Triangle Coalition for Science and Technology Education

Congressional Liaison Task Force

A BRIEFING OF THE OCTOBER 1994 MEETING

Federal Labs Contribute to Science Teaching and Learning

As the U.S. Senate overturned roadblocks attempting—unsuccessfully—to halt passage of the elementary and secondary education reauthorization legislation, representatives from several federal agencies and laboratories addressed Congressional Liaison Task Force (CLTF) participants Oct. 12. They spoke about their commitment, programs, and accomplishments toward the nation's science knowledge, particularly at the precollege level. Marjorie S. Steinberg, legislative assistant to bill cosponsor Sen. Jeff Bingaman (D-NM), and Gary Allen, Triangle Coalition director of governmental affairs, spoke about education legislation and specifically about the Technology for Education Act that was on the Senate floor for a vote in October and now is law. Bruce A. Fuchs talked about the National Institute of Health's (NIH) work in science literacy and education. The National Aeronautics and Space Administration's (NASA) Frank C. Owens and Eddie Anderson contributed to this report.[1]

DOE Contributing to Precollege Science

The Department of Energy (DOE) National Laboratories and other DOE facilities, including accelerators, research institutes, and management projects, have long played an educational role, according to Judith C. Kaye, group leader for science education and outreach at Los Alamos National Laboratory (NM). However, until the 1980s, the focus was on post-secondary levels. When it became apparent that U.S. students were falling behind in mathematics and science, she said, DOE and its facilities "stepped up their efforts...with an increased emphasis on targeting the precollege population."

In 1989, Secretary of Energy James D. Watkins brought together leaders in government, education, science, and business and industry to form a mathematics/science action course for the department, in conjunction with other federal entities, states, schools, businesses, and community groups, Kaye said.

Linda C. Cain, program director of precollege programs, Science and Engineering Education Division, Oak Ridge Institute of Science and Education, noted that 10 years ago, most lab and technical staff were "unenthusiastic" about involvement in K–12 education." This has changed profoundly," she said, noting that many of their scientists are "frustrated teachers at heart."

DOE facilities are "ideally poised to apply our unique resources to national and local problems in science education," Kaye said. The labs and other facilities can "demonstrate state-of-the-art science;" offer hands-on experiences and cutting edge technologies; provide role models; and train teachers and students how to approach, analyze, and critique issues from a scientific perspective.

Kaye summarized for all DOE participants by saying, "We would like our program goals to reflect national and state education priorities and needs; teachers to update their content knowledge and pedagogical abilities; science and math taught in the interdisciplinary way it is actually practiced; students to develop better critical-thinking and problem-solving skills; and students to participate in their own learning as scientists do."

Although all DOE programs operate out of this general mandate, individual facilities emphasize their unique environmental and scientific-technological strengths. DOE programs were strengthened by President Bill Clinton's 1992 Executive Order to "federal agencies that have a scientific mission to assist in mathematics and science education through training, partnerships, and equipment loans, and to encourage young people to pursue careers in science, mathematics, engineering, and technology."

LOS ALAMOS STAFF KEY TO SUCCESS

The Los Alamos National Laboratory has been involved in state education for more than 40 years, Kaye said. Now about a thousand laboratory staff participate in outreach programs that reach thousands of students and teachers statewide. "We have played a key proactive role in the state's systemic initiative in math and science education,"[2] Kaye, a co-principal investigator for the New Mexico Initiative, said.

As part of the systemic approach, laboratory staff work with many stakeholders to improve mathematics and science education. For example, the stakeholders serve on the boards of some state universities and by collaborating with other federal agencies and the American Chemical Society.

Ninety percent of the laboratory's precollege program participants go on to post-secondary programs. Reflecting the state's ethnic diversity, 50–70 percent of participants are minority students.

CALIFORNIA LABS COLLABORATE FOR SCIENCE

Eileen Engel, precollege program coordinator at Lawrence Berkeley Laboratory (CA), described her laboratory's joint work

[1] For further information on NASA's educational offerings at all levels, consult the pamphlet enclosed with this report. *How to Access NASA's Education Materials and Services* is available free from NASA Office of Human Resources, Education Division, Washington, DC 20546.

[2] The National Science Foundation's Statewide Systemic Initiatives in Science, Mathematics, and Engineering Education currently fund innovative programs in 25 states and territories. NSF's Urban Systemic Initiatives support reform in nine cities, and the Rural Systemic Initiatives are in the planning stages. The foundation awards $2–$3 million annually over a five-year period to comprehensive programs working for reform and fundamental changes in curriculum, instruction, assessment, teacher preparation, and staff development, as well as innovations in policies bearing on accreditation and certification.

DISCLAIMER

with the Lawrence Livermore Laboratory, the Sandia National Laboratory/California, the Stanford Linear Accelerator Center, and various other post-secondary, science, technology, and community organizations, which work on behalf of the 2,000 teachers and 55,000 students of the Oakland Unified School District. The Oakland district, where only 18 percent of the culturally diverse student body continues on to college, is the sixth largest in the state. These varied 21 entities have in the past four years created the Bay Area Science and Technology Education Collaboration[2] to support Oakland's science education.

Initially, the meetings, designed to include all district reform stakeholders (especially teachers and administrators), served to provide new stability in an environment where annual turnover of students and administrators is high. In urban districts the average superintendent lasts approximately two years. When work began, there was no district science supervisor, no staff development, and no curriculum, Engel said.

During that year's planning meetings, the laboratory involvement, including scientists and some Nobel laureates, gave collaboration members a sense of permanence. The collaboration also offered "two badly needed components," Engel said, namely "leadership and coordination of effort." Likening the process of teaching in many urban districts to trying to leapfrog across a swirling stream, the collaboration agreed to provide "five firmly grounded stepping stones on which teachers could depend," Engel said, including new science curriculum, summer workshops, an annual district-wide conference, grants to teachers, a newsletter, and an annual science awareness day for students.

The new core curriculum, developed by the collaboration and 100 teachers, and approved by the Oakland School Board, reflects the California Frameworks and the designers' belief that "students need to be involved in the process of doing scientific studies, not just learn lists of facts or specialized vocabulary," Engel quoted.

Although the collaboration's financial contribution makes up only about one-sixth of one percent of the overall district budget, "in only four years, it has become an essential component of district-wide reform," Engel concluded.

The immediate payback is evident: new ideas, resources and a support system for teachers, and growing interest in science among students. The long-term pay back is incalculable, going far beyond the classroom to: critically thinking citizens, responsible consumers, and a scientifically literate population.

PRINCETON PARTNERS WITH TRENTON SCHOOLS

Diane L. Carroll, head of the science education program, Princeton University Plasma Physics Laboratory, described a fruitful collaboration between laboratory staff and the Trenton School District to effect fundamental systemic reform in science, mathematics, and technology. With a goal of generating more interest among the predominantly minority students in the district and better preparing them for post-secondary classes in these fields, laboratory staff assist in developing new instructional programs, teacher training in new scientific and technical concepts, and providing better equipment for classrooms.

[2] The collaboration also works with the California Science Implementation Network, a statewide alliance of elementary schools, comprised of 800-plus schools involved in planning science programs, which operates a collective where teacher leaders share craft knowledge and change strategies related to implementing science curricula consistent with the new *California State Science and Mathematics Framework*.

Trenton schools reflect a troubled community, Carroll pointed out. The tax base is weak. Ninety percent of the district's students come from families receiving Aid to Dependent Children. The average per capita income is about half the statewide average. The high school dropout rate is more than 50 percent. There are some strengths, however, including a good relationship between local government and the schools, the cultural resources of the state capital, a large industrial and research community, active educational partnerships, and innovative district leadership. Building on these pluses, Carroll said, Princeton laboratory staff joined in 1993 with 25 (K–12) teachers and administrators to redesign the science curriculum in line with the proposed New Jersey Content Standards, based on the National Research Council's National Science Standards.

As a result of the reform, there are now new "opportunities for advancement and enrichment, including a new honors track in the sciences," Carroll said. Besides activities manual for grades K–5, administrators and teachers agreed to implement flexible scheduling which allows the teaching of activity-based science. Most elementary school children now study science 40 minutes a day, compared to 20 minutes daily before reform.

EMPOWERING TN SCIENCE & MATH TEACHERS

Cain described the work of the Oak Ridge National Laboratory and the Institute for Science and Education in the demographically diverse East Tennessee area as a "two-way process." While the purpose of the Oak Ridge partnership program Science and Mathematics Action for Revitalized Teaching is to empower science and mathematics teachers, it has also profoundly changed the way staff view K–12 teachers. "We work with schools and communities daily, asking them what are their needs," she emphasized, "never telling what we think is required." Although the teachers have almost universally benefited from their new access to world class facilities at Oak Ridge, Cain said, "it's not enough to try to change teachers."

Effective reform not only touches teachers and students, and that's why the partnership also involves local business and industry, civic organizations, parents, higher education, and state and local government, as well as DOE facilities. The partnership: offers programs for teachers, students, and parents; organizes field trips; provides access to sophisticated equipment; leverages such programs by making them available statewide; and involves other federal agencies and local science museums in the process.

Reform, Cain said, is a slow process, calling for both short- and long-term goals and requiring constant, system-wide evaluation. The partnership, only four years old, aims to continue its work —attending to the needs of its constituents—teachers, children, and the community.

SCIENCE TEACHING IN WASHINGTON STATE

Because Washington is not heavily populated, the approach of Battelle's DOE programs supporting precollege science education is statewide, and the Pacific National Laboratory programs can put "their arms around the entire state," said Irene D. Hays, manager, science education center, Pacific Northwest Laboratory (WA). Sometimes this means developing a multi-activity program, other times it's much more basic. "Give me a phone and a sink," said multiple teachers when asked what technology they needed.

Overall, the laboratory's science, mathematics, engineering, and technology education programs each year support more than 700 students, teachers, and faculty with research participation, workshops, classroom teaching, internships, and apprenticeships.

For the last three years the laboratory developed teams of diverse individuals with a stake in science education to connect systemically the various players in its reform. Each of the 23 teams across the country comprise two high school science and technology teachers, two middle school teachers, a school administrator, and a partner from industry, the post-secondary community, or a research and development laboratory.

The laboratory also has joined with the National Science Foundation (NSF) in an ambitious program to reach elementary school teachers and students in Science Alive. Science Alive focuses on immersing teachers and students in the scientific process for four weeks each summer. The laboratory linked this program with statewide systemic reform by supporting teacher training teams who work across Washington's 296 school districts. "In a nutshell," Hays said, "the teams work to bring live science and technology into classrooms and, also, to bring teachers and students into a laboratory research environment."

Developing effective science standards and opening more educational technology and the electronic highway will aid all mathematics and science teachers, Hays said. But she saw the need for somewhat different priorities to affect best science education at various academic levels. In high school, she said, "linking work-based and school-based education is essential, whereas for middle school students the most important thing is keeping options open for future science careers." To this end, laboratory scientists have been helping teachers with curriculum enhancement and staff development in an effort to reach students from groups traditionally underrepresented in science and technology, such as women and ethnic minorities.

NIH Talks to the Community

Bruce A. Fuchs, on loan to NIH's Office of Science Education Policy from the Medical College of Virginia, discussed four outreach programs NIH offers to area students and adults wanting to know more about medicine, biology, or science. Two of the four programs appeal to pre-secondary school students. The other programs focus on science education for nonspecialists in the community as a whole. All four are popular, he said.

■ **Science Alliance.** This program, initiated four years ago, puts 72 scientists into the same number of elementary school classrooms in 12 Washington, DC and Montgomery County, MD schools. The goal is to have one scientist available per grade level in each of the schools. Each scientist agrees to visit four times during the school year, Fuchs said. "Some do the minimum possible; others become charged and provide more generous commitment of time and energy," he said.

Putting scientists into a classroom directly without initiation in pedagogy is a "recipe for disaster," Fuchs said, so the scientists attend training sessions before they go to the schools. In addition, the frequently hands-on activities they offer are coordinated with the teachers' curriculums they are to complement.

■ **Biomedical Research Advancement Saturday Scholars.** The second program is aimed at middle school students from two Washington, DC and two Montgomery County schools "who are not already pro-science, but could be turned around," Fuchs said. A special emphasis is given to attracting the traditionally science-shy groups—girls and minorities.

On six Saturdays, the students come into NIH laboratories to learn about health-related topics. "We are long on doing and short on talk," Fuchs said. Students do labs on hematology, genetics, cancer, AIDS, and other topics with direct implications to their own lives. In addition, tours of the NIH campus highlight health-services careers available for students who stop their schooling at high school or baccalaureate level. The program provides follow-up through in-school clubs and summer reunions for participants.

■ **Medical Science Education for Adults.** Two NIH programs are geared toward informing a lay audience. Ninety percent of lay audiences gets most of their medical information from television.

The Mini-Med School, a nine-session, two-hour evening lecture series aims to introduce interested nonspecialists to topics common in medical school curriculums. Despite fears of lack of interest, 1,300 people applied for the available 300 seats.

The scientists who gave the lectures were asked to avoid jargon and limit their technical descriptions to a list of specialized terms provided in advance to participants. "We were mostly successful in keeping them from speaking in tongues," Fuchs laughed.

The second medical literacy program aimed at adults, Science in the Cinema, focused on four films that dealt with medical issues—"The Story of Louis Pasteur," "Benny and Joon," "Lorenzo's Oil," and "Awakenings." In each case, scientists separated scientific, biographical, and historical fact from fiction. Program information appeared in *The Washington Post*, and the event was well-attended.

Improving NIH's Science Literacy Programs

Fuchs emphasized that although the programs are a promising beginning, a number of problems still need solving. For example, of the 5,000 medical doctors and scientists with doctorates and the 14,000 technicians who work at NIH, only a tiny percentage participates. Among the "disincentives" for participation is a certain disrespect for the importance of nonspecialist science education, and a difficulty of finding time off to go into a science literacy program. Federal scientists still must punch time cards. The respect issue needs honest addressing, Fuchs said. Once the importance of science literacy at all levels has been established, provisions for a formal time to help achieve it would follow.

Space-Age Educating from NASA

Unable to address the CLTF directly, NASA's Frank C. Owens, director, Education Division, Office of Human Resources and Education, and Eddie Anderson, branch chief, Elementary and Secondary Programs, later presented NASA's considerable resources in support of precollege science, mathematics, and technology education. In the early 1980s, NASA supported more than 260 programs from elementary to postgraduate levels.

Since 1992, NASA's support for precollege programs increased from 23 percent to 30 percent of the total educational budget, and the budget increased from $77 to $118 million. Following the federal mandate for interagency cooperation, as expressed by the National Science and Technology Council[4] and its own strategic educational plan, NASA has been further sharpening its precollege mathematics, science, and technology education. To define NASA's vision, the agency is: 1) maintaining its current programs only if they are found to be effective and support education reform; 2) implementing new initiatives only if they agree with NASA, national, and federal education aims; and 3) expanding the impact of agency programs through partnerships with industry, other federal agencies, and professional, educational, and scientific associations. Underpinning these three NASA goals are what Owens calls "enabling systems:" evaluation, educational technology, and dissemination.

NASA'S PLAN TO SUPPORT SYSTEMIC REFORM

NASA programs aim to support national efforts in achieving a systemic approach to reform. It aligns its programs according to those compiled and tested by the National Council of Teachers of Mathematics, and works in concert with the developers of state curriculum frameworks, as well as with the needs of school districts and the higher education community.

NASA offers its "inspiring mission," unique facilities, and specialized workforce to capture children's interest in science, mathematics, and technology to channel students towards future careers in those fields, and to enhance the knowledge, skills, and experience of their teachers, Owens said. By collaborating with others working at local, state, and national levels, NASA hopes to leverage its contributions to science education reform.

PROVIDING TECHNOLOGY FOR TEACHERS AND STUDENTS

"We do a good job of getting NASA technology into the hands of students and faculty in higher education," Owens said. "But we also need to open our data base to the educational community at the elementary and secondary levels." Although Owens is aware that many of America's schools are technologically deprived and unequipped,[5] NASA's push to share its state-of-the-art technology is based on the expectation that this deficiency is changing.

Among NASA's resources available to students and teachers are the Central Operation of Resources for Educators, the Spacelink (an electronic database for educators on the Internet), the Satellite Video Conferences, "Launch Box" on the Nickelodeon cable television channel, and computer software programs (including a bibliography of software for aerospace education) which are being developed in cooperation with the Johnson Space Center Education Working Group.

Getting American education on line to meet teacher and student needs, Owens believes, will be the best motivator "for students to pursue science, mathematics, and technology disciplines and for their teachers to enhance their skills and knowledge."

TRAINING FOR TEACHERS

NASA currently is expanding its programs for teacher enhancement. Because of its belief that "the next generation of science, engineering, technology, and research will only be as good as the next generation of scientists, engineers, technicians, and teachers,"[6] NASA aims to increase student interest in these fields by helping their teachers. The agency uses NASA-related topics to expand teachers' content and pedagogical approaches to science, mathematics, and technology and to leverage the impact of the programs through the multiplier effect—participants sharing newly gained knowledge with colleagues.

THE TECHNOLOGY FOR EDUCATION ACT

Reflecting the nation's awareness of the essential importance of technology education in the post-industrial era is the new section Title III that passed into law as part of the Improving America's Schools Act provides $250 million for educational technology ($40 million earmarked for FY 95). Cosponsors were: Sens. Bingaman, Thad Cochran (R-MS), Edward M. Kennedy (D-MA), and Tom Harkin (D-IA),

Steinberg quoted Bingaman as calling for increased support for technology education on the grounds that it "levels the playing field and helps students in rural areas achieve the same level of educational excellence as those who can attend larger schools in bigger cities." The act provides grants to disadvantaged schools to purchase computer hardware and software, communications equipment, and other technical resources. It also supports the development of curricular-specific software and promotes teacher training in the use of technology.

Federal technology resources are coordinated through the Office of Educational Technology, established pursuant to the Bingaman amendments to the Goals 2000 legislation, which supports related research, prepares evaluations of technology for education programs, and helps states use technology effectively.

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[4] This group, comprised of representatives from 16 federal agencies and 3 executive offices (Office of Science and Technology, Office of Management and Budget, and the White House), compiled a comprehensive baseline inventory of federally funded programs that affect mathematics and science education at all levels. Since 1990, the council's predecessor, the Federal Coordinating Council for Science, Engineering, and Technology, began to work actively for increased cooperation and coordination of math and science education initiatives across the government.

[5] According to a 1993 National Education Association survey, classrooms "lack the most basic technologies found in office environments." (p.1) Only 12 percent of teachers even have telephones in their rooms, and although 90 percent have "access" to computers, only 52 percent have one in their classrooms.

[6] *NASA's Strategic Plan for Education: A Strategy for Change, 1992-1998* (First Edition, 1992), Washington, DC. (p. 47).