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Science Education Program Semi-Annual Report

October 1, 1997 – March 31, 1998

LOS ALAMOS NATIONAL LABORATORY

SCIENCE EDUCATION PROGRAM

SEMI-ANNUAL PROGRESS REPORT

October 1, 1997- March 31, 1998

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EXECUTIVE SUMMARY

Los Alamos National Laboratory has a unique contribution to make to science, mathematics, engineering, and technology education. The mission of the Science Education Program is to apply the unique scientific and technical resources of the Laboratory to the critical needs in education. Our goals are to:

- improve the quality of science, mathematics, engineering, and technology education;
- enhance the technical literacy of the public;
- contribute to systemic change in mathematics and science education; and
- ensure a highly trained, diverse workforce.

With this mission and these goals in mind, Los Alamos conducts a wide variety of science education projects, funded primarily by the Office of Defense Programs of the Department of Energy, with additional funding from other DOE offices, the National Science Foundation, the American Chemical Society, the New Mexico Department of Education, NASA, and other sources. Some of the projects are national in scope, others are regional, and still others are local (Northern New Mexico). The activities in these projects during the first six months of FY98 are described in this report.

In FY98 we are conducting 24 separate projects. In all of the Science Education Projects, we partner with other organizations and entities. We partner with the schools, teachers and administrators, with other national laboratories, the New Mexico Department of Education, the U.S. Department of Education, the National Science Foundation, NASA, curriculum specialists, universities, industry, and others.

We make a special effort to link every science education project with the unique resources of the Laboratory and to the technical programs and core competencies of the Laboratory and the Department of Energy. Those projects funded by the Office of Defense Programs of DOE are especially linked to technical areas of interest to DP and to DP goals and objectives. All of the projects make extensive use of Laboratory technical personnel for talks, demonstrations and tours. These direct contacts with the scientists and active science projects result in excited and enthusiastic students and teachers. This enthusiasm is the very best way to improve the teaching and learning of science and math.

Many of the post-secondary projects bring in students (and teachers) as research interns to work alongside Laboratory scientists and engineers. Each of these interns is assigned a Laboratory staff member as a mentor. Care is taken in choosing the mentors, and training and information are provided for the mentors. These mentors provide role models for the student and teacher participants.

The Science Education Projects have a very good record of diversity, of which we are proud. Diversity is an important goal for each of the projects.

An Internet Web Site (http://www.education.lanl.gov) is maintained that describes all of the science education projects and gives contact addresses for those who would like to apply or need more information. In addition, many of the projects use their part of the site to post schedules, products, summary reports, lesson plans, suggested activities, and other materials from their project. The projects are making more and more use of the Internet each year.

The Science Education Program at Los Alamos is very valuable to the Laboratory and to DOE. We are very proud of our accomplishments recorded here. Please feel free to contact us if there is any additional information that you need.

LOS ALAMOS NATIONAL LABORATORY

SCIENCE EDUCATION PROGRAM

SEMI-ANNUAL PROGRESS REPORT

October 1, 1997 – March 31, 1998

I. TEACHER/FACULTY ENHANCEMENT

A. Teacher Opportunities to Promote Science (TOPS)

TOPS (Teacher Opportunities to Promote Science) is a three-year teacher development program that creates opportunities for teachers in grades 4-12 from rural New Mexico schools to improve their teaching skills. It targets teachers who are interested in (1) enhancing their math, science, and technology teaching skills, (2) integrating math, science, and technology concepts throughout the curricula, and (3) remaining with their school districts for a minimum of three years and serving as a role model and mentor for colleagues. Teacher recruitment focuses on communities with a high percentage of minority populations, and we serve teachers and students from three major ethnic groups: Hispanic, Native American, and Anglo. Los Alamos National Laboratory (LANL) has long been committed to working with teachers and students throughout New Mexico.

Sixty-five teachers in levels K-12 are participating in the program which enables a side-by-side approach to promote district-wide systemic change in science, technology, and math, enhance communication through networking and skill development, and to optimize the opportunities for teachers to meet their individual, school, and/or team needs. The program is designed to increase New Mexico teachers' knowledge of science, mathematics, and technology while providing instruction and support to impact their student's understanding of science and mathematics concepts. Through hands-on activities, research experiences in Lab-related cutting-edge science, and a strategy to help them transfer their program experiences to their classrooms, this program exposes teachers and students to innovations and applications in real world science.

Highlights of the Program for October 1,1997 - March 31, 1998

In the months of October to December, the mathematics component for the program was developed and integrated into the design of the program. The development of a web site for all participants continued throughout this time period, and continues to serve as a central hub for communication to the participants. All sixty-five teachers in the program have secured an e-mail account and Internet access. Ultimately, a collaborative workspace was developed to provide an area for threaded communication between and among participants.

The first regional workshop was held on February 13-14, 1998 in Kirtland, New Mexico, for 32 of the participants who come from the communities of Kirtland, Shiprock, Farmington, Cuba, Aztec, and Bloomfield. A second workshop was held on February 20-21, 1998, at Los Alamos National Laboratory for 33 participants from the communities of Los Alamos, Santa Fe, Pojoaque, Española Valley, Jemez Pueblo, Santa Clara Pueblo, Pecos, Tierra Amarilla, and Las Vegas.

In preparation for the summer institute, teams of teachers representing cross grade-level groups began the planning process for developing science and math education to be put on the Science Education web site. The teams identified the concepts to be covered, mapped them to their district requirements, and developed curricula. These curriculum units will be thematic and will provide a 2-4 weeks experience in the classroom. This approach required each group of teachers to organize their design and communicate about it in the planning stages.

At each workshop, the participants established three- to five-member teams that represented elementary, middle, and high school levels. Teams were formed in the one of the following combinations: Elementary-Middle-High; Elementary-Middle; Middle-High. Each team had at least two levels of teachers represented, and it was desired that all three levels be represented in each team. The teams then identified the astrophysics concepts they will cover, and what that tie is to the LANL science mission.

In addition, each teacher was asked to design a personal web page that will be added to the TOPS web page. An html template was provided, along with some resources on the web. This activity built on the lessons given to the group last summer and at the fall workshop in September. Each participant in TOPS is required to complete a personal web page and submit it via electronic mail or on a disk to the program coordinator. To date, 42 participants have their personal sites posted on the TOPS web page.

Another series of regional workshops is being planned for April, which will include further instruction in the use of the collaborative workspace, concept mapping, and content research. A partnership with the Los Alamos Astrophysics (LAA) working group has provided 12 LANL mentors to assist the teachers in understanding the content material associated with space sciences. The summer institute is planned for all program participants in Los Alamos from July 13-24, 1998.

Throughout the three years of the program, the teacher teams will be developing a web-based communications network to provide educational support among the program participants, the students they teach, and the members of their communities. Each networked team will develop and publish curriculum projects on its own web site. The projects will be designed to promote communication between the

schools, LANL mentors, and the surrounding communities. Currently, the TOPS web site can be accessed at the following URL: http://education.lanl.gov/resources/tops.

Anecdotal Data

TOPS teachers made the following comments:

"I really like the idea of getting together as a group now and having things somewhat in place for us to start working in the summer. I also think that what we are doing in our teams will be much more useful than last summer's project."

"I welcomed the opportunity to meet with my team so we can lay the groundwork for the summer session. This should be more productive since we will be working on content from the start of the summer session."

"I get re-charged ever time I attend TOPS workshop training because there is always something I can take back to my district. I practice what I learn here and take it back to my colleagues. My motivation is always higher because I have been around teachers who are excited about what they do and it rubs off."

B. TOPS Assessment

This program is a collaborative assessment that builds on previous work between Los Alamos and the University of New Mexico's College of Education. The purpose of the assessment is to evaluate the TOPS K-12 Teacher Development Program. The goal for our evaluation is to examine changes in teachers' perceptions and behaviors based on their participation in TOPS. The evaluation activities designed to accomplish this goal fall into three major categories: Identifying changes in TOPS teachers' perceptions of influences on their teaching and their students' learning, examining changes in teachers' perceptions of their teaching, and maintaining active connections with the TOPS teachers and staff to improve the program.

From a systemic change perspective, context influences teaching and learning, and extends well beyond each teacher's classroom. Thus, this evaluation program examines perceptions of community-wide influences as well as influences that directly impact individual teachers' day-to-day teaching. The evaluation task was designed to examine these influences from each perspective.

The first task was designed to identify teachers' perceptions of community-wide influences. During a half-day session in the summer 1997 Institute, the teachers formed community-based teams of their choice to engage in this task. Each team created a concept map that represented these influences. They were asked to identify the influences as positive or negative, or both, and to indicate the influences they hoped to impact through their TOPS participation.

Once each group had completed a draft of their map, the groups rotated through the room examining other groups' maps. They then revised and finalized their own maps.

The teacher teams created 14 concept maps, 6 maps from participants from the North Central region and 8 maps from the Four Corners region. We began our analysis of these maps by sorting the influences into broad categories and noting their frequency of occurrence; frequencies were determined across all maps as well as by region. These concept maps showed that the teams shared some common perceptions regarding community-wide contextual influences. Across all maps, we identified 14 categories encompassing positive influences. Six of these were included on half or more of all the maps:

1. business (for resources)
2. post-secondary schools (for resources and professional development)
3. government (for funding and policies)
4. religion (for values)
5. families (for support for students and values)
6. national laboratories (for resources and professional development)

Common negative influences included substance abuse and gangs. The teams generally included more positive than negative influences in their maps and the maps more frequently emphasized common positive, rather than common negative, influences. Teachers expected that their participation in TOPS would influence change in their interactions with parents, in technology, teacher networking, professional development, and their use of resources. We will track these influences and changes in them across the remaining year of the TOPS Program for this cohort of teachers.

Four program issues were identified and discussed with the TOPS program staff.

1. Teachers have common views of the influences that they expect TOPS to impact. Do these expectations match TOPS goals? Specifically, are there any categories that the Program is not designed to impact? Are there any omissions (e.g., impacts on students)?

   The resulting discussion indicated that TOPS is designed to impact the influences identified by the teachers.

2. Should TOPS use the positive influences to help the teachers begin to work on the negative ones, (e.g., bring to the Program successful community programs on substance abuse prevention)?

   Discussion of this issue clarified the emphasis on Lab sciences within the scope of TOPS for purposes of this particular assessment. The program accomplishes this goal through using Lab sciences as the basis for curricula developed by the TOPS teachers and through using Lab technology to network the participants. Within this framework, one of the TOPS goals is to

develop leadership skills in the teachers so that they are able to work on these kinds of influences themselves.

3. There are regional differences. Should some of the regional workshops reflect these differing needs?

   The answer for this question is that TOPS also is making partnership connections that should allow their partners to help with common as well as regional needs.

4. The teachers made lists in the form of maps. They didn't synthesize the influences into broad areas, and they didn't interconnect them. Successful systemic reform requires a "big picture" view. Should TOPS assist them in developing this broader connected view?

   Because systemic reform is one goal of TOPS, the teachers should develop this kind of view. The issue is how to help them achieve this level of understanding. The next set of maps will be compared with this first set to see if synthesis has occurred.

Another evaluation task was designed to identify teachers' perceptions of influences on their teaching, and on their students' learning in their own classrooms. During the Institute, instructions were distributed asking each teacher to draw a concept map representing these influences, to indicate which ones are positive and which are negative, and to identify the ones they hope to impact through their participation in TOPS. They were asked to complete this task before school began in the fall and to send us copies of their maps. Only seven maps were received. To allow for the collection of meaningful information in a timely fashion, a survey was created based on the individually drawn maps received, the community-wide maps, and other measures designed to examine influences on teaching and learning. The survey was created to assess information in 11 areas. Three of these areas were directly related to TOPS goals: technology, teaching strategies, and TOPS participation in general. The other 8 included community resources, professional development resources, local school characteristics, family characteristics, student characteristics, local community characteristics, government, and teacher characteristics.

This survey was administered by a teacher-volunteer during the two regional TOPS workshops in February and mailed to us. Surveys were mailed to the teachers who were unable to attend the workshops. The initial computer entry and analysis of their responses has been completed. A summary of the results and an opportunity for discussion will be provided for the teachers during the April TOPS regional workshops. A report will follow.

At the end of the first Institute, teachers were asked to create a concept map showing what they learned at the Institute and how they would apply that learning in their classrooms. Now that the teachers have taught for almost one school year since entering TOPS, a plan has been developed to repeat this evaluation task during the April

TOPS workshops to assess the application of TOPS Program content to teaching.

The assessment team meets regularly with the TOPS program staff. The goals of the meetings are to develop the most effective evaluation possible and to provide feedback from our results in terms of implications for the program. The TOPS Program has initial reports outlining findings from the two concept mapping activities. Those reports will be revised and extended based on additional evaluation work in these areas. Communication with program participants about the evaluation and results takes place through e-mail and the TOPS web site.

C. Advanced Composition Explorer (ACE)

The Science Education Team has designed an educational program for the NIS-1 Group of Los Alamos National Laboratory which will formally begin May 1, 1998. The Advanced Composition Explorer (ACE) educational program will focus on a current NASA project exploring the composition of the solar winds. The educational component of the ACE project will involve teachers, K-16, in the development of multidisciplinary/multi-level classroom lessons and activities which focus on the NASA project.

The ACE education project will involve teachers in developing current real world science lessons and classroom activities through a collaborative, distance learning process. The teacher teams will enhance their use of computer technology by developing skills in web page development, concept mapping, and Internet research. Participant efforts will be consolidated via e-mail and a web-based curriculum. The teachers will interact with LANL mentors throughout the program during workshops and summer sessions.

In the program, teachers will critically investigate the ACE Project by examining the science behind the project goals. LANL (NIS-1) mentors will collaborate with the educational program participants providing current content, motivation, and support. The participants will learn how the scientific data is collected, analyzed, and interpreted. They will learn effective instructional methodologies to be incorporated into the lessons and activities which will be published on an ACE educational web site. The teams will be expected to collaborate through telecommunications during the research phase and participate in a culminating activity where they will finalize and deliver their web formatted lessons and activities for the ACE project.

This project is representative of the types of collaborations with the technical groups at the Laboratory that are conducting research for other agencies and who require that these projects include an education component for dissemination.

II. CURRICULUM IMPROVEMENT

A. Risks, Rewards and Responsibilities

Little was done on this program since the principal was assigned almost full-time to support the International Conference on Technology and Education (reported later in this report). Work will continue now that ICTE 1998 has concluded.

One of the central themes of the R3 curriculum is the assessment of risk. Unfortunately, most risk assessment materials are targeted at the collegiate level and beyond. However, as was done with the Laboratory's MegaMath Program, many of the concepts of risk assessment can be understood without the need for rigorous and complex mathematical development. It appears prudent to take this path as well as bringing MegaMath up to date (its web presentation is over five years out-of-date). Unifying these two needs suggests a program that places greater emphasis on mathematics in the science, mathematics, engineering, and technology array.

Directions for the rest of the year include developing a couple of concepts in traditional and Bayesian statistics as well as assessing what is needed for Megamath. Further, options for teacher/student participation in developing materials for NEWNet will be explored. Through these avenues, Defense Programs work can be emphasized since risk assessment is directly related to public understanding of many DP issues and NEWNet materials focus intently on radioactive decay models.

B. AIMS Fluid Instabilities Curriculum Development

We are writing a book, *Spills and Ripples*, collaboratively with the AIMS Education Foundation (Fresno, CA) to teach pre-college students about the exciting world of fluid dynamics. The original concept was a monograph devoted to Rayleigh-Taylor Instability (RTI). However, the scope has broadened to a novel book of hands-on activities for students in grades 5-9. The text uses RTI to motivate students by challenging their understanding about fluid properties. Additional activities within the book provide students with 2-3 lessons each about the fundamental fluid properties of density, pressure, surface tension, and interfaces. About one-third of *Spills and Ripples* is the science, engineering, and history of RTI and related fluid instabilities. This innovative book will be the first middle-school text of hands-on activities about fluid instabilities.

Several of the Rayleigh-Taylor instability activities have been published in the AIMS Magazine for field testing and the response has been quite positive. During this reporting period we published another activity, "Soapy Spills," in the March 1998 issue. This activity challenges students to learn how decreased surface tension on a water surface reduces the ability of that surface to resist RTI. Consequently, confining water in a gauze-covered, upside-down glass is more difficult

with soapy water than with fresh water. Students doing "Soapy Spills" make both qualitative and quantitative measurements on the integrity of the water surface.

The next Rayleigh-Taylor instability activity is a composite of three challenges. The format is an Olympic-style event. Entitled "Trickle Triathlon," it motivates students to explore the practical limits of surface tension to suppress ripples so that water stays confined in an upside-down jar. The friendly competition among small groups of students designed into this activity is modeled after a previously successful AIMS activity. This activity is about 90% complete.

The explanation in a previously published Rayleigh-Taylor instability activity has been enhanced for publication in *Spills and Ripples* . "Flow Fingers" shows the flow patterns of RTI as an observation of a drop of food-coloring falling through still water. Rayleigh-Taylor spikes are clearly seen as tentacle-like projections of the food coloring as it penetrates the water. This RTI occurs after the evolution of the "Widnall instability," which was observed but not properly identified in the "Flow Fingers" AIMS Magazine article, March, 1997. When the food-coloring drop falls through the water surface, the drop is deformed into a ring, similar to a smoke-ring. The ring of food coloring soon becomes wavy and then "grows" Rayleigh-Taylor spikes. This breaking up of the ring is known as the "Widnall instability," named after Dr. Sheila Widnall, a contemporary fluid dynamicist. *Spills and Ripples* will call attention to this phenomenon and will include a biographical sidebar on Dr. Widnall, an excellent female scientist role model.

In addition to writing this middle-school, hands-on text about fluid instability with AIMS, we are exploring an extension of this educational initiative by teaching people about these phenomena in a museum setting, and by providing teacher workshops. We met with educators and exhibit-developers at two prominent California science museums. The staff at one museum is interested in collaborating on the development of such an exhibit. This project, developing a museum-quality Rayleigh-Taylor-instability demonstrator, is considerably more difficult than basic RTI demonstrations because RTI induces mixing between fluids, but museum exhibits demand rapid resettability of demonstrations. Because fluids do not usually "de-mix," exhibit developers must cleverly de-mix the fluids or "hide" the mixed fluid by making it appear to be unmixed. Several methods are being evaluated for a museum-quality RTI demonstrator, including magnetic fluids, acid-base reactions, and bleaching. We provided a teacher workshop during this reporting period at the High School Physics Teacher Day at the annual Fluid Dynamics meeting sponsored by the American Physical Society (November 1997 at San Francisco). This presentation was done with the same hands-on methods recommended for teachers to use with their students.

C. Navajo Translation Pilot Project

Last fiscal year, the K-12 Science Education Team and a team of translators from the Navajo Nation completed work on the interpretation of science education and career development materials for use in science classrooms. These materials were developed through funding provided by the Life Sciences Division of NASA. The project was developed around a New Explorer Series video and teacher guide developed by Bill Kurtis Productions and Argonne National Laboratory, entitled *On the Trail of a Killer Virus*, a medical mystery about the hantavirus outbreak in the Four Corners area of New Mexico in 1993. The materials feature a science activity guide that accompanies the video and brings a problem solving approach to teaching science in middle and high school classrooms. Following a program presentation to the funders of the project and to the educators of the Navajo Nation in Window Rock, Arizona, the selection process began to bring the pilot sites into the project.

Five core sites were selected to participate in the pilot of the completed curriculum materials. Other teachers who were interested in using the materials were given copies of the video and the curriculum. Teachers were selected according to the following criteria.

- Interested in improving science learning in students.
- Committed to teaching a science class using Navajo language, as well as English.
- Willing to use the video, activity book, and software with their middle or high school students in the classroom.
- Willing to attend training in Los Alamos in the use of the materials.
- Willing to conduct a pre- and post-program assessment of the classroom use of these materials.
- Willing to submit a written review of the materials to be used for revisions.
- Willing to submit a student developed version of the Hyperstudio guide for possible inclusion in the final package.

The teachers for the pilot sites were from Ft. Defiance, Newcomb Jr. High School, Chinle Jr. High School, and Window Rock Elementary School in Arizona, and from Tse bet'ai Middle School in Shiprock, New Mexico. Training was held for teachers from those sites in November and December. In addition to the pilot curriculum materials to use in their classrooms, teachers received the benefit of a computer gifted from the Laboratory with the appropriate software for the project to use in the classroom. Teachers who had Internet access were encouraged to communicate with the program coordinator at the Laboratory if they had questions. They received no additional resources.

We are informally evaluating the material using questionnaires and classroom observations, with the feedback used only to prepare a final version of the translation and not to judge student performance. We are collecting data according to these categories: quality of the translation, cultural issues, learning points, and the equivalence between the written text, and the video and voice script. Some of the things we hope to learn about the translated version are:

- Does translated text provide the intended student involvement in the lessons?
- Which lessons generated the most interest in the students and why?
- Which lessons did the students find most difficult and why?
- Is there consistent use of terminology and usage?
- Does the interpretation remain science oriented?
- Is there interest in the mystery approach of the story?
- Does the interpretation correct wrong information?
- Is the work pitched to a level appropriate for mid- and high-school students?

Pilot assessment results are expected to be completed in May, 1998, and the revisions are to be completed by the end of the fiscal year.

D. Web of Learning

Begun in FY98, this new project uses the World Wide Web to distribute and continually upgrade educational materials among a community of students and educators. The program is being designed to combat the shortcomings of the Internet while disseminating first-rate educational materials for use in the public domain. The long-term goal of this project is to place on the Web, at least one student or teacher developed interactive tutorial for each topic covered in math and science in grades 4-12. A challenge in creating these tutorials is ensuring their quality, continuity, usability, and critical alignment with national standards in math and science. Eventually, we anticipate that these tutorials will continually be refreshed with new, more effective versions that the students and teachers develop and contribute to the project Web site.

Los Alamos has chosen to begin to meet the specific need for mathematics curricula that support nationally accepted standards. As students and their teachers develop tutorials that will run on the Web, we expect them to deepen their own understanding of math concepts, to benefit from designing and constructing tutorials, to enhance their ability to communicate on topics involving mathematics, and to generally take ownership of their learning through these processes. We have been developing the project with a mathematics professor on

sabbatical from Thiel College in Pennsylvania, who is a math scholar and a student of Abraham Hillman, co-author of the book, P*roblem Solving through Algebra.* The work, thus far, has consisted of creating the web site that will feature the problems and problem solving approaches that are recommended in Hillman's and Alexanderson's exemplary book. The material is being converted into html chapter by chapter for the web, to be used as a tool in preparation for a competition that will identify students who have potential for excelling in the field of mathematics. Sample tutorials will be developed and placed in the site as exercises to enable the problem solving activity. This development phase is expected to be complete by summer, and then practical use and dissemination of the Web of Learning will begin in earnest.

III. STUDENT SUPPORT

A. Critical Issues Forum (CIF)

The Science Education Team of Los Alamos National Laboratory has designed the Critical Issues Forum Program for high school students and teachers as a multidisciplinary curriculum, integrating computer technology. The CIF Program focuses on current, globally oriented topics crucial to the security of not only the United States, but to all nations. The program involves both teachers and students in seeking solutions for current, real world concerns through a collaborative, distance learning process. The teams enhance their use of computer technology by developing skills in web page development, concept mapping, and Internet research. Participant efforts are consolidated via e-mail and a web-based curriculum. The teams interact with electronic mentors through the web site's question submission area and through the ongoing dialogue page.

In the CIF Program, teachers and students are asked to critically investigate an issue by examining interactions between the scientific, social, economic, and political domains, while considering diversity issues including geo-political entities, and cultural and ethnic groupings. The teams are expected to collaborate through telecommunications during the research phase and participate in a culminating multi-media activity where they produce and deliver recommendations for the current issue being studied.

Highlights of this Year's Program to Date

A teacher workshop was held October 31-November 1, 1997 at Los Alamos National Laboratory. Twenty-two teachers representing fourteen New Mexico high schools continued the process of curriculum development which began in September. In addition to the participants, ten LANL mentors from the plutonium facility (TA-55) provided technical assistance to the teachers in building understanding of the Laboratory's role in the context of terrorism in the nuclear age. Participants established a working relationship with the LANL mentors, which will be continued throughout the program.

Another teacher workshop was held December 5-6, 1997, at LANL. The program participants finalized the curriculum to be implemented in their classrooms during the spring semester. The content of the curriculum was formatted in HTML for web publication. The curriculum consisted of eight benchmark areas culminating with a student conference on terrorism to be held at Los Alamos National Laboratory in early May.

In early January, the program coordinators delivered a two-day workshop at Lawrence Livermore National Laboratory to a group of teachers representing a number of California high schools who are participating in LLNL's version of the Critical Issues Forum Program. The Laboratory benefits from the collaboration because the Critical

Issues Forum is being tested outside Los Alamos, thus helping to increase public understanding of LANL's mission. In addition, Southern Regional High School in Princeton, NJ, also is using the Laboratory-developed Critical Issues Forum Program.

The first regional workshop for students and teachers was held at the TVI complex in Albuquerque and the Corbett Center at NMSU on January 23-24, 1998. There were 120 students and 21 teachers and administrators in attendance at the workshop. The thrust of the workshop was to provide students and teachers with collaborative practice and skills in conducting brainstorming, organizing, and questioning sessions. These skills are useful as the student/teacher teams begin to address the program benchmarks.

The second regional workshop for students and teachers was held at the Corbett Center at NMSU and the TVI complex in Albuquerque on March 20-21, 1998. There were 100 students and 16 teachers and administrators in attendance at the workshop. The workshop was held to synthesize the material from the first half of the spring semester. Through dialogue groups, student teams established a set of matrices as a culminating activity for Benchmarks 1-4. They focused on regional and local acts of terrorism and determined causes and considerations for each event. This activity was designed to allow students to demonstrate their understanding of the material to date.

Many LANL staff members have been participating this year, including Terry Hawkins, Deputy Director of NIS, who delivered a keynote address at the March workshops, to students, teachers, and administrators on the topic of terrorism and the Laboratory's efforts to counter such terrorism in the areas of science and technology.

Student teams collaborate with fellow students as well as LANL staff who act as electronic mentors. Questions are posted on the CIF web site, and staff members send e-mail to the program coordinators, who publish the responses for everyone to read. The students investigate the topic through benchmark assignments in their classrooms, participate in regional workshops, and publish their work on the CIF web site in an electronic team portfolio. The fact that the student teams are writing for an audience that includes fellow students, teachers, scientists and educators (as well as anyone with Internet access) helps to increase the intrinsic motivation of the students to produce a well-researched and well-thought out position on a given assignment.

Students will demonstrate their accumulated knowledge at Los Alamos National Laboratory by participating in a student conference which serves as a culminating activity for the 1998 Critical Issues Forum (CIF). Students throughout the state will come to the Laboratory on Friday, May 8, to deliver multimedia presentations on the topic of terrorism in the nuclear age. For more information and to view student work, visit the CIF web site at http://education.lanl.gov/resources/cif/cif98.

B. New Mexico Supercomputing Challenge

The Challenge began the new year with a new main computer. An SGI O200 was purchased, at a discount, to replace the six-year-old Cray YMP/EL. Though the O200 is not a "supercomputer" class machine, it is compatible with the SGI O2000 machines that make up the new ASCI environment at LANL. The O200 is still front ended with a Pentium Pro running Linux, which hosts the LANL Challenge web page, http://mode.lanl.k12.nm.us.

New to the Challenge this year are Celia Einhorn and Betsy Frederick who were hired by New Mexico Technet to replace retired John Jenkins who was the "executive director" of the Challenge the past four years, and a charter member of the Challenge executive committee. Technet has a new president this year, and LANL now has a new director. At last year's awards ceremony, recognition was given to these three retiring founders: John Jenkins, Tom Thornhill, and Sig Hecker.

The Kickoff Conference held at the Glorieta Conference Center in October was attended by 423 students and 81 teachers from 46 schools composing 112 teams. We had a total of 106 abstracts entered on-line at http://mode.lanl.k12.nm.us/abstracts. This year, the Kickoff Conference was shortened to reduce expenses and was concentrated more on computational science and less on connectivity. LANL provided 15 of the instructors and 14 instructors came from other sponsors.

The executive committee decided to charge a $20.00 registration fee for each student and teacher attending Glorieta to help cover food costs. A scholarship fund was established to provide funds for participants unable to pay the registration fee, but fewer than five participants requested assistance. The fee did not seem to be a deterrent to Challenge participation but did help subsidize Technet's cost of the Kickoff Conference.

In November, the executive committee did not make visits to all the schools, just to ones that requested a school visit. In retrospect, we probably should have visited more schools than those who requested visits.

The Challenge executive committee has been approached to allow the El Paso School District to participate in the Challenge using funds from a NASA grant. Technet has been opposed to expanding for funding reasons, but with the opportunity of involvement from NASA, we plan to allow El Paso to participate next year with the hopes of spinning them off in a few years with their own "Challenge".

In January, six one-day Regional Workshops were held at Eastern New Mexico University in Portales, New Mexico State University in Las Cruces, New Mexico Tech in Socorro, San Juan Community College in Farmington, University of New Mexico in Albuquerque, and New Mexico Highlands University in Las Vegas. They were attended

by a total of 225 students and 54 teachers. From 3-6 Challenge staff were at each of the Regionals to deliver talks and answer questions. An addition to the Regional Workshop day was the "meet the scientist luncheon" where local faculty members and local scientists discussed the team's project with them over lunch. This worked well at five of the six Regionals and will be repeated and fine tuned again next year.

Seventy-nine interim reports were received and posted on the web at http://mode.lanl.k12.nm.us/interims.

The Microsoft Corporation has joined the list of Challenge sponsors and will be providing an award this year for the "best use" of MS Office in a final report, along with giveaways for all award ceremony attendees. The "best use" award will be a copy of MS Office97 Professional for each student member of the winning team (or FrontPage98 if they have Office97). The first place winners will receive one each of Office97, Bookshelf98, Encarta Reference Suite 98, and FrontPage98. Microsoft will also reward this year's judges with software. Next year they will provide software for each team to use during the year (Microsoft Office97 Professional for Windows95) and software for each participant (a customized version of Microsoft Internet Explorer).

By the end of March, two current Challenge participants had already been hired by LANL groups as UGS students for Summer 1998.

A former Challenge participant, Gina Weber, was hired by CIC-6 when she entered college in 1994 and she has worked part-time on the Challenge for four years. She recently got another job with LANL and is not involved in the day-to-day operations of the Challenge. She was able to help at the Kickoff Conference and one Regional Workshop and plans to teach one of the subjects at this summer's Teacher Training Session . Her absence is noticeable as at this time last year, we had 30 teachers interested in the STTS while we only have eleven applications this year. More effort will be concentrated in that area in the next few weeks, to solicit teachers to participate in the STTS and to finalize the plans.

Preparations are well underway for the 8th Annual Awards Day activities at Los Alamos April 29-30, 1998.

C. Undergraduate Research Semester (URS)

The Fall 1997 URS Program was completed with 20 students participating in the closing Poster Session at the Bradbury Science Museum. The program began with 23 students. One student left the program, one could not present a poster due to emergency surgery, and the third student presented her poster at the student section of the Nobel Prize Awards Conference in Sweden. Six students stayed at LANL for further research of varying duration. As of this writing, there are four students continuing their research with their mentor scientist, and one who transferred to another division, before attending graduate

school for Fall 1998. Eight females and 14 males were among the 22 students who completed the program. This ethnically diverse group included 2 Asians, 1 African American, 13 Caucasians, 3 Hispanics, and 3 not offering ethnicity information. The 22 students provided support to fundamental research in 9 divisions.

The Spring 1998 URS Program is in progress with 19 students composed of 7 females and 12 males. This group is also ethnically diverse with 1 Asian, 1 African American, 13 Caucasians, 3 Hispanics, 1 Native American, and 2 not offering ethnicity information. Site visits are complete and the results suggest that this is the best overall group in a long time. We had comments such as “she will have her own research lab in fifteen years” and “he is my best student since 1989.” With five weeks still to go, we are expecting about half of the students to stay at LANL for the summer. The number would probably be a record-breaking 80% if mentor-scientist funds were more readily available.

Overall, the URS Program is seeing a substantial reduction in incoming student applications due to the loss of the national recruiting infrastructure. There were only 80 student applications for LANL in the Fall 1997 placement round, and only 54 applications were available nationwide for Spring 1998. LANL got the lion’s share at 19 due to aggressive interviewing by our mentor scientists. To compensate for the reduction, the four Defense Program laboratories are unifying their recruiting efforts and reestablishing a national recruiting effort beginning with the development of flyers, posters, mailing lists, and a new web site with an on-line application process. The Fall 1998 matching process has begun with the receipt of 25 project proposals from the research community and about 40 student applications for all four laboratories.

D. Atomic, Molecular, and Optical Physics Summer School (AMO)

We report several activities and developments since the close of the 1997 session of the Summer School in late July, 1997.

- Binding of the student reports of their mentored research projects and general information on the 1997 session into a Laboratory Report [LA-UR-97-3921] for distribution.
- Acceptance of a paper by Todd Meyrath with mentor Dr. Daniel James on Quantum Computing to *Physics Letters A*.
- Submittal and forthcoming publication of six papers contributed by participants to the *Eastern Science Journal*, a specialized journal for student research projects, edited by Kelly Cline, one of the 1997 students.
- Acceptance of two students: Beckisue Roybal (Northern Colorado Univ.) and Savvas Koushiappas(University of New Mexico) to the *Second Undergraduate Research Poster Session on Capitol Hill*; Mr. Koushiappas was also invited to participate in the International

Conference of Physics Students in Vienna, Austria during August, 1997.

- Follow-up contact of the 1997 class (about 60% so far). The undergraduates still pursue studies in physical sciences; all of the seniors are applying for and accepting offers from graduate schools in the sciences.

Conference Experience for Undergraduates (CEU)

Due to the heavy involvement of personnel from LANL and UNM in the organization and operation of the American Physical Society(APS) Conference in Santa Fe in late May, we decided that for FY98 we will institute a different, shorter program in place of the usual Summer School. Running in conjunction with the APS meeting, the *Conference Experience for Under-graduates* (CEU) complements the usual student mentored-research projects. This novel initiative fills a neglected area in most student research endeavors and summer schools – the actual participation in a large scientific conference. While final reports, talks, and posters within a given program provide important training in the dissemination of scientific knowledge, they do not generate the overall climate, tension, and excitement of a major conference nor expose the students to the wealth of ideas and personalities that infuse such gatherings. Even in the electronic age, major scientific conferences still remain an invaluable communication link in the life of professional scientists. We intend this experiment to lay the foundations and to build the expertise for such programs at future meetings.

The CEU will span a two-week period centered on the APS Conference. For the first week, the students attend the APS Conference in Santa Fe and receive daily guidance and mentoring from LANL and UNM staff, including orientation on the day before the meeting, assignments of interesting sessions to attend, and general instruction on and discussion of the various topics presented. In the second week, the students travel to Los Alamos and attend an intense set of tutorials and lectures from many of the distinguished, invited speakers at the Conference. Topics include: Bose-Einstein Condensates, Quantum Computing, Quantum Control of Molecular Processes, and Parallel Computing.

As in the past, we continue our long-running collaboration with the University of New Mexico. The University has received funding from the National Science Foundation, through the Center of Graduate Studies of UNM-North, as a special project under the usual Research Experience for Undergraduates Program (REU). Professor Howard Bryant, Department of Physics, serves as Principal Investigator and Professor Mike Zeilik, as a co-investigator. Both have had long associations with the Summer School. In addition to the funds from DOE Educational Programs, both institutions provide in-kind support through use of personnel and facilities.

This period has covered the basic organization and recruiting phase of the program. Many facets parallel those for the Summer School such as securing housing, enlisting mentors and lecturers, and arranging logistics and transportation. The two-site nature of the program has inflicted some new challenges, but all arrangements for accommodations, transportation, and curricula appear to be in place. We advertised extensively using (1) the Conference's vast mailings, which included special fliers for the CEU; (2) a new web page [http://t4.lanl.gov/ CEU], well linked to many other sites; and (3) direct contact with other REU sites. We received over 40 completed applications from an outstanding group of students throughout the country. We plan to accept about 16 into the program. Our first-round selection process is underway with 17 offers already made of which 12, so far, have accepted and only one declined due to scheduling problems. Those accepting are evenly split between men and women with Hispanic and Asian minorities, as well as 11 different states [CT, IL, MA, MD, MO, NE, NM, NY, OH, OR, PA] represented. Two students return from overseas exchange programs in Finland (Helsinki University) and in England (University College London) to attend. Therefore, our student body contains a broad diversity of talent, background, interests, and experiences.

A previous research experience was thought essential for any participant to enter the CEU as reflected both in our initial proposals and in strong indications from the reviewers. To this end, all of our participants meet this criteria with eight having attended past REU programs and four completing student research projects during the academic term. Eight of these plan to attend REU sites this summer after the CEU; the remaining four have applied for research-oriented full-summer programs at, for example, national laboratories and agencies. Two students will present their work at a special session for undergraduate research at the APS Conference, and others have associations with papers at the meeting. While we usually have a large pool of outstanding students from which to draw for the regular Summer School, this particular group of applicants is sterling.

E. Summer of Applied Geophysical Experience (SAGE)

Although the main SAGE Program takes place in the summer months (June and July), considerable student and faculty activity occurs year 'round. In November, Professor George Jiracek, SAGE Co-Director, and Scott Baldridge attended the Annual Meeting of the Society of Exploration Geophysicists (SEG) in Dallas. Contact with the SEG has been vital for promoting and maintaining the participation of Industry. In addition, SEG provides direct funding to SAGE, made possible by a grant from ARCO. Baldridge and Jiracek presented a "recruiting" poster at the Student/Faculty reception, talking with numerous students, faculty, and industry representatives. On this occasion, a representative of the Australian Society of Exploration Geophysics (ASEG) raised the idea of sending an Australian student to SAGE on an annual, competitive basis; and Professor Thomas Jordan of MIT requested closer coordination with the SAGE Program as a means of

soliciting promising undergraduate students for their new Geosystems Professional Masters degree program. Thus, SAGE enjoys a broad reputation, and, we hope, will be used by other geophysical programs. Baldridge and Jiracek also presented a report on the SAGE 1997 activities to the SEG's Academic Liaison committee, which coordinates the Society's educational and outreach activities. The report to this committee constitutes SAGE's annual report to industry and provides a means of soliciting feedback from industry representatives. The organizing committee of the Annual Meeting allowed SAGE to display a poster in the main technical poster session for four days at no charge. The poster session was staffed by Baldridge, Jiracek, Professor John Ferguson (SAGE faculty), and by Kathleen Aiken, a SAGE 1997 student and SAGE enthusiast. The poster attracted considerable and continuous interest from meeting attendees.

In January, SAGE sponsored a week-long seismics/gravity/magnetics Workshop at San Diego State University for the SAGE 1997 REU students. Twelve REU students attended. In addition, two graduate students from SAGE 1997 attended at their own cost. Victor Gonzales, a former SAGE student and presently a graduate student at San Diego State University, assisted with various tasks related to computer processing. All of the SAGE faculty were in attendance for at least part of the workshop. The REU undergraduate part of the workshop is funded by the National Science Foundation, and faculty donate their time. The workshop is important in allowing students to continue with data processing that they began during the main SAGE Program, and to explore other techniques in greater detail than they may have had time to do. Altogether, we have found that the January workshop helps "cement" the experience gained during the previous summer and allows students greater insight into geophysical problem-solving.

In January and February, approximately 1000 information packages about SAGE 1998 were mailed to colleges and universities across the U. S. and to many foreign institutions. This wide mailing is important in assuring as diverse a student group as possible. Also, Baldridge and Jiracek are in nearly daily contact by e-mail with prospective students.

In March, the SAGE faculty convened at the IGPP Office at LANL for a semi-annual planning workshop to prepare for SAGE 1998. Agenda items included the location and workplan for field work, decisions regarding techniques and equipment to be used, planning for industry and academic visitors, and scheduling. Several of the faculty used the opportunity to take a brief look at the field area, which will be new for SAGE.

During this period, the faculty prepared a paper on results of the SAGE 1997 work at an ER site (MDA-B, TA-21) at Los Alamos. The purpose of the paper is to make the geophysical community aware of the type of work that can be done by students, to promote the educational value of "hands on" exercises, and to present technical results.

Applications for SAGE 1998 are arriving and being compiled in the IGPP Office. The process of obtaining the necessary permits and NEPA-required documentation has begun.

Finally, improvements were made to the SAGE web page at http://geont1.lanl.gov/sage/sage.htm.

F. Underrepresented Minority/Female Initiative

- Currently there are 4 GRA students on board. Two of the four are on a 50/50 salary cost share basis with their host technical organization and the URMF Program.

- The UNM-LA portion of the URMF Program is preparing for the eight-week summer program that supports 20 graduating high school seniors that are college bound. Of the students that participated last summer, 18 of the 20 are currently enrolled at a postsecondary institution. Plans are to provide internships at LANL this summer to about 5 of these students that participated last summer. The idea is to provide a SMET track for these types of students.

- Much recruiting has taken place since last October. Plans are underway to start placing students for summer internships. Whenever possible we try to leverage the number of students by trying to get the technical organization to split the salary costs.

G. Regional Two-Year College Initiative

- Continue working with business/industry and two-year postsecondary institutions in New Mexico. We have formed a working group called the “Technology Advisory Coalition (TAC). The objectives are to (1) communicate business/industry needs and employment demands, (2) identify industry-based competencies for Associate Degree technology curriculum, (3) map out and integrate initiatives and players, (4) and provide input to colleges regarding articulations with high schools and universities.

- Continue to work with LANL property staff and CIC Division in trying to get equipment out to some of the postsecondary schools. This has not been a very successful initiative. We are still waiting for DOE/ALO action on our request.

- Continue supporting the draft of a proposal to the National Science Foundation for an Advanced Technology Education Grant that would impact Northern New Mexico two-year postsecondary institutions.

- One graduate student has been an offsite student, teaching courses at the School of Education at New Mexico Highlands University. He has been developing curricula on technology which has now been integrated into the school of education curriculum.

He is also teaching four technology education classes and providing technical assistance to the regional two-year postsecondary institutions.

- Providing part-time internship support to five undergraduate students attending one of the regional two-year schools.

- Providing support to the Luna Vocational Technical Institute (LVTI) in the development of a pre-engineering Associate Degree Program.

- Continue working with New Mexico State University (NMSU) and twelve two-year postsecondary institutions to develop a New Mexico advanced manufacturing technology consortium. Plans to create this consortium will be to establish technology centers of excellence in New Mexico. A preliminary proposal has been drafted and is being reviewed by participating institutions. Private sector companies (Intel, Phillips, and Allied Signal) have been invited to discuss their participation in this initiative.

- The (Dine') Navajo Community College is being supported on their Geographical Information System (GIS) summer program. They hope to incorporate the GIS program as part of their curriculum next year. On March 23, 1998 the Dine' Community College dedicated their new GIS/AUTO-CAD facility. They gave much of the credit to the LANL- TYCI Program for getting them started and supporting them via internships. DOE and DoD have been actively supporting the college with their infrastructure.

H. Historically Black Colleges and Universities (HBCU)

Collaborations

- Campus

Morehouse College (Atlanta, GA) has just recently been identified as a campus with which LANL should develop a collaborative effort. Their strong *Project S.P.A.C.E. Program* sponsored by NASA enables us to introduce qualified and capable young men to the mentors for summer internship opportunities.

The HBCU Program is providing partial support for a 1997 HBCU Program graduate student from ***Southern University and A&M College*** (Baton Rouge, LA) who is conducting research on his master's thesis. The research involves the analysis of neutrino-carbon scattering data from the Lab's Liquid Scintillator Neutrino Detector (LSND) experiment.

Professors at ***Spelman College*** (Atlanta, GA) are working with LANL to identify students who are interested in a summer internship. These young women will come to us with funding through campus from the U. S. Department of Energy. It is

anticipated that the students will come from the biology, math, and environmental science departments.

- Organizations

The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM) (Notre Dame, IN) serves to enhance the recruitment efforts of the HBCU Program. Through GEM we are introduced to qualified and capable minority graduate students in engineering and science. Opportunities are there to provide graduate support to students through the Laboratory. In addition, the support is there for selected summer interns, through the University Programs Office, to further enhance the students' summer by attending the GEM Summer Institute this July in Ft. Lauderdale, FL.

The LANL HBCU coordinator currently serves on the planning committee for this summer's Institute to also coordinate the "Student Resume' Booklet". We have provided the resumè guidelines, on-line, for the students to submit their resumes to further compile them for the Summer Institute to market their academic and professional capabilities.

National Association for Equal Opportunity in Higher Education (NAFEO) (Washington, DC) has been a successful new relationship toward identifying HBCUs with the strongest departments in science, engineering, and technology. Their national conference is held every year in Washington, DC in which students, campus presidents and administrators, and corporate and government sponsors participate.

Recruitment

GEM, Inc. held its Draft Pick in January. As mentioned above, the Laboratory will support four engineering students over the next two academic years with academic fellowships. These students comprise one Ph.D. candidate and three M.S. candidates. Their commitment to the Laboratory will involve working here for two consecutive summers.

Howard University (Washington, DC) was visited by the Human Resources Office to recruit for permanent positions. We participated in the evening information session to introduce students, informally, to the Laboratory. Former HBCU students participated to give interested students their perspective. Philip Nelson is now an M.S. candidate in Chemical Engineering and plans to return to the Laboratory this summer. Kareem Washington is now a Ph.D. candidate in Human Genetics.

Conferences

- Student

  Society of Hispanic Professional Engineers (SHPE) held its national conference in Orlando, FL. Over 150 students stopped at the career fair booth to discuss opportunities at the Laboratory and to leave resumes.

  National Society of Black Engineers, Inc. (NSBE) held its national conference in Anaheim, CA. Two days of career fairs resulted in over 200 students stopping to inquire about summer and permanent research opportunities. Students also attended workshops, one of which was conducted by Dr. John Hurley of Clark Atlanta University. He was introduced to the Conference planners due to our collaborations with the campuses in the Atlanta University Center.

- Professional

  National Association of Minority Engineering Program Administrators (NAMEPA) held its annual conference in Albuquerque, NM this year. We participated on a panel to discuss Anti-Affirmative Action and its effects on Government Programs.

Summary

The HBCU Program is growing and flourishing with new relationships with various organizations interested in the continued accomplishments and opportunities for all minority students in science, engineering, and technology. Future collaborations with the organization, Quality Education for Minorities, Inc. (QEM, Inc.), in Washington, DC will ensure a future for all minorities in engineering. This is critical as reported by the National Action Council for Minorities in Engineering (NACME) which “has warned that this is the last year of growth in graduations of minority-group engineers” in the Electronic Engineering Times.

I. Mentored Collaborative Research Project (MCRP)

The Mentored Collaborative Research Project was piloted in the summer of FY96 and was designed to develop connections between universities and technologies that are important to the science-based stockpile stewardship program. In MCRP, a multilevel team of students came to the Laboratory during the summer to work with research staff. The FY96 project brought four students together researching the mechanical and structural properties of polycrystalline and single-crystal erbium oxides, materials that play an important role in stockpile stewardship. One of the students is a graduate student and has continued on the project for one year.

The MCRP plans to have three teams in place this summer. One is the continuation of the erbium oxide research project (one graduate student and two undergraduate students) and two other new research projects, yet to be identified.

J. American Indian Community and Science Education Partnership (AICSEP)

This collaboration between the Laboratory and the Santa Fe Indian School is a comprehensive approach to enhancing science and mathematics teaching and learning that has its foundation in community involvement. The program is designed to increase academic interest and achievement in science, mathematics, and technology by engaging students and tribal communities in problem-solving using community issues and problems.

One such problem for the tribal communities is their proximity to Los Alamos and their lack of understanding of the role that the Laboratory plays in nuclear deterrence on a global scale. For them, the real issues are closer to home than the global nuclear danger. As a result of this opportunity to collaborate with Los Alamos, SFIS is demonstrating its readiness to expand and integrate the community-based vision and philosophy to other aspects of the school and communities. Thus, the goals of the AICSEP program interface with the community-based concept.

Goals

- increase academic achievement in math, science, and technology;
- involve Pueblo communities in the education of their children;
- increase student awareness of the issues facing LANL and the surrounding Pueblo communities; and
- prepare and motivate Indian students to seek education and training in science, math, and technical fields.

Working with tribal communities to develop this program has proven to be a slow and challenging process. There are formalities that cannot be overlooked if LANL is to create trust among its Pueblo neighbors. Steady, consistent contact and interactions over the past seven months have contributed to the collaborative environment that is finally being achieved for this project to go forth. Two Pueblos, Jemez and Santa Clara have been identified as the communities where the program will realize its goals. The Governors and Tribal Councils of those Pueblos have given their approval for the work to proceed. Two teams of four students each are being identified for a six-week experience that includes time at the Laboratory, in the communities, and at the school. Students in the summer program will be required to mentor the younger students in the Pueblos.

Laboratory staff members from the plutonium facility (TA-55) have been identified for assignment to this project. Our effort allows the

Nuclear Materials Technology Division to meet its diversity goals by providing opportunities for its scientists and technicians to voluntarily participate in an education activity. Their involvement makes it possible to provide technical assistance, presentations and mentoring to the student teams. Final planning is underway to resolve a number of logistical issues surrounding the content delivery, laboratory-based activities, field-based activities, transportation to and from each of the sites, and schedules, to name a few. One of the activities will be a 2-day Youth Symposium as part of a larger conference to be held in August 1998.

K. Other Activities

- The Science and Technology Alliance (S&TA) has been in existence since 1988 as a consortium of three of the DOE national laboratories and four predominately minority universities. This consortium had been funded out of the DOE Office of Energy Research. Because of drastic budget cuts the consortium is having to retool and rethink its direction, as well as its strategies for other funding sources. Three senior managers from the participating national laboratories, have demonstrated their willingness and commitment to keep the S&TA intact with a new focus on direction. The direction being discussed will have a collaborative research emphasis. There was no funding in FY97, but the lead laboratory (Sandia National Laboratories) has been working closely with DOE in an attempt to secure funding for FY99.

- LANL has been actively involved in the planning and organization of the Hispanic Serving Institutions Consortium for Research in Engineering, Science, and Technology (HiCREST). An MOU was signed in Washington in November 1996. This consortium involves six Hispanic Serving Institutions and seven of the DOE national laboratories with a focus on graduate level research at the laboratories. It appears that DOE will announce the go ahead soon, with some funding later this summer. Three of the five research projects are expected to be in collaboration with LANL.

- We have been involved with the New Mexico Universities Research Collaborative initiative. This project will involve four UCRD grants to participating New Mexico universities that submit graduate-level research proposals that are in line with LANL's core competencies.

IV. EDUCATIONAL TECHNOLOGY

A. Teaching Hearing-Impaired Students to Speak

Technical Advances – The main weakness that concerns us in the current system is insufficiently accurate representations of consonants. Therefore, technical work on the ADAM system has focused on defining the map from speech acoustics of consonant sounds to consonant vocal-tract articulation. Our current results have an rms error of 1.8 mm and correlations of 0.8 between inferred and measured articulation. This improvement over previous results has resulted from four advances:

1. *Determining an appropriate representation of articulatory configurations for consonants.* We had previously experimented with different forms of removing the correlations between the various articulator movement measurements of the lips, jaw, and tongue. Projections onto different linear components using principal component analysis (PCA), independent component analysis (ICA), and parallel factor analysis (PARAFAC) all produced qualitatively different representations. The accuracy of ADAM's results differed little from representation to representation but varied greatly from dimension to dimension for consonant articulation. All these representations gave approximately a 15% improvement over using the raw articulator measurements. However, each of these representations was determined from natural speech, which is heavily biased in favor of vowels over consonants, both in terms of phoneme frequency and phoneme duration. Using PCA with a normalized data set (NPCA), results improved an additional 5%, and the maximum consonant error dropped 20%.

2. *Determining the required acoustic context (i.e., width of the acoustic input window) to capture consonant articulation*. Vowel articulation can be accurately captured from acoustics with a single 23 msec. frame of acoustics; however, consonant articulation cannot. Using the NPCA articulatory representation above, we empirically determined that a four (non-overlapping) frame context window of 92 msec. improves consonant performance 10% over using a single frame of acoustics. Using more than four frames reduced performance.

3. *Constructing the consonant mapping function*. Even with the improvements achieved using the NPCA articulatory representation and the optimal acoustical frame width, the construction of the acoustic-to-articulatory mapping is difficult. Previous attempts used a neural network to do nonlinear regression from acoustics to articulation. However, these attempts failed to capture consonant information. The results discussed above (in 1 and 2) were achieved using a high-resolution segmentation of the acoustic space into 2000 regions. The articulatory training data corresponding to each region is represented using a Gaussian mixture model (GMM). Incoming acoustics are quantized into one of

the 2000 acoustic regions and the means of the articulatory distributions are returned as the mapping function values. This mapping provides a 25% improvement in consonant performance and 5% improvement in vowel performance over a neural network. While a neural network is capable of mapping any smooth function and the articulatory measurements are indeed smooth and continuous, the acoustic-to-articulatory mapping varies greatly over very small changes in the articulatory values. This variation is easier for the segmented map to capture with minimal loss in computational speed. At the moment each region is modeled using a single Guassian probability density function. However, we believe the using of multi-mode mixtures in particular regions will continue to improve performance. This will be the focus of next quarter's research.

4. *Applying physiologically appropriate filtering to the output of the mapping function*. The output of the mapping function described above (in 3) is not smooth. We have calculated the frequency spectrum of the articulatory data and determined that there is very little energy above 8 Hz. Therefore, by passing the output of the map through an 8 Hz cutoff low-pass filter, we obtain smooth trajectories. The frequency spectrum of real articulation falls off quickly from 5 Hz to 8 Hz. Next quarter we will construct a more physiologically realistic filter than the low-pass to more accurately represent consonant articulation.

Related Project – Technical work done on this project continues to contribute to other Laboratory projects in ways that could not have been foreseen. In particular, the acoustic filtering we have developed has been incorporated into a proposal for detecting underground facilities by separating various acoustical sounds that may be associated with the construction and operation of underground facilities.

B. Educational Networking Support (EduNets)

Overview

Making a Difference

Students at St. Bonaventure Mission School in Thoreau, NM, using the ***Guess What*** *class they said was their favorite!*

The Los Alamos National Laboratory Educational Networking Support Program (EduNets) was developed to use Laboratory technical expertise and experience to help school districts – schools, school classrooms, libraries, and offices – establish networks with

connections to Internet resources and to provide teachers, administrators, and technical teams training to use and support these resources. The project started with a pilot district in July 1994 and was established as a formal support program in October 1994. It is designed to provide a coordinated networking consulting resource for school districts in the program and to establish partnerships with and provide support for community colleges, universities, and departments of education to help establish regional training and technical support centers to ensure continued future support for the schools.

The current scope for direct assistance is primarily Northern New Mexico school districts, with some requested advisory and training support for a few districts in Colorado, Arizona, Texas, and Oklahoma through partnership efforts and research grants. Requested advisory, technical, and training support is also provided as much as possible for other schools in related LANL support projects and other community networking efforts.

- Direct Participant Level: Administrators, Teachers, Staff, Faculty

- Indirect Participant Level: Students and other teachers and staff in the districts represented whose network and training are supported by the EduNets district support team

- Grade/ Faculty represented: K-14

Primary Goals

The primary goals of the EduNets Program are: providing technology planning support, consulting, and training for schools; helping schools and school districts determine how to get connected and plan their networking infrastructure to ensure feasible and validated networking plans and implementation; developing and documenting models for successfully connecting schools to the Internet; making information gained available for educators nationally; and, developing and testing communications, networking, and internetworking applications for education.

Activities include: establishing and supporting regional training and support centers/hubs and Internet computer labs; forming school, regional, and district Internet Education Working Groups (IEWGs); providing Internet education resources support; and recognizing progress and sharing information gained.

Principal direct support efforts for EduNets schools and hub sites include:

- Consulting - Networking and computing advisement and support, network design, specifications reviews, walkthroughs

Consulting and Onsite Technical Support

Providing network consulting and onsite technical support and training for EduNets. Helping to design networks, test, and install. Server management support and training are some of the most requested services.

- On-site Support - PC, server, network installations and management, troubleshooting

- Training - Teacher and staff Internet and networking workshops, technical support team on-site training and support, train-the-trainer and technical support workshops

<u>October 1997- March 1998</u>

Direct support provided this reporting period:

- Onsite PC, Server, and Network Management Support:
  We provided 70 sites – 1-5 days onsite support each – this reporting period.

  - 57 schools, district offices, and technology centers in 18 public school districts
  - 8 non-public schools
  - 3 community college support hubs
  - 2 partner community support sites

- Networking Consulting, Troubleshooting, and Design Support

  This report period, we provided networking consulting (WAN and LAN) for

  - 16 public school districts
  - 4 non-public schools
  - 7 support hubs and community support partners

- Technical Support Team and Train-the-Trainer Workshops and Training

  Workshop attendance this period included trainers, technical support staff, teachers, administrators, librarians, and school support staff.

  - 198 workshop attendees (125 for 1-day and 73 for two-day workshops)
  - 48 schools and 5 hub campuses represented
  - 14 school districts or non-public schools and 5 hub/partner sites sent attendees
  - 32 network managers completed NT Basics I (from 12 districts and 5 hub sites)

In addition to onsite training for technical support teams, we presented 16 workshops; 23 days (7 two-day and 9 one-day sessions):

- Mini-conference (four workshops) at Northern New Mexico Community College (NNMCC), January 7-9, 1998: Internet Research for Educators (one day), HTML-Designing and Building Web Sites (two days), Introduction to Networks (two days), and Networking Fundamentals (one day)

- Mini-conference (four workshops) at University of New Mexico-Gallup, January 12-15, 1998: Internet Research for Educators (one day), HTML-Designing and Building Web Sites (two days), Introduction to Networks (two days), and Internet Research for Educators (one day - second session)

- Three two-day sessions of *NT Server Basics* for network managers at NNMCC: January 15-16, 1998; March 16-17, 1998; March 19-20, 1998.

- Five one-day workshops: Networking Fundamentals, January 30, 1998 at UNM-Gallup; Internet Basics, Gallup-McKinley County district in-service, February 6, 1998 at Tohatchi High School, Tohatchi, NM; Introduction to the Internet, Netscape and Search Engines, February 11, 1998 at NNMCC; Internet Basics, February 13, 1998 at NNMCC; and, Introduction to Electronic Mail, March 20, 1998 at NNMCC.

<u>Other Support Provided this Report Period:</u>

- ICTE Conference Technical Support

  March 8-11 the Fifteenth International Conference on Technology and Education (ICTE) was held in Santa Fe. Los Alamos National Laboratory was one of the co-sponsors of this conference. Dennis Gill, Education Program Office, was co-chair of the event. The

EduNets Program was asked to coordinate the technical support for the conference.

The job was challenging - it required networks in Santa Fe at both the Sweeney Convention Center and the historic La Fonda Hotel with a server and Internet access support for 10 presentation rooms, Sweeney Auditorium a vendors area, two information desks, two tech support centers, an interactive education area, and an e-mail and practice room. Each presentation room required a PC, a Macintosh, drops for laptops, a multimedia projector, video capability, and Internet access. Both technical support and training on using the equipment and e-mail support were provided throughout the conference. Over 240 talks were presented in three days, most requiring computer and multimedia support. The nine main sessions were broadcast live from the Sweeney Auditorium directly over the Internet using RealVideo.

The technical support team for the conference was praised highly and recognized many times during the conference. We were told that DOE representatives from Washington were very impressed with the LANL computer support, Members of the ICTE Committee and governing board thanked us profusely, many presenters told us personally that they had never had such outstanding technical support, and, in the closing session we were applauded as the best technical support the speaker had ever seen at a conference.

This was truly an International Conference - approximately 40% of the attendees and presenters were from foreign countries. The ICTE is held each year alternating between a site in North America and a site in Europe. Typically, delegates represent technology-using educators from a wide range of higher educational institutions, state departments of education, ministries of education, and school systems worldwide.

ICTE Conference

Team from Chama schools at the International Conference on Technology & Education in Santa Fe, New Mexico, demonstrate videoconferencing with students and team members in Tierra Amarilla 100 miles away.

EduNets: Sites Supported

	K-12 Districts*	Regional Training & Support "Hubs"	Total Districts, Hubs & Sites	NM K-12 Schools	K-12 Sites Supported
FY 95	9	5	17	102	> 50
FY 96	16	11	37	124	> 80
FY 97	39	19	76	194	>160
Mar 98	41	20	79	197	>170

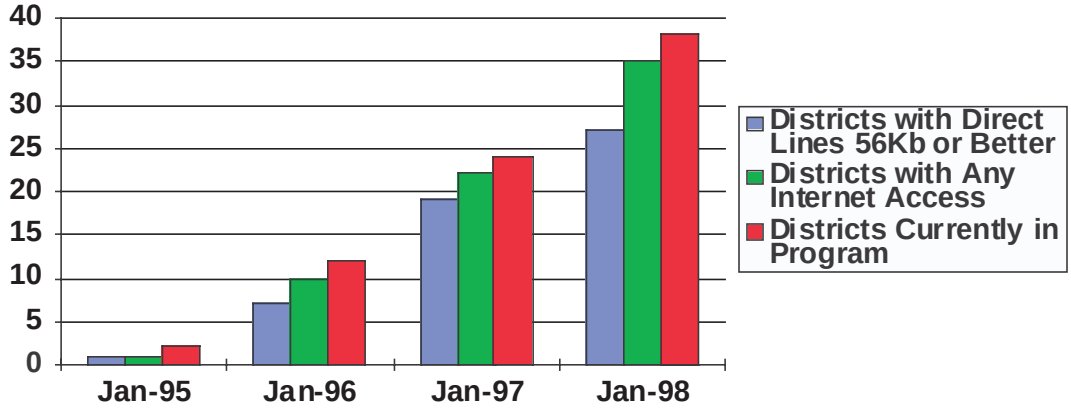
* Includes Public School Districts and Non-public School Campuses/Districts

EduNets Scope: Sites Supported

Current Support and Partnerships Scope: 41 School Districts (24 public and 17 non-public), 11 community colleges, 27 other (2 departments of education, 3 regional technology centers, 4 support cooperatives, 3 related LANL networking programs, and 15 non-program school districts/schools for workshops).

Current data indicates that in current program public school districts, over 80% of the students are in national minority populations, 11 districts with over 90%. According to the New Mexico Department of Education reports based on census data, over 30% of the students in the public schools in our districts are classified as living in poverty.

Internet Access: New Mexico EduNets School Districts – Our primary goal is to help schools establish working and reliable Internet access.



EduNets Program Growth and Internet Connections Progress

DP Mission Benefit – This project uses the unique resources of Los Alamos National Laboratory - extensive computing, networking, and technical training expertise and experience - to help schools and school districts (primarily in remote and rural areas) get connected to

the Internet and its resources. Resources on science, mathematics, engineering, and technology (never before available in many of these districts) are being accessed daily through these networks. The full potential of these resources is just beginning to be realized at our school sites.

C. Systems Modeling for Education (SME)

The Systems Modeling for Education Program is a multi-faceted project to develop web-site software for investigating basic physical science phenomena like heat transfer, sound, force, optics, etc. Intended to target students and teachers in grades 7-12, the project is a Web-based "dynamic text-book" allowing student experimentation in a virtual laboratory environment. Along with conventional text-book theory, equations, and examples, the site will also provide a virtual laboratory where visitors can build simulated experiments related to the selected physics content areas, permit access to computer modeling and simulation of physical phenomena, and offer applicable background information and curriculum. The goal is to enhance science education and teaching on a national scale by extending and enhancing the capacity of computer-based learning.

The SME Project is making progress with the recent completion of the units converter feature as a model for the use of Java Cafe Database Edition (JCDE). JCDE supplants and streamlines the original schema for management of materials properties and units. In parallel with this effort, the mathematics was developed for the one-dimensional finite element mathematical conduction model. This will be used as our initial heat transfer study case in the virtual laboratory. We are behind chronologically (not fiscally) in the development of the Graphic User Interfaces due to the death of our programmer. We have located a graduate student in Instructional Technology to perform this assignment and related tasks. She will be available beginning in June. Thus, the critical body of work on this project will happen this coming summer, during the second half of the fiscal year.

D. Robotics Challenge Workshop

The 4th Annual Los Alamos BEAM Robotics Workshop is scheduled to take place from April 16-18, 1998. Most preparations are done. The BEAM mentors have been contacted and will be participating. The Public Affairs Office has helped distribute an announcement on the Workshop, and registrations have been pouring in from all over New Mexico. Since the BEAM guru, Mark Tilden, has been on national television (as part of a two-hour documentary on the Discovery Channel), and has also been traveling around the world talking about BEAM robotics, we have had inquiries from all over the country and the world. We presently have several college and graduate students registered, as well as many middle school students. Of the 60 students presently registered, 20 are Native American or Hispanic.

E. International Conference on Technology and Education (ICTE)

During the first half of the fiscal year, the Laboratory was committed to supporting the International Conference on Technology and Education 1998, held in Santa Fe, New Mexico on March 8-11, 1998. Dr. Dennis Gill, the Laboratory's Program Manager for Science Education, was one of the co-hosts for the conference. Attendance was worldwide and numbered over 750 registrants.

The principal function of LANL was to coordinate all aspects of the conference and ensure smooth operations through extended technical support and real-time administration during the event. Additionally, the Laboratory had major commitments in chairing the program committee and soliciting and coordinating invited plenary speakers. As part of the effort, the Laboratory generated live coverage of the plenary sessions and broadcast them over the Worldwide Web using Netcast technology.

In addition to direct Laboratory support, other assistance was received from U. S. West in the form of T-1 support and from Proxima Corporation, which donated the use of Proxima video projectors for all presentation rooms. Further, the University of New Mexico and the Santa Fe Institute participated as co-hosts.

The Laboratory's efforts in technical support received many accolades both during and after the conference. A separate support room was established to ensure the presenter programs ran smoothly and to overcome technical difficulties associated with differing world standards such as PAL and NTSC compatibility. Additionally, e-mail support was provided for all conference delegates as well as web access in all presentation rooms. Finally, Laboratory personnel participated directly with separate presentations about Laboratory science education programs as well as on-site demonstrations of New Mexico-based programs.

ICTE, Inc. has requested continued Laboratory participation through the 1999 conference which will be held in Scotland.

F. Program for Technology Support

The Program for Technology Support was created to maintain an electronic infrastructure and telecommunications environment to support the collaborative networks required by the Science Education programs. The Program for Technology Support focuses on providing real and ongoing interaction with Laboratory personnel and program participants. Telecommunication allows program participants to exchange and compare data, maintain communications among students, teachers, scientists, and Laboratory education specialists, and provide information about Laboratory research to the educational community locally, and nationwide.

The Program for Technology Support has created an ongoing technological infrastructure that supports Science Education programs by involving teachers, students, and Laboratory personnel in the use of computer technology. This program has made it possible to enhance classroom practices by developing skills in web page development, concept mapping, and Internet research. Participant efforts are consolidated via e-mail and a web-based curriculum. Science Education program participants are taught and encouraged to effectively integrate computer technology into their classroom curricula through direct instruction, modeling, and practice.

Highlights of this Year's Program to Date

The Science Education server was brought on-line at Los Alamos National Laboratory. The server houses specific detailed versions of many of our programs, provides a location for on-line interactions among program participants, is a repository for teacher developed materials, and links to the Laboratory's education web site. It is intended to be a virtual resource center for program participants. Questions are posted within the Science Education programs web pages, and staff members send e-mail to the program coordinators, who publish the responses for everyone to read. The participants investigate the programs' current topics through benchmark assignments, participate in regional workshops, and publish their work on the Science Education web server in electronic team portfolios.

Ninety teachers from both of our flagship programs, TOPS and CIF, representing New Mexico schools (K-12) have been impacted by technology support through this program. These participants have been instructed in:

- Web page design
- HTML programming
- Network planning and implementation
- Internet research
- Design of curriculum integrating computer technology

In addition, numerous LANL employees have established collaborative electronic mentoring relationships with the Science Education program participants and have been prepared for doing this as a function of the Program for Technology Support. Electronic communication forms the link between our education programs' participants and the Laboratory community that maximizes the impact a single individual will experience while in a program. It is also the gateway to the vast material and human resources available over the Internet and the Worldwide Web to teachers and students.

A postdoctoral student in educational technology from the University of California at Berkeley and a teacher from New Jersey who is pioneering on-line communities, joined our program this year. They have contributed to the overall approach to the implementation of the

program and its interface with technological components of the other programs. Development of specific educational technology applications and assessment were a significant portion of their responsibilities in this program.

G. Equipment for Education Program

In the first half of 1998, this program provided 65 computers to 10 school districts in 2 programs. Developed to meet the technology needs of specific science education programs sponsored by the Laboratory and funded by DOE, this program is an exemplary model among DOE Laboratories for excess-equipment gifting to K-12 schools. The primary objectives of this program are tailored to the intended use of the equipment in each specific program. The objectives include:

- Providing teachers and students with technology that enables their understanding of Laboratory research.
- Providing schools with equipment that creates instructional opportunities for K-12 classrooms, thus promoting systemic reform.
- Providing computers so teachers can network and communicate with the Laboratory in order to contribute data from specific program research.
- Enabling teachers to share instructional strategies and resources with each other to reduce geographical isolation.
- Providing technical assistance and training in the use of technological applications.
- Removing the barrier of access to technology, especially for minorities and females.

The current activity in calendar year 1998 is to hire a technician and program administrator in preparation for the summer programs.

The Laboratory is experiencing a shortage in computer technicians, and required service for the program is difficult to obtain. Our understanding of this problem has allowed Los Alamos to respond to the workforce needs in this technical field by developing a prototype program where students could be trained to refurbish excess computers for gifting to schools. Our undergraduate student technician from last summer has been implementing this pilot training site at the K-12 school where he teaches in Socorro, New Mexico. Although we normally gift only refurbished computers to our program participants, this project allowed us to provide a service to the Laboratory, as well as to the school community, by gifting computers that needed a variety of repairs and that would be otherwise unusable and suitable only for salvage. This equipment gift provided student apprentices an opportunity to work on units that demonstrated a wide range of ailments and defects, in order to learn how to produce whole, working

units to put directly into the classrooms in their school district. Our goal in this small effort is to develop a model for how to implement a refurbishing center that can provide on-the-job instruction and training at the precollege level for students who represent the future workforce of the Laboratory. Ultimately, we hope to develop several of these centers around the region in collaboration with two-year colleges offering concurrent enrollment to local high school students who participate in the program. The evaluation results from this project are anticipated in May 1998.

H. Educational Pipeline for Student Initiatives Linked on the Network (EPSILON)

Project EPSILON continues the effective practices from past student projects, and adds technology as the common thread for this new program. Since the program began last fall, students have participated in a variety of activities designed to help them improve their skills. Participants were selected from several area high schools, middle schools, and elementary schools to test the program's design. Teams participated from schools in Los Alamos, Española, Farmington, Pojoaque, Albuquerque, Santa Fe, Mesa Vista, and Jemez. Through the course of the academic year, a variety of activities will prepare the students to (1) develop a proposal and (2) develop career and scientific skills.

Goals

- Increase the students' knowledge, skills, and abilities in appropriate content areas.
- Increase the students' research process skills and abilities to integrate technology into their learning.
- Develop the students' abilities to make sound educational decisions connected to career and professional goals.

To meet the goals for the academic year, students received instruction from the beginning via e-mail in how to improve their skills in scientific thinking, writing, graphic design, and multi-media communication. They also learned to practice effective teaming skills. There were several mini-workshops performed at the schools for the teacher leaders. These workshops included use of e-mail, accessing the Internet, teaming skills, and basic communication skills.

Laboratory scientists; staff and technicians from Earth and Environmental Sciences, Physics, Material Science Technology, Chemical Science and Technology; and Nuclear Materials Technology Divisions are providing technical support and input for on-line lesson design. These scientists are working with science education staff to create requests for proposals (RFPs) on a variety of topics for the participating students.

Concluding the academic year phase of the program, student teams are now being selected to receive the RFP from the Laboratory Project Preceptors. The RFP and final Lessons will be deployed to the web site by April 15, 1998. Students will respond to the RFP's by submitting proposals that describe a problem that they wish to solve, either as a project description or as a model design. Elementary-school teams and middle-school teams will be invited to present their project ideas from the RFP on May 15, 1998. Students will be evaluated by a team of technical staff and science education staff and will receive implementation awards to make their proposal a reality. The high-school students selected will be given the opportunity to work with a preceptor at LANL for a six-week experience starting June 8, 1998.

Since its inception, EPSILON has used several evaluation tools to ensure that the program meets both programmatic goals and participants' expectations. Most of these tools are embedded in the technology and include notebook entries, portfolio development, e-mail from participants and their parents, and a pre-survey and later a post-survey on science and technology. Other tools used to collect formative data have been teacher interviews, student interviews, and site-visits.

The following anecdotal evidence received from e-mail confirms participants' positive experience.

- "This science class is so fun!"
- "This program keeps me in touch with Laboratory science."
- "I really enjoy working on computers."
- "Keep the Lessons coming."
- "Your educational programs excite the children, and they want to learn more." (Santa Fe, Principal)

V. PUBLIC UNDERSTANDING OF SCIENCE

A. Science Education Information On-line

The principle project activities during the first half of FY98 included upgrading the server hardware system, building a database of program information with an interface on the WWW, participating with the LANL WWW editorial board to coordinate the education WWW site with other LANL WWW activities, updates of the server software, assistance to the New Mexico State Department of Education and the expansion of information on several programs.

The major activity during the first half of FY98 was to build a database of all education activities at LANL and then to build an interface to that database on the WWW. The database includes all of the Education Program Office programs and also other education programs at the Laboratory. We also implemented a scheme for including information about former or currently inactive programs. The URL changed for this program information. The new URL is **http://stb.lanl.gov/EPO/**.

We continue to work with the New Mexico State Department of Education (NMSDE) in several areas. These efforts include assistance with their WWW server, implementation of an e-mail list processing program (majordomo), assistance with PPP connections to the Internet via New Mexico Technet, and teaching department personnel the Hypertext Markup Language (HTML) so that they may create WWW pages for their server. A full-day workshop on the Internet was presented in February to about 20 people from the NMSDE.

From October 1, 1997 through March 31, 1997, there were 35,110 different sites submitting 598,024 requests for information from 3,306 distinct files for an average of 3,286 requests per day. These visitors accessed 311,224 pages representing more than 6.3 gigabytes of data. Each day detailed statistics on access to the server are updated and summaries are available for viewing on the server.

The top eight subject areas of interest on the server for this period were:

1. Critical Issues Forum (CIF) Program
2. Science at Home
3. Hydrogen Conference
4. Science Education program information and status reports
5. Teacher Opportunities to Promote Science (TOPS) Program

6. National Teacher Enhancement Program (NTEP)
7. Educational Pipeline for Student Initiatives Linked on the Network (Epsilon)
8. STB Mentor Information

The uniform resource locator (URL) for the WWW server is:

http://education.lanl.gov/

Los Alamos
NATIONAL LABORATORY