

## 2022 BEST Student and Teacher Research Program

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The primary goal of the Broad Exposure to Science and Technology (BEST) Research Program is to engage teachers and students from historically marginalized experiences in various aspects of science and technology that support LLE's laser science and applications research.<sup>1</sup> This broad exposure helps guide students in their pursuit of science, technology, engineering, and math (STEM) fields and encourages them to explore the next generation of related jobs and careers. The BEST Program was carried out at East High School within the Rochester City School District (RCSD) during the summer of 2022. Five students and two teachers participated in this research experience over a six-week period during the months of July and August. Students were also given credit toward high school graduation through the Work-Based Learning Program sponsored by the RCSD.



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Figure 1

The students and teachers who participated in the 2022 BEST program included (left to right); Terry Kessler [LLE DEI (Diversity, Equity, and Inclusion) Manager], Nigel Copeland (East High), Tiketa Thomas (Rochester Early College), Isis Wearing (Johanna Perrin Middle School), Olivia Galloway [YWCP (Young Women's College Prep)], Chavon Phelps (YWCP, teacher), Bre' Ay'zha White (YWCP), Trent Russell (East High teacher), and Marco Romo-Gonzalez (LLE DEI Deputy Manager).

Multi-faceted scientific institutions, such as UR/LLE, employ a wide variety of professionals to carry out a diverse set of research and development activities. Each of these research activities requires support teams consisting of professionals who

contribute their expertise to ensure a thriving research program. Exposure to the members of the LLE community provides the students and teachers with an understanding of the broad range of research activities as well as the rich diversity of individual professionals that enable successful research programs.

A team of LLE volunteers worked with the BEST students and teachers in a variety of science, technology, skilled trade, and technical communication fields. Twenty volunteers spent between one and two days at East High school over the six-week period. These volunteers, experts in their field, were able to bring detailed information, coupled with hands-on opportunities, into the high school laboratory environment.

The teachers and students were exposed to many different areas of science and technology research including laboratory safety, optical microscopy, spectroscopy, magnetic technology, illustrations and graphic design, light polarization and liquid crystal applications, high-energy-density physics (HEDP), diffraction grating applications, electrical technology, building operations and maintenance, optical system alignment, database applications, acoustics, code development, and laser holography. The importance of engineering support for research, including chemical, electrical, mechanical, optical, and computer engineering, together with support from facilities groups and graphics experts, were emphasized to highlight the extensive teamwork required to make scientific advancements and be able to communicate the results (see Fig. 2).



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Figure 2

Members of the Publications and Illustrations department at LLE, Heather Palmer (near monitor), Mike Franchot (near board at right), and Jenny Hamson (far right) are shown instructing the BEST students and teachers on the principles of technical communication through graphical illustrations.

One of the areas of science that is central to fusion science is electricity and magnetism, especially electromagnetic waves or light. Both laser fusion and magnetic fusion are studied around the world to eventually harness the vast resource of nuclear energy. In addition, many technological applications involve electromagnetic systems and the electromagnetic spectrum. Bob Boni, research engineer, taught the BEST group to use the magnetic compasses in their cell phones to locate magnets hidden around the classroom and to build and test electric motors (Fig. 3).

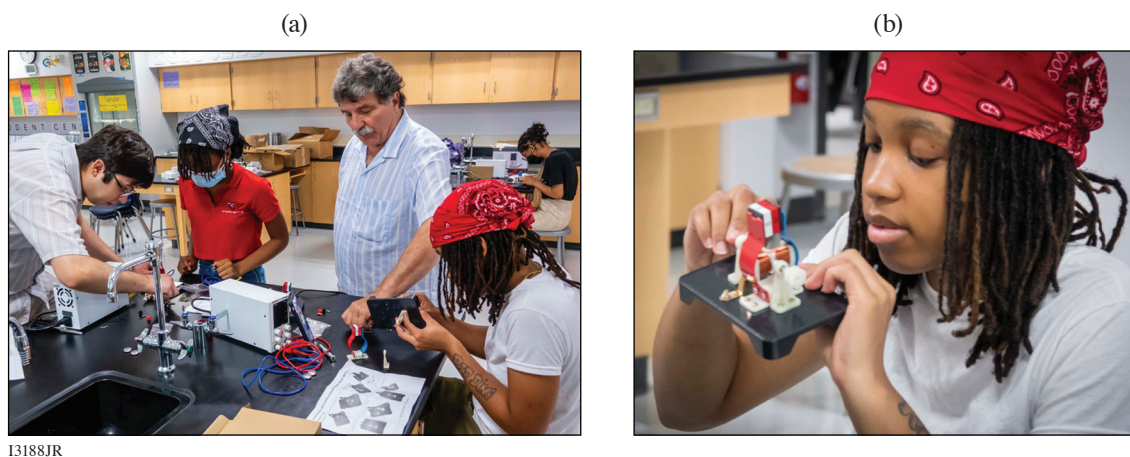


Figure 3

(a) Deputy Diversity Manager, Marco Romo-Gonzalez and research engineer, Bob Boni are shown working with students Isis Wearing and Bre' Ay'zha White to construct electric motors. (b) Bre' Ay'zha is shown examining the operation of a completed motor.

Spectrometers are used to study of the absorption and emission of light and other radiation by matter. There are numerous applications of spectroscopy at LLE, including optical material composition analysis, light-scattering investigations, and the study of laser-matter interaction. Jeremy Pigeon, scientist in the Plasma and Ultrafast Laser Science and Engineering Group, worked with students and teachers to construct a cell-phone spectrometer. Stavros Demos, Group Leader of Optical Materials Technology, activated a spectrometer for the students to measure the wavelength transmission of optical filter glass. Spectroscopy reliably engages the curious mind into the many wonders of light (Fig. 4).

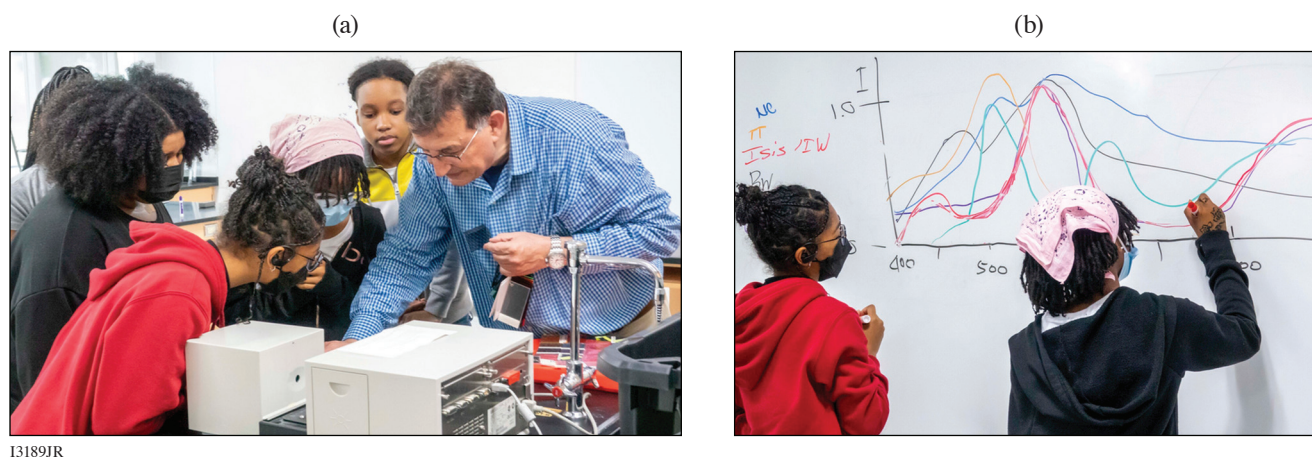
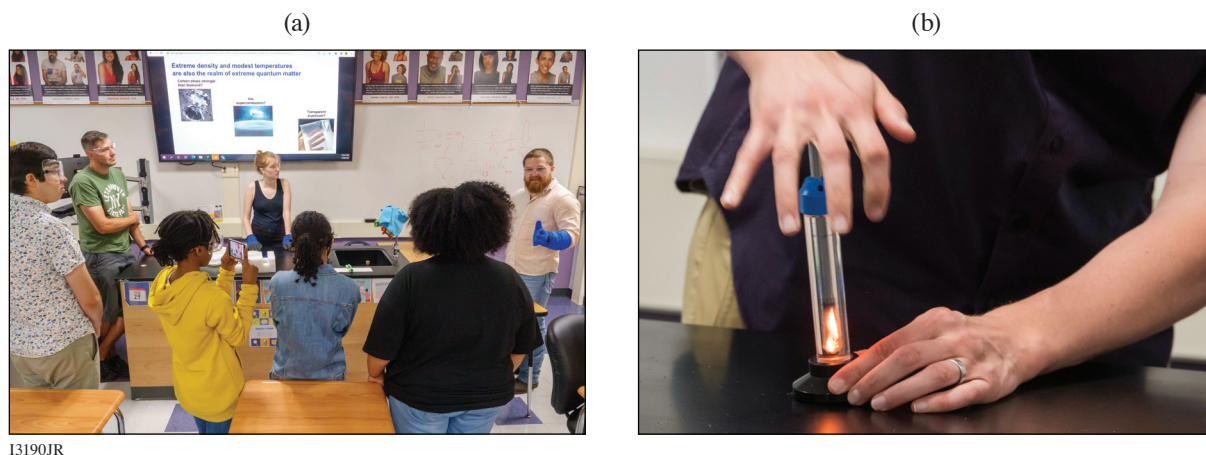


Figure 4

(a) Senior scientist, Stavros Demos, is shown demonstrating use of a spectrometer to measure the wavelength-dependent transmission of glass filters. (b) BEST students Tiketa Thomas and Isis Wearing are shown plotting the observed transmitted spectra for one of the color filters.

In this second year of LLE's BEST Program, aspects of theoretical physics and computation were introduced in ways that engaged the students and teachers. Theoretical physicist, Duc Cao, provided instructive examples of computer code development while Suxing Hu, Group Leader of HEDP Theory, shared his personal career path from grade school to graduate school and his professional experiences. In addition, graduate students from the University of Rochester's physics department developed a series of demonstrations to simulate superconductivity and compressed matter without the danger associated with very cold and very hot conditions (Fig. 5).

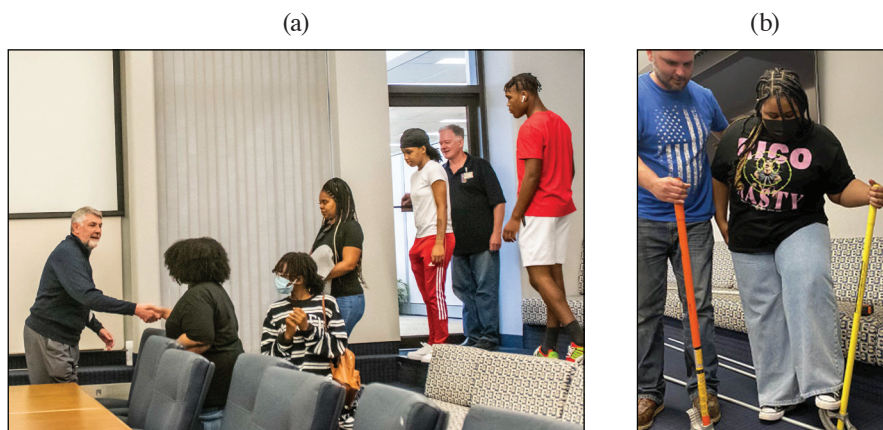


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Figure 5

(a) Graduate students Maggie Huff and Gerrit Bruhaug (wearing blue gloves) demonstrate magnetic effects under extremely cold temperatures. (b) Graduate student David Bishel is shown igniting cotton strands by compressing the air with a plunger in a sealed glass cylinder.

The BEST participants visited LLE three times during the summer program to tour the OMEGA lasers, optical manufacturing facilities, and other support laboratories (Fig. 6). Together, the students and teachers were exposed to elements of science and technology that underscored the importance of their STEM high school curricula. Laboratory Director, Chris Deeney, emphasized the importance of STEM education and the numerous areas of employment in the DOE/NNSA complex. In addition, the BEST group participated in tours of optics and imaging related departments at Monroe Community College, the Rochester Institute of Technology, and the University of Rochester.



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Figure 6

(a) During one of the visits to LLE, the BEST program participants met with the LLE Director, Chris Deeney (left), to learn about the scientific mission of the laboratory and the variety of staff careers that form a successful research team. (b) During another visit to LLE, the students and teachers were exposed to many of the trades needed to build and maintain a large laboratory complex. Nate Heckman (Facilities Group) is shown bending an electrical conduit with student Olivia Galloway.

Throughout the following school year, the students and teachers of the BEST Program serve as ambassadors for outreach to other students enrolled at RCSD high schools. They created a PowerPoint presentation showing the broad range of science and technology topics included in the program. In addition, a photomontage video was created to show the relationship between the BEST Program experiences and the wide variety of work activities carried out at LLE. The images for the photomontage were generated by LLE photographer, Eugene Kowaluk, and by several of the program participants.

On the last day of the six-week schedule, LLE mentors joined the students and teachers to celebrate completion of the 2022 BEST research program and to share their broad exposure to science and technology with family members (Fig. 7). The attendees had the opportunity to describe their roles in the program and to highlight their area of interest. In planning for the 2023 BEST program, students from several additional RCSD high schools are being invited to participate in this unique learning experience.



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Figure 7

Members of the LLE staff, students, teachers, and parents assembled in front of the teaching monitor and “Google Board” on which questions are posted each day for further investigation.

1. T. J. Kessler, LLE Review Quarterly Report **169** (2021).