LABORATORY OUTREACH PROGRAMS INSPIRE THE NEXT GENERATION

UNDERLYING Lawrence Livermore's national and global security missions is the need for a continually engaged, trained, and inspired workforce. The quality and accessibility of science, technology, engineering, and math (STEM) education help shape future generations of scientists and engineers. To this end, the Laboratory's Director's Office oversees a multipronged outreach effort administered by the Science Education Program—part of the University Relations and Science Education Office—and by the Public Affairs Office.

As the Laboratory celebrates its 65th year in Livermore, California, promoting STEM literacy is also a way to give back to the region. This outreach relies on deep engagement with school districts in surrounding communities. Joanna Albala, Science Education Program manager, describes the Laboratory as a

Livermore's Fun with Science booth engages children of all ages at the Bay Area Science Festival Discovery Day. (Photograph by Don Johnston.)

community steward. “Our programs show the public what kind of work Lawrence Livermore is doing in their backyard,” she says.

Educational outreach is vital to all Laboratory organizations, as evidenced by a range of student internships and academic partnerships. At the institutional level, the Laboratory approaches STEM education as occupying a continuum, from elementary school to early career. Public Affairs Director Lynda Seaver says, “The Laboratory prides itself on hiring the best and the brightest, so it’s incumbent on us to bolster STEM foundations.” Lawrence Livermore has invested in facilities and curricula that help accomplish that goal. The Discovery Center provides interactive displays and demonstrations, and workshops and career panels are held at the Edward Teller Education Center. Among the most popular programs are Fun with Science, Science on Saturday, and the Teacher Research Academy (TRA) program.

Livermore’s Science Education Program activities are promoted online, at regional schools, and within the teaching community.

Field Trips and Road Shows

Each year, more than 8,000 students visit the Laboratory to experience the Fun with Science program. Tailored to fourth and fifth graders, the program begins with a tour of the Discovery Center, followed by staff-led, hands-on demonstrations and experiments that explore electricity, density, states of matter, and other basic scientific concepts. In one popular demonstration, a Laboratory scientist—a retiree or employee volunteer—makes “elephant’s toothpaste” in a clear graduated cylinder. The presenter mixes hydrogen peroxide with a few drops of dish soap and food coloring, then adds potassium iodide as a catalyst. Livermore scientist and Fun with Science volunteer Laura Berzak Hopkins explains, “What starts as a small amount of soapy liquid ends up as frothy, bubbly ‘toothpaste’ overflowing out of the cylinder. The class always reacts with surprise and laughter. This demonstration is a great opportunity to introduce terminology without it becoming a dry dictionary discussion.”

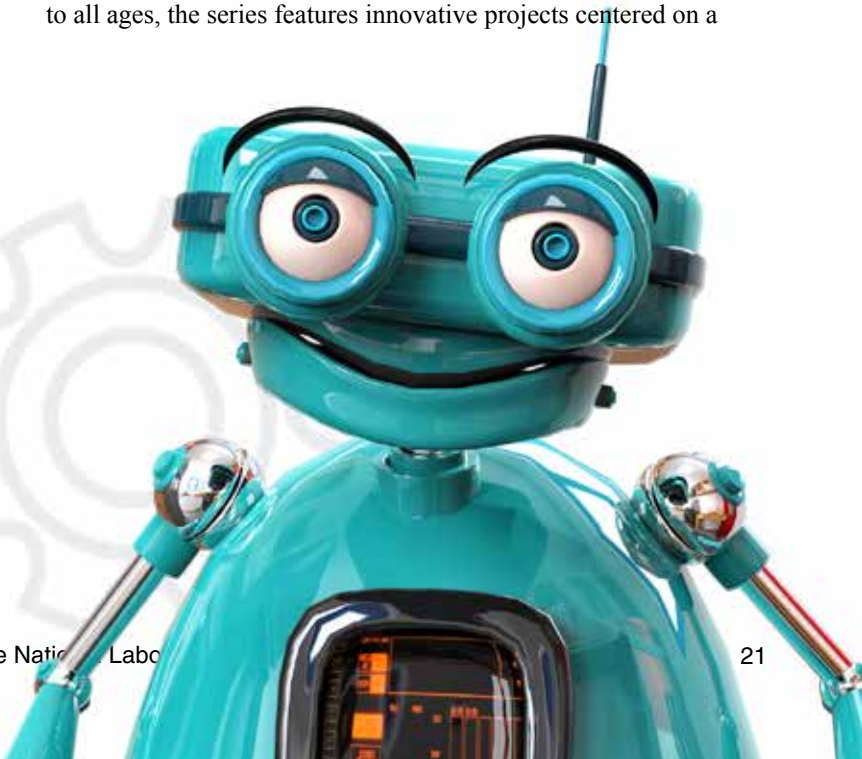
The Fun with Science team contributes to the Bay Area Science Festival Discovery Day, held once a year at AT&T Park in San Francisco. Laboratory volunteers run a booth stocked with hands-on experiments, games, and trivia questions. The event is geared toward families with children up to age 14, and attendance in recent years has topped 30,000. Seaver observes, “It’s also great to see how interested the parents are. They learn something, too.”

After two decades, the Fun with Science repertoire now includes local involvement with the Exceptional Needs Network’s summer camps for developmentally disabled children and Family Science Night hosted by California state legislators. In its third year, STEM Day at the Laboratory encourages underrepresented and underserved middle and high school students toward STEM pursuits. Last year, the program hosted over 400 middle school students for a fun day of STEM education. Seaver states, “Our goal is to reach every student in the Livermore school district at some point during the elementary, middle, or high school years.”

The program sees steady participation year-round, and volunteers like Berzak Hopkins enjoy preparing attendees for school science classes. She says, “Rather than thinking of science as a school subject that’s hard or boring, students can start to build a new association, one that sees science as fun, interesting, and something they can take part in.” Seaver confirms, “Our volunteers have a zeal for translating science for young minds. Kids feed off that enthusiasm.”

Weekend Wisdom

Every weekend in February, the Laboratory holds weekly Science on Saturday lectures at the Bankhead Theater in downtown Livermore. Aimed at middle and high school students but open to all ages, the series features innovative projects centered on a



theme. Laboratory scientists lead each talk, assisted by local high school teachers and students. Albala states, "For the Livermore area, Science on Saturday has become a local staple, like the farmers' market."

National Ignition Facility (NIF) physicist Tammy Ma first attended Science on Saturday in eleventh grade. She says, "Over multiple seminars, I learned about lasers, spectroscopy, and meteors. I recall attending a lecture on NIF and thinking how cool it was." When Ma delivered her own Science on Saturday talk 16 years later, she quickly appreciated the challenge of communicating NIF's mission to a general audience. "Conveying the enormous progress we've made toward fusion ignition is incredibly complex. By going through the exercise of preparing a Science on Saturday talk, I now have a much better sense of how to talk about our work in an understandable way."

The series has grown in popularity since its inception in 1999, and efforts are ramping up to bring the series to cities in the broader community. To reach an even larger audience, videos of events are published on Lawrence Livermore's YouTube channel and broadcast on the University of California's television station. A spinoff series, Science on Screen, pairs a staff scientist with a feature-length movie at the State Theatre in Modesto, California. At both Saturday events, students can ask questions about the science described in the lecture or shown in the movie. Ma speaks from experience when she states, "Science on Saturday helped me to see the different types of science out there, and to get a better feel for what application-driven innovation really means. It played a big role in my choosing to study science in college."

In an experiment that illustrates basic chemistry concepts, hydrogen peroxide reacts with dish soap and potassium iodide to create "elephant's toothpaste."

Professional Development

Since the mid-1990s, the Laboratory has offered summer workshops to middle and high school teachers through the TRA program. The current curriculum includes four levels of instruction across six disciplines—biotechnology, climate change, computer modeling, fusion and astrophysics, technical writing, and three-dimensional (3D) printing—and aligns with California and national science standards. Teachers pursuing a master's degree at California State University, East Bay, can earn graduate-level credits through the TRA program.

In Level I, teachers build introductory skills and knowledge in their chosen discipline. In Level II, participants receive more days of instruction with a deeper topical dive. Level III includes job shadowing and preparation for the eight-week mentored internship of Level IV, in which teachers can contribute to real-world problems and publish their work. Albala says, "If you reach one teacher, you can reach thirty to a hundred of that teacher's students."

The TRA program is designed to accommodate participants' teaching schedules, and the courses are taught in the summer by "master teachers" who have been through the program themselves. This unique format allows teachers from multiple school districts to learn from master teachers and Laboratory scientists, work with fellow educators, and bring new knowledge back to their classrooms.

Erin McKay began attending the TRA program in 2003, and since completing all four biotechnology levels, she has spent her summers as a master teacher. At Tracy High School, McKay is responsible for teaching biotechnology—molecular genetics and

During a Science on Saturday lecture, Livermore scientist Tammy Ma describes the concept of fusion and the National Ignition Facility's role in national energy security. (Photograph by Joanna Albala.)

During STEM Day at the Laboratory, interactive exhibits include a plasma globe (shown above), a bicycle that generates electricity, and three-dimensionally printed objects. (Photograph by George Kitrinos.)

bioinformatics on top of a baseline biology curriculum—to 11th and 12th graders. She explains, "I participate in the TRA program to make sure I have the resources to teach my advanced courses. I don't want to be stagnant."

A Full Calendar

Lawrence Livermore responds to consistently high demand for STEM education opportunities both on- and offsite, hosting tours and sponsoring STEM events around the San Francisco Bay Area and San Joaquin Valley. For example, Livermore sponsors the San Joaquin and Tri-Valley Expanding Your Horizons conferences, which offer STEM workshops and career fairs. Albala describes the Laboratory's roster of activities as increasing STEM learning at critical moments. She states, "The Science Education Program provides tours to high schoolers and pre-service teachers who are at a critical point in their science education." Other events include the onsite Community College 3D Design Summer Academy (a one-week workshop) and offsite lectures at Las Positas Community College in Livermore.

To continue the cycle of outreach, the Science Education Program and Public Affairs Office encourage as many Laboratory scientists and engineers as possible to volunteer in educational programs. Annie Kersting, director of the Laboratory's University Relations and Science Education Office, says, "I am thankful our staff help ensure our STEM outreach programs continue to excite and engage the next generation. One day, we hope these children become our future workforce." For Ma, being a scientist carries a responsibility for outreach. She states, "It's important to continuously remind the public of the essential role science and technology play in driving innovation and economic growth, and to engender that trust so that when policy decisions are being made, the scientific rationale is taken seriously."

—Holly Auten

Key Words: community outreach; Discovery Center; Edward Teller Education Center; Fun with Science; Science Education Program; Science on Saturday; science, technology, engineering, and math (STEM) education; Teacher Research Academy (TRA).

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