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University of California
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Lasers and Fusion Energy Education



To increase the interest of students and teachers in the latest scientific developments, the Laser Programs and the Science Education Center at LLNL have developed a special program featuring lasers and fusion energy and using workshops, classroom visits, and specially designed media.

Staff members from the Inertial Confinement Fusion (ICF) Program and the Science Education Center (SEC) have developed a special program for teaching K–12 students about lasers and fusion energy. Workshops held at LLNL and other national laboratories (including tours of the experimental areas involved in fusion research) provide opportunities for teachers to observe science in practice. The workshops and classroom materials go beyond a simple introduction to the science of fusion; they also inform teachers about the challenges and accomplishments of current fusion research. These “real-life” topics, seldom found in typical classroom lectures or school textbooks, can inspire students to consider and seek out careers in science. Integrated scientific

endeavors, such as fusion research, allow teachers and students to see science as more than a collection of facts, figures, and natural laws; the real challenges and excitement of discovering the unknown are opened up to them (see Figure 1).

Workshops targeting high-school teachers of physics, chemistry, and physical sciences are held periodically to update teachers’ knowledge of fusion science and technology. These workshops are announced through flyers mailed to school districts and through local teachers’ associations. At the workshops, teachers learn about the latest advances in fusion science through presentations by fusion-research scientists. For the LLNL workshops, teachers tour our fusion research facilities to gain a personal understanding of the research

environment. They are also introduced to instructional materials and strategies that can be used to teach fusion in high-school science classes. The teachers can receive academic credit for these workshops.

The workshops at LLNL were so successful that managers of fusion programs at the Argonne National Laboratory and the Oak Ridge National Laboratory requested help in setting up similar workshops at their laboratories. The Lasers and Fusion Energy Program has been selected as an American Physical Society (APS) education program for secondary-school teachers. This APS/LLNL-sponsored workshop was first held at the 1988 annual meeting of the APS-Division of Plasma Physics (DPP), and it continues to be held every year in conjunction with the APS-DPP annual meeting.

Instructional materials for the program were developed initially for high-school science teachers and students. Supporting materials have been prepared in conjunction with the LLNL fusion programs to expand the program into middle and elementary schools. Materials developed and used in the high-school program include:

- A booklet on fusion, called *Fusion Energy: Meeting the Challenge*, and a set of visual aids based on the booklet that are intended primarily for use in high-school classes. This material is introduced during teacher workshops.
- A set of 47 slides, *Fusion Energy*, that are suitable for use in grades K-12. The narration and slide selection vary with grade level.
- A full-size poster, called *Nova: The World's Most Powerful Laser*, that explains how ICF works and how the Nova laser is, at present, the best tool for ICF research.
- A four-part videotape, called *Fusion Research*, produced by the ICF program, that consists of *Fusion Energy* (5 minutes), *ICF* (12 minutes), *Nova, the World's Most Powerful Laser* (6 minutes), and *How to Make a Star* (9 minutes).

This fusion education program also has many links to the scientific and education communities. Effective networking has provided valuable support and opportunities for sharing experience and resources. The instructional materials and teaching strategy have been disseminated widely, through associations with other national laboratories and local school organizations and through participation in professional organizations of scientists and educators. Networking activities include:

- Classroom visits. Many local schools participate in the fusion education program by arranging for the series of classes advertised through the SEC newsletter and

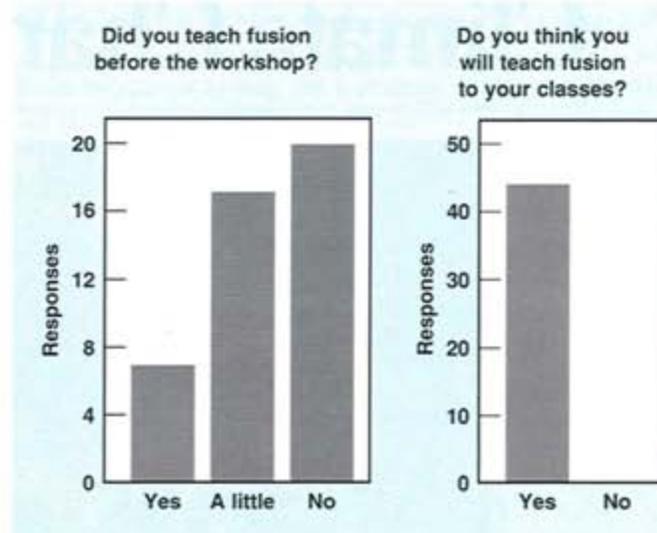


Figure 1. This bar chart from a past high-school science teachers' workshop shows the effectiveness of enriching science teachers' understanding of research topics such as lasers and fusion energy.

flyers. The program also uses the network of schools that have participated in SEC activities over the past several years.

- Workshops. The fusion education program has been presented and materials distributed at teacher workshops through the American Physical Society, the American Association of Physics Teachers, and the American Association for the Advancement of Science.
- Academic credit. Teachers can gain credit for teacher workshops through colleges in the states where the program is held.
- Partnership programs. Fusion education has been part of several partnership programs, such as Industry Initiatives for Science and Mathematics Education, Pleasanton Partners in Education, and the Livermore Chamber of Commerce Business/Education Committee.
- Special events. Fusion education has been made part of many special events sponsored in conjunction with the SEC (such as visits with students and adults from the Soviet Union; summer programs for local elementary-, middle-, and high-school teachers) and the National Science and Technology Week.

The effectiveness of the fusion education program, like that of any education program, can be evaluated properly only in terms of its long-term benefits. What we hope will result from our efforts is a healthy future for science and technology through a well-trained workforce and an informed public. However, one measure of "success" in the short term is provided by comments of the program participants after they have taken part in the activities, heard the lessons, and studied the instructional materials. For example, one student wrote: "I learned more in one day than I can write ... I feel that spending a full day at the lab would be a magnificent way to learn more about lasers and the effect they will have on the future of our world."

Key Words: American Physical Society, Inertial Confinement Fusion Program at LLNL, Lasers and Fusion Energy Program, Nova laser, Science Education Center at LLNL

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