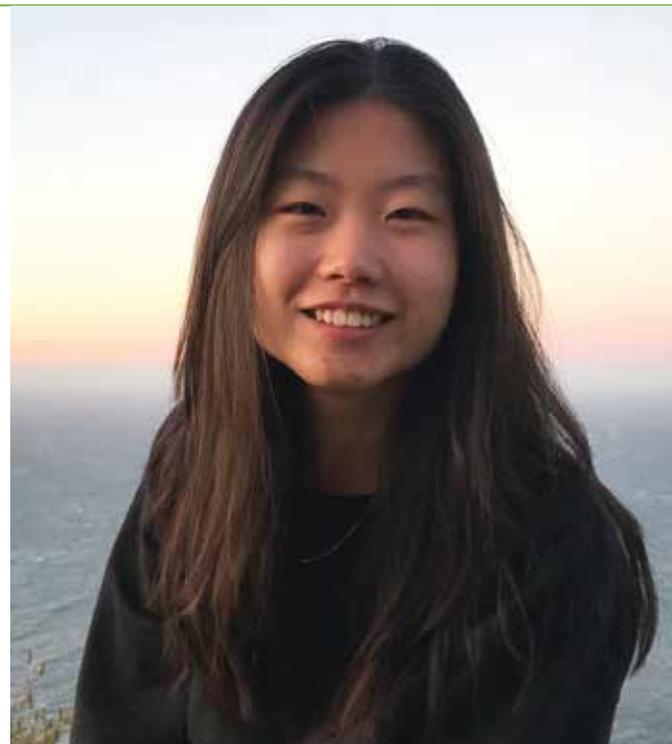
Lincoln Laboratory collaborates with MIT faculty to offer courses through MIT's Professional Education Short Programs. These professional education courses attract participants from industry and business to the campus for topics designed to expand familiarity with emerging technologies, like biotechnology, 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. /

MIT 6-A Master of Engineering Thesis Program

Lincoln Laboratory offers a variety of research and internship opportunities to university students. Candidates in MIT's 6-A Master of Engineering Thesis Program may spend two summers as paid Laboratory interns, participating in projects related to their fields. Then, the students work as research assistants while developing their theses under the supervision of both Laboratory engineers and MIT faculty. In 2022, six students conducted their thesis research at Lincoln Laboratory. The Laboratory also typically employs about a dozen other research assistants from across MIT's engineering departments. /



Lincoln Laboratory is an industry partner of MIT's Department of Electrical Engineering and Computer Science 6-A Master of Engineering Thesis Program. The program matches industry mentors with students in their junior year of study who have demonstrated excellent academic preparation and motivation.



Lucy Cai spent her summer at the Laboratory testing neural network codes for image conversion through the MIT Undergraduate Research Opportunities Program.

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.

One of the students who interned at the Laboratory this summer was Lucy Cai, a computer science student at MIT. Cai worked in the Laboratory's Active Optical Systems Group on a project that involved using machine learning to convert 2D images into 3D point clouds. "I think Lincoln Lab incorporates the research-like environment of academia with the real-life impacts of industry, which is a rare combination," Cai said. "Now that I know it's possible to get the best of both worlds, I would like to pursue a career that will allow me to do similar work. I am also grateful to have gotten a taste of both software and hardware work, and my experiences on both sides will certainly guide me as I look toward finishing my degree in college."

“ I loved learning about all of the different impacts each group's work in the Laboratory has. From disaster relief to combating drug trafficking, it was very cool to witness the extent of the power that these technologies could have.”

— LUCY CAI, MIT UNDERGRADUATE RESEARCH OPPORTUNITIES PROGRAM INTERN



Scan here to read more about Lucy Cai's internship at Lincoln Laboratory.

RYAN BURROW

EMPLOYEE SPOTLIGHT



Why do you think mentorship is important?

We have all experienced being new to something, not knowing where to look or who to ask. Growth and learning are universal experiences, and a good mentor helps you to be the best version of yourself. Most of us probably wouldn't be where we are without some sort of mentor, and I think it's our job to continue that cycle of support.

Why should other people consider being a mentor?

As a mentor you get the chance to share your experiences and wisdom with your mentee(s). But it's also an opportunity for you to learn and grow.

What moment made you feel the proudest?

I got a message from a few of the interns on the I3C [Intern Innovative Idea Challenge] team I got to mentor, letting me know they'd won second place overall. In that message, they thanked me for all the support I'd given them over the summer. They already had an amazing idea and had put in tons of work before I was paired with them, and my role was really to guide their vision and passion into something they could complete and present at the end of the challenge. Knowing that I had a significant positive influence on their experience was a pretty great feeling.

Military Student Programs



Military officers representing the U.S. service branches participate in technology research and development at the Laboratory through the Military Fellows Program.

Military Fellows Program

Every year, the Military Fellows Program offers military officers pursuing graduate degrees or advanced education the unique opportunity to engage in R&D at the Laboratory. Fellows are directly involved in developing capabilities important to national security and relevant to their individual fields of study, and in turn, Laboratory staff benefit from the officers' unique insights pertaining to the military's needs and goals. For graduate students, the military fellowships cover tuition and fees and require that

the students perform thesis research at the Laboratory. Officers enrolled in a service school program do research at the Laboratory while taking courses in national security management at MIT campus. Since the program's start in 2010, more than 300 fellows have worked alongside Laboratory staff mentors. Because of the COVID-19 pandemic, the program has begun supporting both in-person and remote work for fellows. /



ROTC cadet Viet Tran worked in the Laboratory's Homeland Sensors and Analytics Group developing docking systems for autonomous vehicles through the military summer internship program.

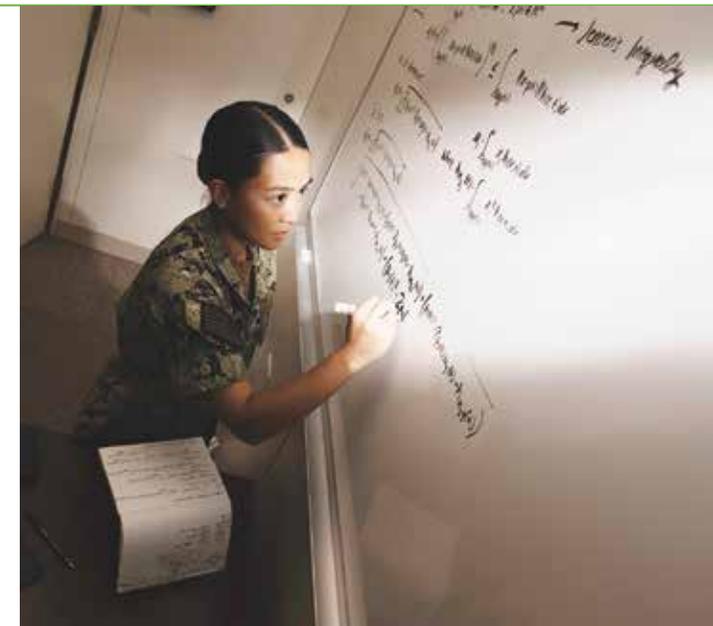
Military Summer Internship Program

Military interns spend three to five weeks of their summer working at Lincoln Laboratory under the Military Summer Internship Program. The program has been held at the Laboratory yearly since 2012, but because of the COVID-19 pandemic, it was paused from 2020 to 2021. The onsite internship program resumed this year, and military interns representing the U.S. Naval Academy, Air Force Academy, Coast Guard Academy, Military Academy, and Army Reserve Officers' Training Corps (ROTC) program spent four weeks of their summers developing technology at Lincoln Laboratory.

U.S. Army ROTC cadet Viet Tran plans to pursue a career in robotics, and interning in the Laboratory's Homeland Sensors and Analytics Group gave him the opportunity to research a docking mechanism that allows an unmanned aerial vehicle to land on top of an unmanned ground vehicle during a mission. Tran said the hands-on experience and team environment helped his leadership and technical development.

"I had the wonderful privilege of learning from leading Department of Defense employees and working alongside team members with diverse backgrounds and thinking perspectives, which ultimately broadened my open-minded approach to problem solving," Tran said.

One of the benefits of the military internship program is that interns can use what they learned in the classroom to solve real problems facing the military. Midshipman Kelly Bye, who is studying operations research at the U.S. Naval Academy (USNA), was able to apply her lifelong love for math to a Lincoln Laboratory project that seeks to improve processes for detecting bioaerosol threats.



U.S. Naval Academy midshipman Kelly Bye conducted R&D related to bioaerosol threat detection as a military intern in the Laboratory's Counter Weapons of Mass Destruction Systems Group.

"I believe the most important lesson from this internship is learning to work with others in a real-world research environment," Bye said. "No matter how many classes I take at USNA, none of them will be able to teach me what the real world is like."

Bye plans to continue pursuing research at USNA as well as a master's degree, and hopes to be selected as a submarine officer after commissioning from the academy. /



Scan here to read more about Viet Tran's and Kelly Bye's internships at Lincoln Laboratory.

SOCOM Ignite

The Special Operations Command (SOCOM) Ignite program is a yearly innovation pipeline that brings together SOCOM operators, military students, and researchers to find solutions to real-world problems, such as big data analytics, uncrewed system autonomy, human-machine teaming, and real-time generation of actionable intelligence from battlefield sensors. The SOCOM Ignite Innovation Challenge kicked off its third installment in September 2022 at MIT campus and Lincoln Laboratory.

At the kickoff event, SOCOM operators outlined their most pressing challenges. Military students then worked with teammates and mentors throughout a two-day ideation and

hackathon event to jump-start their projects. During the school year, the teams will build prototypes of their solutions, with some participants returning for internships at the Laboratory for further development. Select teams have the opportunity to continue developing their concepts, with the goal of reaching a stage where projects can be transitioned to SOCOM for operational use. This year, SOCOM Ignite grew to include more than 100 cadets from 18 universities, representing the U.S. Army, Air Force, and Naval Reserve Officers' Training Corps. Mentors included 18 Lincoln Laboratory staff members. /



Military students joined Lincoln Laboratory and MIT research staff for the SOCOM Ignite Innovation Challenge kickoff weekend, which was held from September 16 to 18.



Students collaborate during the AI Accelerator's Autonomous Cognitive Assistance course at MIT's open learning space in Cambridge, Massachusetts, on March 28, 2022. Photo: Vicente Pamparo

AI Accelerator Course

The Artificial Intelligence Accelerator (AIA) is a joint effort between MIT and the Department of the Air Force (DAF) to conduct research and development related to the ethical application of AI algorithms and systems to advance the Air Force and society in general. In spring 2022, the AIA held a capstone AI course at the MIT open learning space in Cambridge, Massachusetts. The Autonomous Cognitive Assistance, or CogWorks, course is part of the AIA's efforts to lead the way in supporting critical DAF AI education

needs. Sixteen DAF employees from Air Mobility Command, Air Combat Command, Air Force Life Cycle Management Center, 557th Weather Wing, 618th Air Operations Center, 837th Cyber Operations Squadron, and National Air and Space Intelligence Center participated in the five-day inaugural course. The course taught students how to develop algorithms to create AI capabilities, and armed them with the skills and confidence needed to use the algorithms within their respective units. /



Jesse Thaler, a particle physicist and MIT professor, visited the Laboratory to present a lecture about dark matter as part of the Technical Education Committee course, Intro to Modern Physics.

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. From 2021 to 2022, 11 staff members were enrolled in the program. Almost 200 staff members have pursued full-time technical graduate work through the Lincoln Scholars Program. /

Part-Time Graduate Studies Program

The Part-Time Graduate Studies 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. From 2021 to 2022, 20 employees participated in the program. /

Technical Education Committee Onsite Courses

Lincoln Laboratory offers technical education programs designed to help employees expand their knowledge and versatility in unique areas across the Laboratory. The programs offer both short-term and semester-length courses taught by Lincoln Laboratory technical staff or by outside experts. For the 2022 spring semester course Intro to Modern Physics, MIT physics professor Jesse Thaler was invited to give a special lecture at the Laboratory. In his talk, titled "Confronting the Invisible Universe," Thaler presented evidence for the existence of dark matter and the efforts underway at MIT and around the world to detect dark matter. The fall semester of the Technical Education Committee program offered courses on topics including Decision Making Under Uncertainty, Electromagnetics and Antenna Technology, Electronic Warfare, ISR Systems and Technology, Hyperspectral Imaging Remote Sensing, and Systems Engineering Using Model-Based Systems Engineering. /

IEEE Boston Reliability Chapter

The Laboratory encourages employees to participate in professional societies. The Boston Chapter of the IEEE Reliability Society holds events yearlong to provide a forum for members to discuss aspects of reliability engineering, such as technology design, manufacturing, and testing. Every month during the academic year, the chapter coordinates a networking event with presentations about topics in engineering, and, once or twice a year, it holds a tour of a local company. Since 2012, the Laboratory has hosted most of the chapter's monthly meetings. Because of the COVID-19 pandemic, the chapter started to hold its meetings online in 2020 and has continued to do so. /



Daniel Weidman (top row, center), a technical staff member in the Laboratory's Mission Assurance Office, and other members of the Boston Chapter of the IEEE Reliability Society attend one of the chapter's regularly held Advisory Committee meetings, at which members plan future meetings and other activities.



The 2022 Technology Office technical seminars series featured talks given by Ahmad-Reza Sadeghi, professor of computer science at the Technical University of Darmstadt; Mathias Payer, associate professor at the Swiss Federal Institute of Technology School of Computer and Communication Sciences; and Eli Pollock, co-founder of the company Ontologic. /

Technology Office Seminars

Technical talks motivate and inspire staff while facilitating working relationships. The Technology Office directs a program of seminars presented by both in-house speakers and renowned researchers from universities and industry. The seminars reflect current and leading-edge trends in today's technology. The 2022 program included seminars on "The Art of Systems Security: Lessons Learned from Building and Attacking Secure Computing Systems," delivered by Ahmad-Reza Sadeghi; "Fuzzing for Profit: Going from Program Crashes to Vulnerabilities," delivered by Mathias Payer; and "Understanding Computation Through Low-Dimensional Dynamics with Recurrent Neural Networks," delivered by Eli Pollock. /

03 COMMUNITY GIVING

Laboratory employees champion local and national causes each year, giving their time, talent, and funds. The Laboratory community generously supports two main giving categories:

- Helping Those in Need
- Helping Those Who Help Others



The LabAid Committee includes (left to right) Roslyn Wesley, Gerald Augeri, and Allison MacDonald.

LabAid

LabAid—a new initiative established by a subcommittee of the Professional and Community Enhancement (PACE) Health and Wellness group—provides a platform for Laboratory community members who want to help colleagues going through serious hardships. LabAid formalizes and standardizes the traditionally informal giving process that has existed at the Laboratory for years. “During the pandemic, Laboratory-wide collections weren’t possible, and even group collections were difficult because we weren’t all together,” said Allison MacDonald, who helms LabAid with Roslyn Wesley and Gerald Augeri. “We thought it would be great to have a way for us to offer this kind of support, no matter where we are.”

LabAid is an opt-in, personalized program. Services offered vary on a case-by-case basis. For example, some people may seek

financial assistance, while others may simply want cards with encouraging words from their colleagues. “We might have 20 people nominate someone to receive support, but it would be that person’s decision whether or not to participate,” said Augeri. “We would talk to them to determine if they want support and, if they do, what kind of support they want. LabAid is a very personal and personalized service—one in which we respect people’s privacy and preferences.”

This program was inspired by the stories of two former Laboratory employees, the late James Lockler and the late Brian Branson, each of whom experienced an extreme medical hardship while working at the Laboratory. They both received community support and outreach but had very different experiences. /

Lockler, who worked in the Security Services Department, needed support before the pandemic, and, because most staff were working on site, a huge outpouring of support came from across the Laboratory. Branson, who worked in the Contracting Services Department, needed support during the pandemic. “Although his group supported him, Brian didn’t get the ‘big hug’ that James did from the entire Laboratory, simply because the whole community wasn’t physically present. He didn’t experience the same support,” said Wesley.

LabAid seeks to remedy the different experiences of receiving support by streamlining how members of the Laboratory community can help colleagues experiencing extreme hardships, such as severe illness, home devastation, disability, or family sorrow. The complete personal stories of James and Brian are available on the LabAid intranet website.

In addition to providing an easier, more accessible, and anonymous way for people to donate money, LabAid connects people with existing resources. These resources include MIT MyLife Services, which provides MIT staff and their household members with access to a network of experts to help with various life concerns, and the MIT Staff Emergency Hardship Fund, which provides financial assistance to MIT staff experiencing financial hardship due to an emergency such as a serious illness. “You don’t necessarily think to look into these kinds of services until you need them, and having someone to help bridge that gap can be really helpful,” said MacDonald.

Staff can submit requests for support to the LabAid program oversight committee through the Laboratory intranet site, short/ LabAid. The site includes employee stories of need, opportunities for volunteering, and answers to frequently asked questions. Involvement in the program is voluntary, and all financial support provided remains confidential. Any questions or suggestions regarding the LabAid program can be sent to LabAid@ll.mit.edu.

LabAid is the first component of another new initiative at the Laboratory called Lincoln Cares, an umbrella program that covers the Laboratory’s internal and external giving activities to further strengthen its commitment to the community. “One of the strengths of MIT Lincoln Laboratory is the support that we provide to our Laboratory community members in need,” said a Director’s Office email announcing the establishment of LabAid and Lincoln Cares. The Lincoln Cares platform will significantly enhance the Laboratory’s commitment to community outreach locally, regionally, nationally, and globally. /

Ukrainian Supplies Drive

After seeing images of destruction in Ukraine, people around the world—especially those with a Ukrainian background—wanted to help. Two such Laboratory employees set up fundraisers to assist Ukrainian citizens facing the devastating consequences of war.

David Pronchick asked the Laboratory community to donate medical and tactical supplies hard to come by in the conflict zone. Pronchick worked in tandem with the Ukrainian Catholic Church in Jamaica Plain, Massachusetts—one of the many Ukrainian-heritage organizations that cooperatively support donations through Ukraine Forward, an initiative established by the Ukrainian American Educational Center of Boston.

A list of needed items ranging from bandages to drones was posted to the Laboratory community, with a link to a long inventory of items that could be ordered online and shipped directly. Ukraine relief donation boxes at Lincoln Laboratory were set up in the spring and stayed in place the remainder of the year. Working with Ukraine Forward, the Laboratory delivers all donations to a local company that ships to the Poland-Ukraine border on a weekly basis. From there, items are distributed to various areas in Ukraine where the need is greatest.

After realizing the community’s desire to help Ukraine, Daniel Dumanis established a GoFundMe site. With the help of a local shipper, he raised \$30,860 (more than \$3,000 of which came from the Laboratory community) and sent 7,000 pounds of aid in more than 125 boxes to Station Kharkiv—assisting refugees in Dubove, Ternopol’, and Shums’k; aiding a hospital in Lviv; and giving general help in war-torn Kharkiv. For different rounds of collections, Dumanis changed his request, depending on what Ukrainian contacts indicated were the highest priority at the time. The typical items requested included medical supplies, food, clothing, bedding, hygiene products, baby supplies, and children’s toys. Clothing and footwear evolved with the seasons, as refugees didn’t bring many seasonally appropriate items with them. Dumanis outfitted a sampling of donated boxes with a

tracker to ensure that items were delivered to the areas in need as promised; he was encouraged to see a photo of an elderly woman in Kharkiv carrying a box of oatmeal branded with his GoFundMe site information.

“The response from Laboratory folks has been pretty great; everybody wants to help!” said Dumanis. “It’s amazing how our community can pull together to help people half a world away. To actually have a demonstrable impact is pretty incredible. We sometimes question whether or not we can do anything impactful, but then you talk to the people there and hear their stories, and we really are making a difference in people’s lives.” /



At left, Daniel Dumanis (kneeling behind flag) gathers a team to help sort through donations and ship them to Ukraine. Above, David Pronchick sets up donation boxes throughout the Laboratory for medical and tactical items to be contributed to a Ukrainian church and shipped overseas.

Giving Tree

For the past 16 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 holiday gifts and food items. The Laboratory anticipates the giving tree each year and responds generously, donating both large and small gifts in an effort to make holiday wishes come true. Virtual contributions were made possible this year through an Amazon wish list, ensuring that no gift was left unpurchased. Somebody Cares—a charity that helps children, teens, single parents, veterans, and the elderly—receives the donations and delivers multiple bags of gifts to thankful recipients. /



Paula Mason, once a recipient of a giving tree gift, now plans the Laboratory's collection of presents.

Community Bake Sale

In 2020, Victoria Helus developed a method for holding a socially distanced bake sale. She offered a menu for preorders, and touch-free delivery. This year, she included vegan baked goods made by David Perko. Each year, Helus' bake sales are held in response to prominent civil rights conflicts. In 2020, profits went to the American Civil Liberties Union, the Innocence Project, and Black Women's Blueprint. In 2021, proceeds were split between Stop Asian American Pacific Islander Hate, the Asian American Legal Defense and Education Fund, and the Asian Pacific Fund. This year, earnings were donated to Girls, Inc., National Women's Shelter Network, and Ms. Foundation for Women. With each bake sale, Helus matched profits up to \$300. She encourages others to bring about positive change by spreading awareness and showing support. /



Laboratory employees contributed enough toys to fill 10 donation boxes for the annual Toys for Tots drive.

Toys for Tots

For more than 25 years, Lincoln Laboratory has participated in the Toys for Tots donation drive in late November through early December. Susan Curry and Jeffrey Matthews gathered donations of toys from the Laboratory community and delivered them to a distribution center affiliated with the U.S. Marine Corps Reserve, the organization that has conducted this nationwide toy collection for 75 years.

Employees contributed hundreds of new unwrapped toys to the Toys for Tots collection boxes in the MIT Federal Credit Union lobby and Forbes Road Cafeteria. All donated toys were offered as holiday gifts for needy children in the area. This year, an online link was set up to enable the Laboratory community to easily donate funds for purchasing toys as needed. Through the link, more than \$1,000 was contributed to this cause, providing toys for hundreds of area children. The in-person donation was also greater than expected this year. Curry said, "You can always count on the Laboratory community for its generosity. It is wonderful that we can guarantee a happy holiday for local children." /

Winter Clothing Drive for Veterans

In 2022, MIT spearheaded a donation drive to benefit the New England Center and Home for Veterans, which equips veterans who are facing or at risk of homelessness with the tools for economic self-sufficiency and provides a path to achieve independent living. Throughout November, Lincoln Laboratory joined MIT in collecting new winter coats, socks, t-shirts, and sweatpants. An Amazon wish list donation link was set up to accommodate remote employees seeking to donate. /



Kwajalein students from Ebeye (like those pictured above) receive boxed lunches, as they cannot return home for lunch during the school day. Lincoln Laboratory donations help fund this program to ensure that no student goes hungry.

Marshallese Outreach

The U.S. Army's Reagan Test Site (RTS) is located approximately 2,300 miles west southwest of Hawaii on Kwajalein Atoll in the Marshall Islands. As the scientific advisor to RTS, Lincoln Laboratory supports operations at the range and conducts upgrades to the sensors and command-and-control infrastructure. A resident team of Laboratory staff are stationed on Kwajalein Atoll at any given time, serving two- to five-year tours before returning to the Laboratory. While residing on Kwajalein, Laboratory staff have a synergistic relationship with the islanders, supporting each other in different ways, one of which is the sale and purchase of Marshallese handicrafts.

As part of Lincoln Laboratory's Marshallese Outreach effort, sales of Micronesian handicrafts are held throughout the year. Handwoven baskets and wood-carved sea creatures are purchased through the Micronesian Handicraft Shop—operated entirely by volunteers from the Yokwe Yuk Women's Club (YYWC)—on Kwajalein Atoll and sent to Lincoln Laboratory for sale.

The shop features goods from many islands in the Marshall Islands and from Chuuk and Pohnpei in the Federated States of Micronesia. Volunteer buyers develop relationships with craftspeople throughout the islands and receive periodic shipments of goods. Purchases support makers and artisans who have very limited outlets for selling goods. The goal of the shop is to provide a market that will encourage artisans to continue producing their crafts and pass their skills to the next generation. However, the benefits extend beyond this goal; the shop marks up each item for sale to create a profit, which is then distributed via educational grants to schools throughout the Marshall Islands and Micronesia.

The needs of the island schools are great. Frequently, these schools lack textbooks, chalkboards, and desks. Some schools do not even have safe drinking water for students. On Kwajalein's neighboring island of Ebeye, about 7,000 school-aged children are residents, but the local schools can only accommodate 3,500 students, with classrooms often having 50 students each. Many of these schools could not function without the contributions from the YYWC, which, in its best years, has conferred \$60,000 in educational grants.

Lincoln Laboratory is proud to have members of its field site staff on Kwajalein Atoll participate in the YYWC. Field site staff, as well as staff in Lexington, Massachusetts, play an important part in supporting the local schools through the purchase of goods from craftspeople and islanders. /



Laboratory employees can shop from a selection of Marshallese crafts—including ornaments, necklaces, woven baskets, wall hangings, and intricately carved sculptures—all on display by the cafeteria. Purchases from this selection of imported goods supports Marshallese artisans and Micronesian schools.

Walk to End Alzheimer's

Sheila Chabot and Terri Welch served as team co-captains of Lincoln Laboratory's team in the 2022 Walk to End Alzheimer's in Boston. Typically held in September but now in October (as of this year), the 1.5-to-3-mile walk raises funds for the Alzheimer's Association, the largest nonprofit in the world for sponsoring Alzheimer's research and supporting programs for patients and their loved ones. Of all event proceeds, 90% goes directly to research. The remaining 10% supports Alzheimer's Association efforts to provide support and resources to families impacted by the disease.

The Laboratory's Alzheimer's Support Team has a strong following at the Laboratory and formed a 16-person team for the walk, which returned to an in-person format this year. Together, they raised more than \$14,000, ranking them as the sixth-highest fundraising team among the 385 teams participating. /

Since 2009, the Laboratory's Walk and Ride teams have donated more than **\$520,000** to the Alzheimer's Association to further research, awareness, education, and services.



The Lincoln Laboratory Walk to End Alzheimer's team gathers midway during the walk. Some members hold flowers to add to the Promise Garden, which helps participants visualize the vast number of people affected by Alzheimer's disease and all other dementia through different colored flowers representing those who are living with, have died from, or are providing care to someone with the disease.

Ride to End Alzheimer's

In addition to its Walk to End Alzheimer's, the Alzheimer's Association holds an annual Ride to End Alzheimer's for the New England area every June. More than 500 riders from across New England—and from as far away as Italy and Japan—registered for the event to raise critical funds and awareness to advance Alzheimer's research, directly impacting the pace and momentum behind the fight to end Alzheimer's.

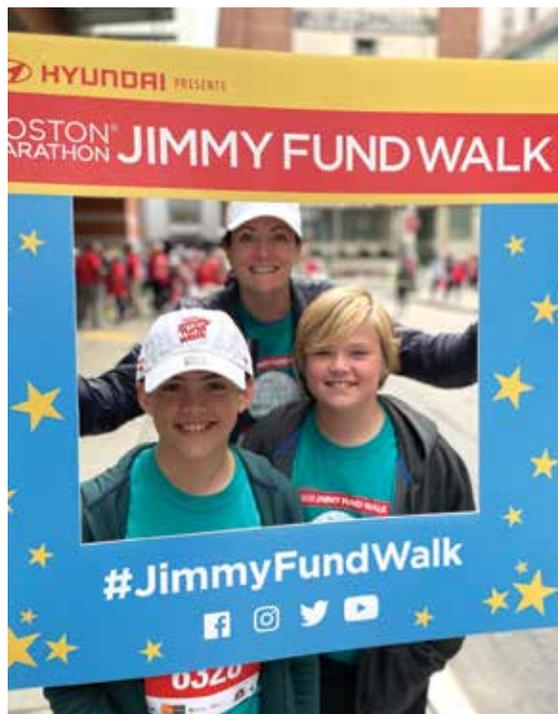
The Ride to End Alzheimer's is a one-day fundraising event for all levels of riders, from casual cyclists to avid enthusiasts. Participants choose to ride 30, 62, or 100 miles along the coast of New Hampshire and through Massachusetts farmland, ending with a celebration on the beach. A virtual option enables cyclists to ride any distance on any path, trail, or road in their own neighborhood.

Now in its 26th year, the Ride to End Alzheimer's New England has raised more than \$7.5 million to directly advance treatments and research toward the first survivor of Alzheimer's. In 2022, John Kaufmann and David Caplan helmed the seven-member Lincoln Laboratory team to raise \$16,000, placing them as the fifth-highest fundraising team in the New England region.

"The Ride to End Alzheimer's gives cyclists the opportunity to challenge themselves while riding toward the same goal: funding critical studies for Alzheimer's research. The experience is truly a unique and inspiring one, bringing together a dedicated community of riders to provide hope to the millions who are living with, caring for, or have lost a loved one to this disease," said Charlene Bemis, director of Special Events for the Alzheimer's Association Massachusetts/New Hampshire Chapter. /



Teams of cyclists from across New England converge on Hampton, New Hampshire, for the annual Ride to End Alzheimer's event.



With her children, Amanda Wait celebrates her finish of the Jimmy Walk.

Jimmy Fund Walk

Amanda Wait hosted a bake sale to raise money for the Jimmy Fund and participate in the Jimmy Fund Walk in Boston. One of the nation's oldest and largest charities, the Jimmy Fund helps provide research funding to help save lives and reduce the burden of cancer on patients and families worldwide. The 26.2-mile walk features a finish line at Copley Square in Boston. Participants can also choose to do a half-marathon walk, starting from Wellesley, Massachusetts; a 10K walk, starting from Newton, Massachusetts; or a 5K walk, starting from the Yawkey Center for Cancer Care at Dana-Farber Cancer Institute in Boston.

"I have been doing the Jimmy Fund walk for over 15 years," Wait said, "but this year was my first time hosting a bake sale at the Laboratory. I was absolutely blown away by everyone's generosity and was able to raise \$600 in cash donations and more than \$200 in direct donations to my fundraising page online. People not only donated but also took the time to share personal stories on how cancer has affected their lives. It was truly humbling. I cannot wait to host this event again next year!" /



Crossing the finish line after a seven-mile race, Laura Bickmeier helps protect the Buzzards Bay environment.

Buzzards Bay Coalition

Laura Bickmeier has participated in the Falmouth Road Race for the past five years. She does so to support Buzzards Bay Coalition, a nonprofit dedicated to the restoration, protection, sustainable use, and enjoyment of the local bay and its watershed. "The Buzzards Bay Coalition works with communities in the watershed to Buzzards Bay to help ensure clean water throughout the watershed communities and the bay," said Bickmeier. "They also steward a large number of recreational sites for nature walks and the like. I have found them to be a great local environmental organization to support." The Laboratory community helped Bickmeier raise \$335 through a bake sale held at the Laboratory. /



Members of LLGrows assist with ground work at Gaining Ground farm to grow vegetables for food pantries throughout the state.

Gaining Ground Farm

Lincoln Laboratory Grows (LLGrows), a PACE subcommittee, organized a volunteer work session on June 11 at Gaining Ground farm in Concord, Massachusetts. Community volunteers assist with ground work at the nonprofit organic farm, which grows fruits and vegetables for statewide organizations that assist people experiencing food insecurity. All resulting produce is donated to 17 meal programs and food pantries in the area, like East Boston Community Soup Kitchen and House of Hope in Lowell, Massachusetts. Most produce is distributed within 20 miles of its farm and within 24 hours of harvest.

This year, Laboratory employees contributed 50 volunteer hours to the farm. They spent a beautiful Saturday in June spreading compost on a field, weeding an onion field, and using broad hoes to prepare a field for planting, as Gaining Ground is a no-till farm dedicated to sustainable, holistic farming practices. Laboratory volunteers included Joan Boegel, Katherine Barlett,

Andrew Dahlberg, James Streitman, Jeffrey Simpson, Kayla Cruz Jimenez, Sara Canzano, Emily Voytek, Cheryl O'Keefe, Stephen O'Keefe, and Phillip Werth, plus a few friends and family members.

During other volunteer days throughout the year, the team helped harvest sugar snap peas, spread compost, and thin out rows of carrot seedlings—assisting the farm in producing 120,000 pounds of fresh organic vegetables and fruit for donation. "I'm passionate about supporting local agriculture. I really enjoyed working alongside Laboratory colleagues while learning from the expert farm manager and field crew about this small organic farm and its nonprofit mission," said Boegel. Farm staff expressed their gratitude to the volunteers: "Thank you for lending a hand at Gaining Ground so we can grow and donate organic produce for hunger relief. Our work couldn't happen without you!" /

The NCMS Run and Dog Walk for America's VetDogs

The National Classification Management Society (NCMS) is a nonprofit professional security society that focuses on the development of security professionals through training, mentoring, and certification. Its members come from almost every federal agency that deals with classification and from the organizations, including Lincoln Laboratory, that work with these agencies. The NCMS has a long-standing partnership with America's VetDogs, a nonprofit that trains and provides service dogs to U.S. veterans, active-duty members, and first responders with disabilities. Annual efforts are made via NCMS to raise funds for America's VetDogs.

Laboratory Security Services Department employees participated in a virtual 5K run and dog walk, held from March 28 through May 6, to help raise funds for America's VetDogs. Former employee Tyler Shoulders arranged Lincoln Laboratory's involvement in this effort. /



Security employees and their colleagues and family ran and walked to support America's VetDogs in its mission.

MIT Community Service Fund

The MIT Community Service Fund Office shared three winter donation drives in 2022, enabling the entire MIT community to join in giving to those less fortunate. The Community Service Fund Office has 50 years of experience turning the generosity of the greater MIT community into real-world impact that helps neighbors throughout Greater Boston. This year, Lincoln Laboratory participated in these MIT-helmed giving opportunities focused on three charities:

- Bridges Homeward**
- CASPAR (Cambridge and Somerville Programs for Addiction Recovery) Emergency Services Center**
- Cambridge Police Department's Secret Santa for Seniors**

Bridges Homeward

The Cambridge, Massachusetts, charity Bridges Homeward (formerly known as Cambridge Family and Children's Service) collaborates with the state's Department of Children and Families and the Department of Developmental Services. Dedicated case workers at Bridges Homeward ensure children are living in stable, safe, and loving homes and help children in Cambridge and beyond develop healthy, permanent relationships.

A holiday fundraiser held by MIT in November and December provided parents and foster parents with gift cards for purchasing presents and bringing holiday joy to the children supported by Bridges Homeward. MIT employees could make donations to this fundraiser through payroll deduction on the charitable giving app on Atlas. /



The Cambridge Police Department delivered a record number of gifts to local senior citizens this year, in part due to online giving options.

Cambridge Police Department's Secret Santa for Seniors

For the past 16 years, the MIT Community Service Fund has partnered with the Cambridge Police Department to donate gifts for senior citizens in public housing who may not have friends or family close by during the holidays. For four years, Lincoln Laboratory has been a part of this collection drive that collects all sorts of small gifts: books, dish towels, robes, blankets, chocolates, jams, crackers, coffee, tea, scarves, gloves, and hats. The Cambridge Police Department gathers the donations in November and December and delivers presents to Cambridge senior citizens on December 24. This year, MIT added several virtual giving options for members of the MIT community working remotely, as well as an Amazon wish list, leading to more than 1,000 bags of donations. /

CASPAR Emergency Services Center

The CASPAR Emergency Services Center has been a vital Cambridge, Massachusetts, institution and MIT partner since its inception in 1970. Each year, the MIT community is eager to help homeless Cambridge residents prepare for the winter. The Laboratory community participated in the donation drive this November to supply the homeless in Cambridge with much-needed cold-weather items. The CASPAR wish list created on Amazon made contributing coats, hats, and gloves easier than ever, helping CASPAR collect plenty of donations for those most in need. /



Other Community Outreach

The Laboratory encourages its staff to support a variety of personal causes and to join colleagues in charitable efforts. The Laboratory community has supported several charities and events on their own time, including

Haley House Soup Kitchen

American Red Cross

Emily Letourneau Memorial Volleyball Tournament

Coats for Kids

Cradles to Crayons

Avon Walk for Breast Cancer

Walk for Hunger

Pan-Mass Challenge

The Trevor Project

TeamWalk for CancerCare

American Lung Association Autumn Escape Bike Trek

American Heart Association

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, cco@ll.mit.edu.



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 Laboratory's external homepage, choose the Outreach section, and then click Community Giving. 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 back 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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