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Los Alamos National Laboratory

Science Education Program Annual Report

October 1, 1996 – September 30, 1997

LOS ALAMOS NATIONAL LABORATORY

SCIENCE EDUCATION PROGRAM

ANNUAL PROGRESS REPORT

October 1, 1996 - September 30, 1997

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were funded by the United States Department of Energy,
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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 FY97 are described in this report.

FY97 was an active year for the Science Education Program at Los Alamos National Laboratory. We conducted 24 separate projects which had a total of 2385 direct participants. The indirect impact of these projects was significantly greater, because many of the direct participants were teachers, each of whom impacts 100 or more students. Also, some of our projects involve working with the schools to help them apply new technologies to the educational process. These latter projects directly involve some participants, but indirectly impact entire schools and districts. Our technology projects make a direct and immediate impact on the educational system and how teaching (and more importantly, learning) is accomplished. We estimate the indirect impact of our programs in FY97 to be approximately 120,000 students.

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. Of all of the direct participants in our projects in FY97, 61.4% were minority and 46.6% were female. The ethnic distribution of the participants is shown in detail in Section VI, Statistics, at the end of the report. It should be noted that this distribution is for direct participants, and the indirect participants were even more diverse. For example, some of our teacher participants are themselves Anglo, but have classrooms that are 80-100% minority.

We carefully evaluate every project internally every year, measuring it against its own goals and objectives as well as against the broader criteria of the Science Education Program and the Department of Energy. We use these evaluations to make modifications in the projects. We also have a few of the projects evaluated formally by external organizations.

Significant changes in the overall program in FY97 included the fact that six programs were discontinued from FY96, primarily due to budget cuts. The formats of several projects were modified extensively. Two new teacher enhancement projects (one at the elementary level and one at high school level) were piloted successfully. Next year (FY98) they will be continued under a single title of TOPS (Teacher Opportunities to Promote Science – a middle school project) and operated as a single, integrated project for all levels K-12. The Critical Issues Forum has transitioned into almost total electronic delivery, using an interactive Web Site.

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. We are in the midst of totally revamping our Education Web site now, and the new site should be up on the Internet within a month. The Web site was accessed an average of 2000 times per day in FY97, by hosts from more than 100 countries.

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, and look forward to FY98 with enthusiasm. Please feel free to contact us if there is any additional information that you need.

LOS ALAMOS NATIONAL LABORATORY

SCIENCE EDUCATION PROGRAM

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I. TEACHER/FACULTY ENHANCEMENT

A. Teacher Opportunities to Promote Science (TOPS)

Program Description

TOPS (Teacher Opportunities to Promote Science), a three-year teacher enhancement program, concluded its final year as a middle school program in FY97. The final workshop for the FY95-97 TOPS cohort was held in Los Alamos on April 17-18, 1997. Final reports were collected for the Student/Parent/Community (SPC) components and teacher professional portfolios were collected. Post program surveys were conducted and the program was officially transitioned into the new cohort.

Transition for TOPS involved strategic reorganization of three programs. Formerly for middle school teachers, the program was redesigned based on the recognition of effective practices revealed by the program evaluation. The new program targets elementary, middle and high school science, math and technology teachers at schools in rural New Mexico, with a high percentage of minority students and very little access to businesses, universities, or research institutions with technical expertise. Recruitment took place in the late winter of FY97 in order to offer a first workshop before the summer institute in June of that year.

This year, 65 teachers were selected for a comprehensive grade 4-12 program which combines the elementary (4-6) Regional Teacher Enhancement Program (RTEP), the middle school (6-9) TOPS program, and the high school (9-12) Science 2000 program. The program has been redesigned to utilize 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.

Elementary School — This component was designed to meet the needs of developing the science teaching skills of teachers in the 4th through 6th grades at schools in New Mexico. Research indicates that positive and meaningful science experiences in these grades is critical for sustaining interest in science for children.

Middle School — This component targeted 6th, 7th and 8th grade science, math and technology teachers at schools in New Mexico. It was aimed at the middle school level in order to engage students in positive experiences with

science, math, and technology at a time in their school careers when decisions are being required about what classes to take in high school.

High School — This component was designed to increase New Mexico high school science, math, computer, and technology teachers' knowledge of science and give them the tools to better prepare their students for understanding science in the coming millennium. Through hands-on activities, research experiences in Lab-related cutting-edge science, and an element to help them transfer their program experiences to their classrooms, this component provides teachers and students with an exposure to innovations and applications in real world science.

Participants at these three levels combined to form vertical cross program teams with representation from the elementary, middle and high school levels from the same school district. Participants met together and broke into smaller working groups as appropriate for the task at hand. These smaller groups were formed by region, district, school, grade level, subject matter, or skill level.

Goals

The TOPS program seeks to enhance the overall quality of science, mathematics, and technology education in New Mexico's outlying, rural school districts by:

- increasing teachers' knowledge of science, math, and technology;
- enhancing teachers' skills in teaching science, math, and technology;
- providing hands-on activities and materials to take back to participants' schools;
- exposing teachers to the application of science, math, and technology to research at national laboratories;
- providing a mechanism for teachers to encourage students to pursue careers in science, math, engineering, and technology;
- enabling teachers to train fellow colleagues in their local school districts; and
- developing a web-based communications network with the intent of developing a strong educational support network among the program participants and within their own communities.

As a result of the program, teachers will become more confident in their professional abilities(e.g., curriculum development, instructional delivery, assessment, and teacher training); become more reflective about their teaching practices and their attitudes towards science teaching and student learning; promote the value of math, science, and technology and related careers among students and their parents; and share TOPS program materials with colleagues in their districts, and will maintain on-going professional communication with colleagues outside their districts.

This program leverages LANL's scientific capabilities with our science education program goals by integrating our core competencies to improve understanding of science, mathematics, engineering and technology in the following ways:

- Develops partnerships between the Laboratory (STB/SE, Computer Information Center, Physics, Nonproliferation and International Security) and the education community;
- Provides resources and technical support from Laboratory personnel to schools and districts;
- Provides electronic communications technology as one method of distributing science educational materials to the public;
- Provides access to Laboratory personnel through face to face workshops and telecommunication links;
- Prepares teachers to utilize technology appropriate to the research topic;
- Enhances teachers' use and understanding of science research methods and technology;
- Provides enrichment opportunities for teachers in cognitive science research, workshops, and science curriculum development; and
- Enhances public understanding of real world Laboratory issues.

Implementation

Presently, the TOPS cohort has sixty-five participating teachers representing 13 school districts with 32 public schools, 3 BIA schools and 4 public schools primarily from the Four Corners and Santa Fe areas. This cohort consists of participants from 34 form elementary schools, 18 middle schools and 13 high schools. Of these participants, 72% are female and 28% are male, with an ethnicity breakdown as follows: 66% Anglo, 23% Hispanic and 11% Native American. The TOPS teachers serve student populations ranging from 20% to 100% minority population, with an average minority population of about 80%.

Summer Institute — The summer institute was held from June 16-27 at LANL, and a total of 65 teachers attended the institute. Teacher participants assembled into teams with representatives from the elementary, middle and high school levels in order to develop curriculum units that could be delivered throughout the grade levels and are centered around the topic of communications.

Participants attended instructional sessions on the use of concept maps, telecommunications software, computer hardware, systems modeling software, word processing and database software. Participants also received instruction on the use of the State and National Science Standards, and were involved in a two day session on the integration of learning styles into the curriculum. Teams across the grade levels developed unit plans to integrate these topics as part of their curriculum during the coming school year.

Science topics for the program are chosen as appropriate to meet the needs of the teacher, to take advantage of the Laboratory's resources and core competencies, and to access and supplement existing hands-on activities and materials. The program provides instruction in science content; training to enhance teachers' skills in teaching science; materials and hands-on activities for use in the classroom; exposure to the applied science, math and technology at the Laboratory; support for establishing student/parent components; and support for training fellow teachers and students.

Participants, within their vertical cross-program teams, designed a set of lessons around a single concept that spanned elementary through high school levels, and which was appropriate for their educational communities, grade levels, and subjects taught. Teacher teams selected topics based on their own and student interests, but all topics were tied to LANL science. The teacher- developed, student-based units are inquiry-driven and model sound pedagogical practices including constructivist and Socratic dialogue methods, cooperative learning, and integration of math, science, and technology.

Throughout the three years of the program, teachers will be developing a web-based communications network with the intent of developing a strong educational support network among the program participants and within their own communities. Each vertical cross-program team will develop their own web page. The curriculum projects will be integrated into the web site, as contributions by teachers and students are posted as benchmarks are reached, and the curriculum will be continuously developed and revised as it is lived out in the classrooms. The projects will be designed to promote communication among the local education communities and encourage both teachers and students to become increasingly proactive in communicating with their wider communities and involving community members in their classrooms. Currently, the web page can be accessed at the following address: (http://www.education.lanl.gov/resources/tops/).

Student-Parent Component — Participants were given the opportunity to write proposals for a student/parent component (SPC) as part of the TOPS program. All of the teacher teams participated and were awarded a small stipend to conduct a student-parent component. The SPC projects were designed to allow teachers to provide math, science, and technology related enrichment activities involving students, their parents, other community members, and school staff. Projects were structured around family nights, field trips, club meetings, or activity days and represented a broad range of themes and topics. SPC interim reports are on file with the program coordinator.

Evaluation

The TOPS program conducts formative evaluation over the duration of the program and a summative report at the end of the three years. Our primary goal in the formative evaluation is to determine whether or not participants are making progress in connecting and transferring what they are learning in workshops and institutes to their actual classroom teaching. Formative data

will be collected through workshop evaluation surveys, teacher journals, written assignments produced for college credit, and interim reports on the student/parent/community component. The data will be collected to measure how teachers will: (1) incorporate information on many levels into their daily lesson plans (e.g., physical, biological, and earth sciences; mathematics; technology; national reform research, etc.); (2) use a variety of instructional materials and strategies; (3) incorporate science, math, and technology topics and real world issues in their regular classroom instruction; (4) have opportunities to identify their own misconceptions regarding scientists and the nature and practice of science, math, and technology; (5) provide opportunities for students and parents to work together on science, math, and technology career-related activities; (6) develop and deliver a presentation at school or district in-service; and (7) communicate electronically with colleagues.

Since the beginning of this project, the following baseline evaluation has been accomplished:

- administered pre-program survey
- designed instructions and supervised the creation for the group concept maps on community-wide influences on teaching and learning;
- designed and distributed instructions for concept maps on the same topic to be completed by each teacher prior to the beginning of school in the fall;
- printed and qualitatively analyzed the content of these concept maps; and
- began the draft report describing these maps.

Anecdotal Data

"When I got home form my first week at LANL, I said over and over that I've learned more in 5 days than I had at any computer workshop in the past five years."

"We covered a great deal of material in the summer institute. I feel more comfortable working with computers now. I understand the terminology better and am able to follow computer-oriented discussions."

"Personally, because of this program, I have doubled my technology resources. I have a list of people to call rather that relying on two or three people. I am thrilled to have these possibilities."

"The information from MS and HS science teacher was invaluable to me because have not had that communication link with these teachers to know what the gaps are."

"For the first time, I'll be going away with new knowledge. Everyday, as stressing as it was, I gained information that I can use as an educator and am now comfortable using the computer. I'm taking this opportunity to better

myself and become better aware of our district's goals for our school, students and parents.

"A lot of teachers in my building/district need exposure to your systemic change approach. I'm not sure how to best cause that to happen: short presentations at faculty meetings, continued modeling of technology, constructivism, alternative assessment."

"The TOPS program is an excellent opportunity to learn in a team environment. I kept thinking that everything the TOPS program had promised us was too good to be true. So far, it has surpassed all of my expectations.

"Working on a final project gave me exposure to many areas. The one I appreciated the most was the development of a unit from the elementary through high school. It really gave me a feel for what other teachers do for my students before they ever enter my classroom."

"As of today, I can only write that I'm so glad that I'm involved in TOPS. This had opened new doors for me as far as ideas, learning, making new friends and changing the way I feel about myself and my job."

"This by far has to be the most productive training I have ever been through."

"I learned more in two weeks in this institute that I had in ten years of in-services. This institute really clarified standards and taught how useful constructivism is as a teaching and learning tool."

"Overall, the TOPS Program has been a valuable experience for me. It provided numerous opportunities to learn new skills, establish relationships with other teachers and to receive materials and equipment to help keep our ideas feasible for integration at the classroom level."

B. Tops Teachers' Perceptions of Influences on Teaching and Learning

Description

This program is a collaborative assessment project that builds on previous work between Los Alamos and the University of New Mexico, Department of Education. Begun with a new cohort of TOPS teachers in FY97, this project will ultimately be conducted across all three levels of the newly designed TOPS program and contributes to systemic improvement in science, technology, engineering, and mathematics education. The work provides valid assessment tools that can be broadly used in determining the impact of DOE programs, and which can potentially be disseminated broadly within the education community.

Specifically, this is a three year evaluation to examine changes in teachers' perceptions about the influences on their teaching and their students' learning as they proceed through the Teacher Opportunities to Promote Science (TOPS) Program. From a systemic change perspective, context

impacts these influences and extends well beyond each teacher's classroom. Thus, this evaluation examines perceptions of community-wide influences as well as influences that directly impact individual teacher's day-to-day teaching.

Implementation

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. To allow the examination of the change, this task will be repeated during each of the remaining two institutes for this cohort of teachers.

The teacher teams created 14 concept maps, 6 maps from participants from the North Central region and 8 maps from the Four Corners region. Analysis of these maps was begun by sorting the influences into broad categories and noting their frequency of occurrence; frequencies are determined across all maps as well as by region. The influences that teachers hope to impact through their participation in TOPS are being noted. This analysis is nearly completed. The most interesting results, however, will come from evaluation of changes in these influences across subsequent summer institutes. That part of the analysis will not begin until the second summer institute takes place.

The second evaluation was designed as a task to identify teachers' perceptions of influences on their teaching and their students' learning in their own classrooms. During the summer institute, instructions were distributed which asked 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 evaluators copies of their maps.

To date, seven maps have been received. At this time of the year, teachers are incredibly busy. In hindsight, asking teachers to engage in this task at this time in the school year was not the best strategy. To allow the collection of meaningful information in a timely fashion, we are creating a survey based on the individually drawn maps that were received, the community-wide maps, and other measures designed to examine influences on teaching and learning. Teachers will be asked to complete this survey (or a revision) early each fall and again track changes across the years as they continue to participate in TOPS.

Summary

The concept maps have been collected and community-wide influences on teaching and learning are being examined. The initial analysis of these maps has almost been completed. An alternate approach to identifying classroom-based influences on teaching and learning is currently being designed.

II. CURRICULUM IMPROVEMENT

A. Risks, Rewards and Responsibilities

Background

This project had its beginnings in the summer of 1995 with a collaboration between the Santa Fe Public Schools, EnterLearn Technologies, and Los Alamos National Laboratory. The initial effort focused on developing a curriculum that would allow radiation to be introduced early in the high school physics academic year. This initial objective was embraced because radiation is a topic usually included at the end of standard physics text books. This means that the probability of the topic being covered in the standard school year is low.

The original concept was tested in physics and physical science classes in the Santa Fe Public Schools at both Capital High School and Santa Fe High School. The results were mixed. For advanced placement physics students (those intent on taking the advanced placement exams offered by the Scholastic Testing Service) including the radiation material early impacted on their preparation for the exam. In short, they were somewhat penalized by the approach with regard to external factors. In contrast, students taking conceptual physics or not preparing for the advanced placement exams benefited from the material in that it provided an overview of most of the physics course. Finally, physical science students were not prepared for the amount of new material included in the first construct of the course.

Concurrent with the testing in Santa Fe, the requirements of the Neighborhood Environmental Watch Network (NEWNet) program became clearer. NEWNet is a program that grew out of Three Mile Island and the nuclear weapons testing program. NEWNet has three major components.

The first component is an environmental monitoring platform. This platform is a stand-alone system that monitors standard environmental or weather data such as temperature and wind direction, but also measures local radiation levels. Radiation monitoring is done with a pressurized ion chamber and provided readings in micro-Roentgens per hour. This approach was chosen to ensure compatibility with measurements used by the health physics profession. Micro-R per hour converts directly to micro-rem per hour. Rem stands for Roentgen equivalent man, the unit used for exposure standards.

Data from the sensor platform are uplinked by NOAA satellite back to Los Alamos for integration into the second component of the NEWNet system. This component is a real-time data base of the collected data. These data are essentially immediately available to the public via the Internet. To explore these data, visit the NEWNet homepage at

http://newnet.jdola.lanl.gov/newnet.html

The final component of the NEWNet system is the Environmental Teller Machine (ETM). The ETM provided access to NEWNet data and other

related educational material through a kiosk. Such kiosks could be located in the vicinity of a local NEWNet platform or other public places such as museums.

Which Way to Go?

The NEWNet Program requires an educational component in order for people to use the available data and understand its implications. This need allowed for two choices: prepare and provide instruction for adult audiences in the community or provide supplemental materials for incorporation into secondary and post-secondary classes.

A choice was made to initially target secondary schools. This direction was chosen because trying to reach the adult population directly has not been found effective. Second, the issue of teaching radiation was considered. And this aspect became the pivotal point for the new curriculum.

From the experience in the Santa Fe Public Schools, it was obvious that another radiation curriculum was not the issue. Los Alamos and many other institutions and organizations have produced materials for teaching about radiation in the past. For example, the American Nuclear Society has many curricula materials available. So does General Atomics and the Colorado School of Mines as well as previous efforts by Los Alamos in SWOOPE (Students Watching Over Our Planet Earth). So the question arose, "What's wrong with what's out there? Why do we need another curriculum and, if we do, what needs to be done differently?"

In exploring this quandary, we concluded that the element lacking from instruction about radiation is the "So what?" question. Radiation curricula deal with the types of radiation, half-lives, decay, and those topics needed to tell people what it is. But these curricula do little to tell people what radiation can do in a context of its risks and benefits in everyday life. Going further, it seemed, through empirical observation, that the skills needed to evaluate risks and benefits are generally not directly taught in schools. The implication is that if people, in general, are to make intelligent decisions regarding radiation and related topics, they need a framework for conducting the evaluation.

From this perspective the concept of Risks, Rewards, and Responsibilities emerged. The curriculum allows for developing a methodology for decision making regarding subjects of immediate concern to teenagers and emerging adults without directly dealing with highly sensitive subjects. Instead, radiation is used as a vehicle for exploring the methodology. This approach capitalizes on the multitude of resources and curricula already developed concerning radiation while adding the "So what?" component.

The Beta Version

From this analysis of need, FY96 was spent developing the subject curriculum to a beta version level. A curriculum kit was assembled with many components and offered to teachers free if they agreed to participate in testing the kit. Participate meant using the kit and completing formative

and summative evaluations during the 1996-97 school year. The availability of the kit was publicized via the Internet as well as locally, resulting in approximately 360 kits being mailed by the end of September 1997.

The curriculum kit contained a black and white copy of the curriculum (ultimately it is intended to be published in color - the current standard in educational materials) and the following:

A DOE nuclear waste series of 8 books (4 student, 4 teacher) that can be either reference or class material. Subsequent to distribution, we received a separate request for 150 copies of the student volumes.

The Los Alamos National Lab issue of LA Science dealing with radiation.

The League of Women Voters NUCLEAR WASTE PRIMER, A Handbook for Citizens.

A pamphlet on Radiation and Our Environment published by the Atomic Energy Control Board of Canada.

A video tape on the Neighborhood Environmental Watch Network (NEWNet).

A video tape about radiation produced by the Atomic Energy Control Board of Canada.

A video tape produced by Achievement Television about science as a career, ethics in science, and the advent of nuclear weapons (this was aired on PBS).

A video tape about Yucca Mountain produced by Los Alamos.

And finally, a book by General Electric Nuclear Energy titled Nuclear Power Quick Reference.

<u>The Curriculum Itself</u>

The curriculum explores the premise that we take risks to receive rewards but incur certain individual and societal responsibilities. This premise obviously is applicable to issues such as drinking, smoking, driving, and teenage sex. But the issue explored is radiation and things such as the storage of low level radioactive waste. It is emphasized that we cannot be responsible citizens if we deal with tough issues by emotional response. In making up our minds on issues, we are responsible for seeking out authoritative information and passing judgment about the veracity of the information. The three week curriculum, without supporting materials, is as follows:

Week One

Primary Focus: Physics Concepts Fundamental to Radiation

Objectives:

1. Examine the differences between thinking and feeling in decision making.
2. Realize that many people have different perceptions and ideas regarding how nuclear radiation affects life on Earth.
3. Understand how the mechanics of solids, electricity, and magnetism, electro-magnetic waves, and modern physics relate to nuclear radiation.
4. Comprehend behavior of objects in everyday life contrasted with that of particles and waves in the nuclear environment.

Week Two

Primary Focus this Week: The Nucleus and Radioactivity

Objectives:

1. Understand composition of atoms and nuclei; visualize mass and volume relationships. Comprehend the strong nuclear force, the nature of isotopes, and the key elementary particles.
2. Learn the process of decay, including alpha, beta, and gamma emissions, and apply the concept of half-life.
3. Explore x-ray and neutron radiation and how they may be artificially produced through energy transfer.
4. Gain a working knowledge of normal distributions, uncertainty, probability, and risk.

Week Three

Primary Focus this Week: Nuclear Reactions & Protection

Objectives:

1. Understand the process of fission, controlled and uncontrolled chain reactions, and operation of nuclear devices.
2. Explore the science of fusion, and examine prospects for future energy sources.
3. Gain familiarity with nuclear regulatory and safety requirements, and understand the equipment and procedures used to prevent nuclear accidents.
4. Be able to use meteorological and radiation database to analyze trends and draw inferences regarding radiation levels.

Request from the State of New Mexico

Toward the end of the fiscal year, the State of New Mexico requested 70 copied of the curriculum for distribution to state emergency action personnel. This request was supported through additional funding from the Environment, Safety, and Health Division at the Laboratory and represented a modest growth in the project beyond direct funding received from DOE.

Activities for FY98

During FY97, funding did not permit completion of an evaluation of the curriculum and appropriate revision. Further, in contact with teachers and others, it became apparent that good materials dealing with probability and risk assessment are not available. Next, if materials such as these are to be widely embraced, endorsement by and perhaps publication through a body such as the National Science Teachers' Association is necessary and prudent. And finally, a curriculum such as this should be available on the Internet to include linked pages that can help both teachers and students.

It is intended that during FY98 these tasks will be undertaken such that a marketable package can be turned over to an external supplier and that appropriate Internet access can be provided. First, a questionnaire needs to go to all participants and appropriate modifications made to the curriculum itself. Integration of resource references is essential. Second, a risk assessment manual (40 to 50 pages) needs development that provides methodologies and concepts. The target audience is high school and college-level students and should be suitable for use across many disciplines. Finally, rapport and partnering must be established with potential publishing bodies.

A Final Note

It was mentioned above that a choice was made to focus on materials for a school environment at the expense of the adult environment. The experience with the State of New Mexico offices, however, suggests that the adult population is not being ignored. The production of high quality scholastic materials establishes a standard that can meet the needs of both populations.

B. AIMS Fluid Instabilities Curriculum Development

Program Description

The study of fluid instabilities provides pre-college students with a window into the exciting world of fluid dynamics. Young students are naturally curious about fluids, but their curiosity is rarely addressed systematically. Concepts like pressure and density are usually taught as isolated effects and are applied only to static phenomena like buoyancy. This Rayleigh-Taylor Instability (RTI) project introduces students to fluid concepts as they apply to familiar, dynamic situations like spilling water and non-turbulent mixing. Students observe that everyday phenomena occurring in ocean, atmosphere and kitchen can be better understood by carefully performing

some table-top experiments, as seen in the figure where two students are observing the unstable flow of food coloring "fingering" into water. The experiments constitute inexpensive, fascinating lessons that provide insight into fundamental concepts (fluid pressure, density, surface tension) and into geophysical flows. The lessons are based on the observation that pouring water by tilting and inverting a water-filled container occurs because RTI at the water surface causes ripples to rapidly grow into a "pouring" flow. By controlling the ripples, one can inhibit RTI and thereby keep water within an inverted glass. This RTI project teaches teachers and students how to investigate this phenomenon and deepen their understanding about fluids. These science activities lead naturally to lessons about engineering, like the design of bottle openings and the relative strength of wet papers. These hands-on activities give students an enormous appreciation of fluid dynamics.

Figure. The students' attention is held by an unexpected experimental result. They get to experience it and find out why it happened.

Program Implementation

This project will culminate in a book, Spills and Ripples, to be published by the AIMS Education Foundation (Fresno, CA). We completed two additional chapters this year ("Flow Fingers" about flow patterns of RTI, and "Soapy Spills" on effect of changing surface tension at a water/air interface), and we sketched several additional chapters. "Flow Fingers" was the cover article of the March 1997 issue of the AIMS Magazine, with a circulation to about 15,000 educators. Also, we compiled the three existing chapters into an attractive handout for teacher workshops, and we did biographical research on Lord Rayleigh and G. I. Taylor in preparation for Spills and Ripples.

We presented this material to several hundred teachers in three invited presentations at educator workshops: (1) National Educators Workshop: Update 96 (October 1996) at Los Alamos, focusing on education in materials science; (2) High School Physics Teacher Day at the annual Fluid Dynamics Meeting sponsored by the American Physical Society (November 1997 at Syracuse NY), focusing on high school education in physics, chemistry and physical science; (3) Advanced Placement Science Conference (March 1997 at Santa Fe) sponsored by The College Board. These presentations were done with the same hands-on methods as the teachers will use with their students.

C. Science Explorers Translation Project

Description

Los Alamos assembled a team of five people to develop a curriculum product in the Navajo language. This product uses material previously developed (in English) by Argonne National Laboratory, as well as some new material. The pilot product was officially introduced to the Navajo Nation in August of 1997.

Background

LANL contributes resources for conducting programs for students and teachers in an effort to broaden the nation's pool of qualified personnel and to promote public understanding and appreciation of science. Our programs place a special emphasis on including minorities and women in an effort to help them achieve equal representation in scientific fields. One underserved population that Los Alamos strives to reach is the American Indian. For Los Alamos this means that in addition to the Pueblos and the Apache tribes, we place particular emphasis on the population in the Four Corners Area of New Mexico, Arizona, Utah, and Colorado, especially the Navajo Nation. LANL has developed special interest in and capability for developing programs and products that address the needs of Native Americans, including recognition of the special constraints for science education in those cultures.

This project was the result of funding by the Life Sciences Division of NASA (National Aeronautics and Space Administration) to support the development of science education materials specifically for Native Americans. The work was based on the Science Explorers program developed at Argonne National Laboratory and disseminated in Chicago and nationally, with funding from the Department of Energy. The video series entitled, "The New Explorer," presents human interest episodes created by Bill Kurtis for broadcast on PBS, and was designed to encourage minority pre-college students to consider careers in science, as well as to choose more math and science classes in junior and senior high school. The program has served well over 100,000 students through their teachers at a number of sites. Up to now, the minority students targeted by this program were predominately African American or Hispanic and have largely been attending school in urban areas. Lack of funding and interest in providing any portion of the video or accompanying teacher guide in a Native American language provided no opportunity to extend this program to Native American students, especially those living in geographically remote areas.

The American Indian people across all tribes are growing increasingly concerned that their students are losing their ability to speak their native language. For example, among the Navajos, some statistics estimate the number of people who speak fluent Navajo in the Navajo Nation at about

one third of the population. Teachers of these students are currently involved in translating curriculum into the Navajo language for more effective use in the classroom, particularly work being done through Headstart and in the health field.

Los Alamos chose to develop this project for the Navajo education community for several reasons: (1) the video focuses on the Four Corners area in the Navajo Nation as the scene of the crisis. (2) the Laboratory works on an informal basis with the Navajo Nation and its entities, responding to requests for technical assistance in a variety of areas; (3) this relationship provides Los Alamos with an opportunity to conduct a unique project that can serve a community not being served in the same way by other laboratories; (4) there is an opportunity for broad dissemination of the translated material; (5) the language can be written and has a formal alphabet.

Implementation

The project is constructed around the following elements which represent the products:

- Content provided by the New Explorers video episode "In Search of a Killer Virus"
- Activities provided by the Teacher Guide of Activities created to accompany the video
- An interactive multimedia product featuring translated text, voice and graphics

The development of a translated version of those three elements comprised the basis for the products. Each element complements the others in a classroom setting where the teacher facilitates the lessons. One element is a Navajo interpretation of the teacher guide in written form to accompany the English version, and both will be used together in the classroom. A second element is the creation of a voice track for the video in the Navajo language to accompany the guide. The third element is an interactive multimedia product that utilizes Hyperstudio authoring software to create a "stack" of translated content. The content is the basis of the curriculum guide used for science instruction of Native American students in grades 7-10.

The subject of the video from the New Explorers Series, "On the Trail of a Killer Virus" and the accompanying teacher guide is about the hantavirus outbreak in the Four Corners area in 1993. The video presents a medical mystery and tells the story of how the virus was identified and treated. The focus of the story is the medical community, both regionally and nationally, how their methods contributed to the eventual understanding of the environmental and physiological reasons for the outbreak, and what the impact was on the community culturally, socially and economically.

The teacher guide contains activities for the students to do in their classrooms. Its focus is not for the students to discover the cause of the mystery deaths, but instead to work through and understand the process of

discovering the cause. The activities lead students through an investigation illustrating the real issues that scientists face. Students receive information in forms such as medical charts and reports, similar to the scientists. The activities also emphasize group work which is modeled after the approach taken by the people in many areas who had to work together to solve the mystery of the disease.

The Hyperstudio multimedia product is intended for students to customize the work of the guide by adding their own art, graphics, and sounds. It is the place where technology can enhance the learning that will take place by using the curriculum.

Project Development Team — A team of five individuals was recruited and selected to perform the translation work. The team included a program coordinator/science education specialist from the Laboratory. Two members are teachers in the public schools, and one is a linguist working on a Ph.D. One team member is a patient advocate and translates medical procedures and one is a farmer and businessman who is interested in working with language and projects for Navajo youth. This development team possessed a combination of the following characteristics:

- Expertise with curriculum development and classroom teaching;
- Familiarity with Navajo students and their culture;
- Fluency and literacy in Navajo, and can translate the language;
- Education technology expertise (using a computer).

Team members attended training sessions at Los Alamos National Laboratory in the use of the teacher guide and video, and in the use of Hyperstudio software. They worked on the translation an equivalent of three weeks, or 120 hours, with much of the work to be done on their own and turned in on a regular schedule. They committed to meeting at least once each month in Gallup for a consensus workshop. The entire team reviewed the work they did and agreed on the best, most reasonable Navajo language interpretation of the English language version of the work.

The team members received several benefits from their work on this project. Each member received a stipend and travel expenses for the work. Each member also received a copy of the New Explorers video and teacher guide for their own use. To complete the project each member received a gift of a computer outfitted with necessary software, including a modem, from excess Laboratory equipment. The computer gift was arranged through Memorandums of Understanding (MOU's) between the school districts and the Laboratory. An agreement was made between each team member and the school of their choice that the computers would be given to the schools to be used by teachers in their classrooms when the translation is done. In addition, each member received an account through the Laboratory to communicate with one another via e-mail. Team members were trained in the use of all their equipment as well as in the use of the software. They were offered technical assistance through the Laboratory in case they had problems during the project.

This work proved to be challenging in many respects. The first challenge was bringing together a team of diverse people from various locations across the Navajo Nation. Teachers could not meet during the week. Meeting on Saturday created a problem for the patient advocate because Saturday sessions with patients had to be rescheduled for a busy Friday. Commuting distance to Gallup from deep within the reservation created special transportation problems. The lack of a telephone line to the home was another problem for one team member which prevented ordinary telephone communication and precluded any possibility of telecommunications via computer.

One significant challenge was the effort to reach consensus about the interpretation. The teacher guide and video have a scientific, problem-solving theme. The translation maintained this approach to keep the material scientifically accurate. It was also important to maintain a lay audience orientation in the translated product. Using interpretations of medical vocabulary and explanations for lay people allowed us to accomplish a consistent tone for the interpretation.

The orthography also had to be accurate and consistent. The interpreted version had to be useable for classroom teachers while maximizing the impact of the activities for the students. All student activities and process explanations were translated into Navajo, while most of the teacher instructions were left in English. The team members who are teachers carefully crafted the phrasing to be informal, to match the way students and teachers interact in the classroom.

Pilot Phase — The project was officially introduced to the Navajo Nation educators in August 1997. The presentation of the project was held in Window Rock, Arizona and included Navajo educators, representatives from the Life Sciences Division at NASA, the U.S. Airforce Reserve from Robbins AFB, LANL's Science Education Team Leader and members of the translation team. The project was received with great enthusiasm and the educators expressed interest in participating in the pilot.

The translated products will be piloted in the schools of approximately five teachers. Application packets have gone out and the educators who have expressed an interest in using the materials have been invited to apply for the pilot phase. Teachers who participate will receive computers with the appropriate software to run Clarisworks and Hyperstudio. We intend to have the students actually develop their own Hyperstudio versions of the activities and to be able to add graphics, photos, and voice to their customized versions. This will be the one area where the technology and the curriculum will merge to become an interactive experience for the students. Teachers will use the materials with their students and provide us with feedback on the usefulness of those materials. They will conduct class sessions using both the English version and the Navajo versions, side by side. Here are some things we hope to learn about the translated version:

- Is there consistent use of terminology and usage?
- Does the interpretation remain science oriented?
- Is the mystery of the story preserved?
- Is there interest in the mystery approach to solving problems?
- Does the interpretation correct wrong information?
  examples: map of Navajo Nation and knowledge of hogan
- Does the interpretation correct misconceptions of culture?
- Is the work pitched to a level appropriate for mid and high school students?
- Is the design well organized and useable?
- How important is a translated version of the video to using the guide? How useful?

Evaluation

We will informally evaluate the material during the pilot phase in FY98 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. Of particular interest is whether the translated text provides the intended student involvement in the lessons. Which lessons generated the most interest in the students and why? Which lessons did the students find the most difficult and why? The informal evaluation will utilize questionnaires and classroom observations, with the feedback used only to prepare a final version of the translation and not to judge student performance.

Impact

Preliminary impact was recorded for the development team. The team members responded in various ways to learning how to use a computer and learning how to create products in Clarisworks and Hyperstudio. Their proficiency grew very rapidly and individuals reported increased enjoyment in doing the tedious work of translating. Once skills were acquired, the team members continued to increase their use of the computer. One team member did not acquire adequate computer skills during the project; however, his contribution to the interpretation and consensus discussions of the content materials was invaluable to finishing the project.

The pilot phase is expected to demonstrate the potential for classroom impact, and the materials will be provided to classroom teachers who are interested in using them. Because the science education materials are of high quality, the translated version will allow students to enhance their native language skills while improving their problem-solving skills. In addition, we expect the use of technology in the classroom to increase as teachers and students use their computers and software to facilitate the use of this curriculum. As a means for interesting students in scientific fields,

particularly medicine or laboratory research, the subject of the video is both appropriate and controversial.

In all, this project holds great potential for (1) contributing to Los Alamos' and Argonne's ability to encourage Native Americans to consider careers in science through the use of the Science Explorers program; (2) providing resources to the Navajo Nation for the development of their science programs through the effective utilization of their native language skills, and (3) investing in product development that ultimately may generate resources and program sustainability for the Laboratories as well as the Navajo schools.

Hantavirus certainly is not a neutral topic, and for that reason, it generated wide debate among the translation team members. The debate revealed points of contention across all areas of the subject, from culture to education, and presented us with ways to be creative in order to overcome barriers that classroom teachers face. Despite our limited resources, we found many ways to embellish the work to make it a more meaningful and richer experience for students.

III. STUDENT SUPPORT

A. Critical Issues Forum

Program Description

The Critical Issues Forum 1997 involved both teachers and students from New Mexico high schools in the process of seeking solutions for real world concerns. Built around the issue of developing a vision for the future of nuclear materials, the participating students and teachers examined many facets of this complex subject of global concern within the realms of the political, social, scientific and economic domains. Program participants interacted with Los Alamos National Laboratory personnel and participated in a culminating activity where the individual teams addressed a real world problem provided by the Laboratory and the U.S. Department of Energy.

Goals

- To increase public understanding of nuclear materials.
- To increase student understanding of telecommunications.
- To increase content understanding in the disposition of nuclear materials and the monitoring of excess nuclear materials.
- To model the use of technology for research purposes.
- To demonstrate how to research a complex critical issue in-depth.
- To increase participant use of the computer in order to communicate and share information with others.
- Understanding of content by using a problem-based approach to learning science
- To model the scientific process and successful teamwork through cooperative learning

This program leverages LANL's scientific capabilities and resources by integrating our core competency in nuclear materials management, stockpile support, and stockpile stewardship. The Critical Issues Forum supports the DP Mission in the following ways:

- developing partnerships between Laboratory and education community;
- providing resources and technical support to schools and districts;
- providing electronic communications technology as one method of distributing educational materials to the public;
- providing access to Laboratory personnel;
- preparing teachers and students to utilize technology appropriate to the research topic;
- enhancing students' use and understanding of science research methods and technology; and

- providing enrichment opportunities for students and teachers in research, workshops, and curriculum development.

Implementation Strategy

Students and teachers applied as teams. Research teams (teacher/s and a minimum of 10 students) participated in four academic year workshops held at regional locations in New Mexico. Participating schools received a quarterly stipend from the Laboratory allowing each team to determine their needs for developing electronic networks with fellow student researchers and Los Alamos National Laboratory scientists and technicians. The schools provided support to the program by providing administrative support and participation, by encouraging the teams to share their research with the student body and the community and provided the students with an academic credit for completion of the program. The following Mechanisms for Quality of Program are utilized.

Site Visits — Each participating school was visited twice during the academic year. This provided an opportunity for Program Staff to interact with students, teachers, and administrators in their school setting. This also helped to ensure that students had access to computers and other necessary resources, were provided with time to pursue the critical issue and that any on-site problems relating to the program could be addressed.

Telecommunications — To insure parity among participants, schools provided participants access to the Internet, so that the Critical Issues Forum Web Pages could serve as a central location for interaction and collaboration. Through the web pages, participants accessed each other, LANL education staff, Laboratory scientists, and university staff as resources. As participant's skills in telecommunications grew, users extended their scope of contact to include organizations and resources throughout the world.

Workshops — The Forum is designed to best match Laboratory expertise with the needs of New Mexico high schools to provide a unique educational opportunity tied to the DP Mission. It was evident that the schools offered standard courses in English, Mathematics, Science, etc., but it did not appear as though the schools provided an opportunity to apply multiple disciplines to a singular topic of current national interest. Three regional workshops and a culminating Forum event were held to provide instruction for students and teachers in process and content, and to supply resources that required teams of students to sharpen their critical thinking and problem solving skills on a real world problem of global concern.

Benchmarks — Teams are required to demonstrate their learning and understanding through various benchmarks that combine content information, critical thinking, problem solving skills and telecommunications. These benchmarks fell along a scheduled continuum that allowed teachers and their students to meet specific program goals in a well-organized, carefully facilitated manner.

Products — Each team produced dissemination products based on their work on the topic. For example, in FY97, each team developed a multi-media presentation delivered in a public forum at Los Alamos National Laboratory, and they developed materials for inclusion in the Critical Issues Forum web page.

Evaluation

This year, the total number of participants in CIF numbered 158, representing 136 students, 11 teachers and 9 administrators from eight public high schools in New Mexico. Of the student participants, 51% were male and 49% were female, with an ethnicity breakdown as follows: 52% Anglo, 43% Hispanic, 3 % Native American, and 2% Asian. Of the teacher and administrator participants, 75% were male and 25% were female, with an ethnicity breakdown as follows: 55% Anglo, 45% Hispanic, 5% African American.

The evaluation included an analysis of student products such as the recommendation packets and presentation materials to determine the extent to which the students developed their critical thinking skills and their abilities to work cooperatively in teams. Measurement techniques involved: Internet use, process feedback forms, student surveys; teacher surveys; evaluation of student written recommendations; evaluation of student oral presentations; evaluation of student products; and, observations by program coordinators.

Students and teachers showed significant positive increases in the following areas:

- understanding what a career in science looks like;
- understanding of nuclear materials;
- understanding of telecommunications;
- how science relates to global issues;
- how science relates to issues in politics, history and society;
- how nuclear materials are stored;
- the disposition of nuclear materials;
- the effects of nuclear materials;
- the locations of nuclear materials;
- how to access information using the Internet;
- how to use telecommunications for research;
- how to research a critical issue in science;
- how to use writing to communicate ideas effectively; and
- how to communicate ideas effectively through an oral presentation.

Program Highlights

Students:

"CIF was a creative program that made its participants aware of nuclear materials, its history, and the distribution of nuclear materials in our lives. It was very educational and helpful in the decision making process."

"I think this program is a really good idea. Students need to know that what we study is related to the world."

"I learned quite a lot, such as how to improve my written communication, to work with a team, and to increase my computer skills."

"It helped me learn about things I didn't know such as the history of science, nuclear technology and telecommunications."

"I personally have learned a lot from this program. I have learned leadership within my group, responsibility to my team, and how to research on the Internet. I have also learned so much about nuclear technology. I feel educated in nuclear materials and all things associated with them."

"My motivation in school has increased because this program has boosted my confidence , and I realized I was capable of much more."

"I learned how to use the Internet for research, and I experienced growth in my writing, communication skills and critical thinking skills."

Teachers:

"The CIF program has been a personal growth experience for me. By participating I have questioned my own understanding of scientific history and of nuclear chemistry. I have developed an understanding of the complexity of the issue of nuclear energy and its uses, and I've acquired insight into the utility of on-line electronic information processing systems. I have also been able to experiment with the constructivist model of learning which is touted as the best form of science education available."

"During the past semester I have seen numerous changes in my students involved in this program. Primarily, I have seen a growing desire in my students to defend their own ideas. Before this program, the students would simply accept the idea of whoever yelled the loudest for the longest period of time. Now the students actually discuss their ideas and evaluate their individual strengths and weaknesses."

"Through our many extended discussions of the wide range of political, economic, and scientific issues involved with the benchmarks I can see that the topics and methods have prompted the students to consider these questions from a much broader perspective than they would have before. Perhaps the biggest growth area for our team this semester is in collaboration. Many of our members are very independent and we were able to do much of the work last semester with small groups of 2 or 3 people. The

design of this semester's benchmarks is already pushing us to bring those small groups together more so that the end product is coherent."

B. New Mexico Supercomputing Challenge

Program Description and Goals

The New Mexico Supercomputing Challenge is an academic-year program in which teams of one to five high-school students and their sponsoring teachers conduct computational science projects using high-performance computers. Each team receives an account on a Cray supercomputer at Los Alamos and an account on New Mexico Technet to access the state network and the Internet. Each team defines and works on a single computational project of its own choosing. The goals of the Challenge are to foster creativity in devising computational solutions to scientific problems and to make a positive difference in students' lives, motivating them to prepare for the work force of the future. The program is both an educational experience and a competition that strives to (1) provide access to high-performance computers, (2) increase students' interest in science-related disciplines, (3) promote careers in science and engineering, (4) institute electronic networking among schools, and (5) expose students and teachers to computational experiences. Numerous organizations in New Mexico have joined with Los Alamos National Laboratory and New Mexico Technet since 1990 to sponsor the Challenge.

During the seventh annual Challenge year, 1996-97, there were 12 sponsors and 21 contributors. The 21 contributors contributed money or in kind services up to $5,000.

The Challenge year began with the Kickoff Conference in October that was attended by approximately 470 students and 110 teachers making up 126 teams from 50 schools. Participants received 14 hours of instruction in computer networks, supercomputers, software development methods, and programming. Hands-on computer laboratory sessions give students and teachers an opportunity to try new skills in both a structured and unstructured setting. Students have an opportunity to talk with scientists about their particular area of interest.

Data was collected about the students. Females represented 27% of the students and 35% of the teachers. Ethnic representation for students was: 63% white, 21% Hispanic, 10% American Indian, 5% Asian, and 1% African American. Ethnic representation for the teachers was: 79% white, 14% Hispanic, 6% American Indian, and 1% African American. Over half of Challenge participants are from small towns and rural areas.

During January, one day regional workshops were held at six different institutes of higher education around New Mexico where the participants were instructed on programming, Unix, the Internet, and public speaking. More data was collected about the students and their abilities.

The Challenge competition came to a conclusion in April when about 250 participants came to Los Alamos where they were given tours that included

many scientific talks given by LANL scientists. They were able to see the computers that they had been working on while walking through the Laboratory Data Communication Center machine room. Talk topics included: SGI/Cray Computers, the Network Operations Center, Pediatric AIDS, TRANSIMS Animation System, Hazardous Devices Team-Equipment and Procedures, Supernova, Research Library Orientation, Particle Accelerators from an RF Standpoint, Snake Awareness Program, Microwaves Never Lie, and Video Teleconferencing. Approximately 90 LANL people were involved with the activities in one way or another, 40 of them as escorts.

Several times during the year, Challenge coordinators attended conferences and workshops to promote the Challenge and encourage participation by others. Among these were Supercomputing 96 in Pittsburg, and Computer Expo97 in Albuquerque.

In July, two two-week Summer Teacher Training Sessions were held at New Mexico Institute of Mining and Technology in Socorro, one beginning and one advanced. A total of 47 teachers participated and received 3 units of graduate credit from NMT. They were instructed in C++, Unix, the Internet/WWW, HTML, and other topics. Although they were intense days of instruction, the teachers learned a lot and said that they would recommend the sessions to others. See the graphs (Fig. 1 and Fig. 2) of the teachers' pre-test and post-test scores to see how they improved during the two-week course. The teachers were very enthusiastic with comments like "Had a great time, enjoyed the intellectual stimulation", "I could have used a 26 hour day", and "It was Fantastic!!", as well as useful reminders like "I think the broad focus should be finding ways to help us all work together to recruit the next generation of scientists/mathematicians".

The Challenge has had a positive impact on students, teachers, schools, and communities. LANL's participation has had a positive effect on participants' perception of the institution.

The unrelenting growth of the Challenge over the first six years had strained the sponsors' ability to support the Challenge. This year high schools were limited to four teams each which the sponsors hoped would control the number of participants and encourage strong commitment to the program. Although the dropout rate was still higher than desired, it was less than previous years. We feel that the students learn and gain from the Challenge however long they participate, but since the expensive portion of the Challenge is the beginning, this change was necessary. The sponsors hope this growth restriction will enable them to continue offering the program to students who are committed to active participation and to more smaller schools.

Large schools will be allowed to ask for a waiver from the state committee. During the registration period for the 96-97 Challenge, no schools requested a waiver. In the past, a few schools have entered as many as 17 teams and have not been able to keep the interest going for that many students. In the 95-96 year, one school that entered 17 teams did not have a single team

finish the entire year. Preliminary numbers for the 97-98 year show that the growth has leveled off and we will continue to work toward less attrition.

The same test was given before and after the two weeks of instruction and the scores show that by the end of the sessions, the teachers were at more comparable levels than when they began. The beginning class, as expected, showed a more dramatic improvement.

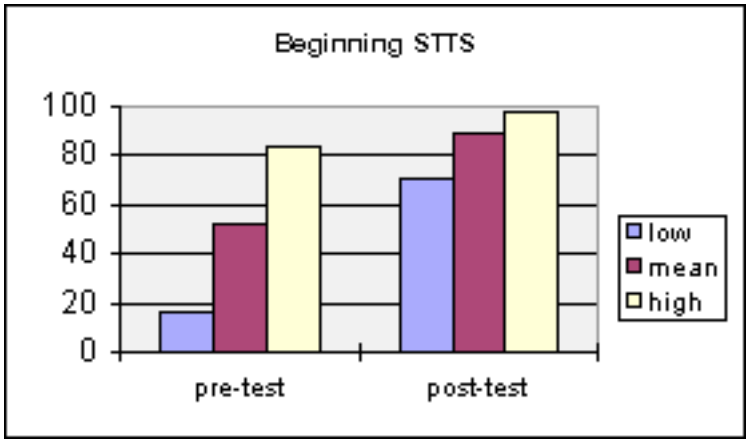


Fig. 1. Pre-test and Post-test Scores for the Beginning Course.

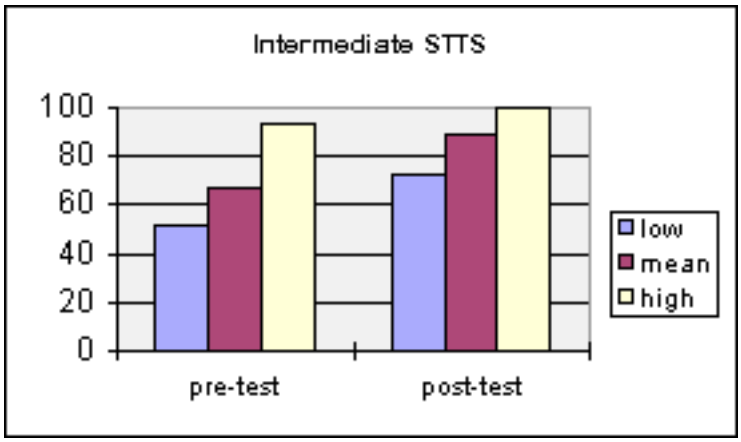


Fig. 2. Pre-test and Post-test Scores for the Intermediate Course.

Current information about the Challenge can be viewed on the Web at:

http://mode.lanl.k12.nm.us

or

http://www.technet.nm.org/challenge.html

C. Summer Experience for the Economically Disadvantaged (SEED)

Description

Project SEED, sponsored by DOE and the American Chemical Society (ACS), is a project that attempts to overcome some of the obstacles -- attitudinal, and educational -- which have traditionally excluded the economically disadvantaged from preparation for the entrance into professional careers. The Los Alamos summer experience is designed to involve students in meaningful research four days a week, supplemented on the fifth day with educational activities that include tours of selected Laboratory facilities, career counseling for post-secondary training, and oral and written communications skills development. Students are required to prepare a technical summary, give presentations to their sponsoring groups, and design and display a poster session.

The Los Alamos summer experience is designed to involve students in meaningful research four days a week, supplemented on the fifth day with educational activities that include tours of selected Laboratory facilities, career counseling for post-secondary training, and oral and written communications skills development. Students are required to prepare a technical summary, give presentations to their sponsoring groups, and design and display a poster session.

Goals

- to increase the students' knowledge, skills and abilities in appropriate content areas;
- to increase the students' research process skills;
- to develop the students' abilities to make sound educational decisions connected to career and professional goals.

Implementation

Participants — Thirteen schools in Northern New Mexico were targeted for recruitment based on the fact that participants have to be able to commute daily to their work site. Site visits, mailings to school counselors and principals and announcements in local media were utilized in attempts to seek student applicants.

Students were selected to participate in Project SEED based upon grade point average, standardized test scores (if available), and teacher recommendations. All students must live within commuting distance of LANL. Preference is given to students whose families have annual incomes that are below the federal poverty guidelines, and who may be encouraged by their work in science to make better use of their capabilities.

In 1997, 13 students were selected for the program, with 1 student entering SEED II and 12 students beginning in SEED I. All students successfully completed the summer program. Participants selected for the program in FY97 were primarily under-represented minorities: 53% of the students

were of Hispanic origin, 30% of Native - American origin. By gender, the participants were 60% female and 40% male.

In cooperation with the local ACS chapter, funding was made available for special recognition opportunities.

Research Experience — Students participating in Project SEED are selected to work alongside a mentor in a research area at LANL. Students spend 80% of their time with a mentor, and 20% of their time participating in problem solving and critical thinking activities, college planning, career counseling, and technical communications. In addition, students participated in site tours to learn about basic research at the Laboratory. Students earned a small summer stipend for their work, but it is the mentor relationship between the student and the researcher that is the key factor in helping the students establish higher goals for themselves and in expanding their horizons.

The program coordinator recruits students and mentors, and matches the candidates to the research topic by analyzing student transcripts for evidence of content background. Student interests and teacher recommendations are also important in identifying capable and motivated students. By identifying students and projects on a scale of introductory to advanced, the program coordinator matches the appropriate levels of student abilities and interests to the scope of the research experience. The mentor works with LANL staff to select the student, to identify the scope of the project, and to link the project to learning objectives. The program coordinator solicits research proposals from mentors, screens the projects, schedules all training and Laboratory tours, conducts the orientation session, facilitates the course work , and monitors the program through site visits and mentor and student feedback.

Educational and Career Guidance - The students attend a career class at the University of New Mexico at Los Alamos where they receive concurrent high school or college credit. Topics include decision-making strategies, critical thinking and problem solving activities, financial planning, time management, career interests and the educational requirements accompanying these career choices. To supplement the curriculum, ACS provides materials on Careers in Chemistry.

ACS offers to assist Project SEED participants with scholarship/grant information and has encouraged students to contact them on any issue of financial concern. In the post-program questionnaire, mentors are asked to recommend students for assistance. Each student also receives a directory of scholarships specifically available for minorities. The students are informed of the various types of scholarships and grants and are instructed on how to complete the general financial aid form.

The students had several instructional sessions designed to improve their oral communication skills. Many of the students have not previously presented a scientific talk and are provided an opportunity to present their research experience in front of their peers and sponsoring groups. Videotaping their presentations and reviewing the tape with the students

individually provides the students with essential constructive feedback to enhance their oral communications skills. Students are required to prepare a technical summary (8-9 pages) of their research, and to submit outlines and rough drafts to the program coordinator. The students are also required to design and display a poster session illustrating their summer experience.

Evaluation

Evaluation materials include pre- and post-surveys of the program, site visits and observations by the program coordinator, a study of the students' career plans, and mentor feedback. Students indicated that Project SEED helped them to increase their interests in science, in pursuing a science major, and in pursuing a scientific career. After the program, 100% indicated that their work with real scientists made a difference in their understanding of the research process.

LANL program staff assessed students' knowledge and understanding by using interviews, video and poster sessions evaluation, and written reports. This was used primarily to identify academic strengths and areas for improvement for each student. Student feedback is also used to assess program effectiveness.

During the summer the students' work was assessed regularly. They all made final presentations to their peers on their projects. Students' reports were reviewed with the students and suggestions and comments were provided. Both the poster session and the written report were evaluated by LANL staff from the Science Education Team.

Each participant of Project SEED was responsible for preparing a final poster and technical report based on their research experience. Students were required to prepare a technical summary (8-9 pages) of their research, and submitted outlines and rough drafts to the program coordinator. The students were also required to design and display a poster for a final session illustrating their summer experience.

Highlights

When asked what they had gained from their summer experience in Project SEED, the participating students responded in a variety of ways, some of which are listed below:

"I have learned that science is very fun and interesting."

"I have learned a lot about light scattering and how to use a laser. I learned a little bit more on cells and organelles."

"More knowledge that will prepare me for the future."

"The ability to work on my own. I have obtained knowledge in the world of Science."

D. Undergraduate Research Semester (URS)

Description

The Undergraduate Research Semester (URS) Program at Los Alamos National Laboratory began as the Science and Engineering Research Semester (SERS) Program in the Spring of 1989. At that time, the U.S. Department of Energy established the SERS program as part of an expanded science education effort at seven multi-disciplinary national laboratories. The purpose of the research semester is to provide unique and challenging off-campus research opportunities for upper-division university undergraduate science and engineering students. To date, Los Alamos National Laboratory has hosted 384 undergraduate students in the URS and SERS programs. Currently, 23 students have accepted appointments for the Fall semester of 1997.

Students and scientists work together on a wide variety of research problems. Science mentors from across the Lab volunteer their time to mentor URS students in the fine art of research. The mentoring relationships that develop during the semester are known, in many cases, to directly influence undergraduates' decisions to attend graduate school and pursue technical careers.

URS participants have access to facilities and state-of-the-art equipment at Los Alamos not ordinarily available on a university campus. The URS Program enhances and facilitates the historic interrelationship between the university community and the Department of Energy laboratories, thereby contributing to the national goal of strengthening the quality of science, mathematics, and engineering research and education. Supplementary educational activities that compliment the research appointment enrich the participants' technical background and perspective for future career decisions. The URS Program encourages participation by women (46% this year) and underrepresented minorities (20% this year) in science and engineering fields.

Goals and Objectives

The principal goal of the URS Program is to

> Use the Department of Energy's unique National Laboratories to develop a diverse workforce of individuals with enhanced problem solving and technical skills to enable the nation to meet current and future scientific and technical needs and to contribute to the research of the National Laboratories.

The principal objectives of the URS Program are to:

- Increase students' knowledge and skills in science, math, engineering, and technology topics.
- Increase students' understanding of the research process.
- Attract students to Department of Energy related areas of research.

- Strengthen and focus their field of study and career plans.
- Increase the diversity of students that participate in the URS Program.

Implementation

Los Alamos - URS students spend 16 weeks engaged in research work and attend supplementary educational activities. The program participants spend approximately 80% of their time conducting research under the direction of a Laboratory scientist or engineer and approximately 20% of their time attending the supplementary educational activities. These activities include a wide variety of planned events The planned activities are designed to enhance the students' experience at Los Alamos and allow students to see the types of initiatives that are underway at LANL. Tours, lectures, and field trips also permit students with diverse interests to get a feeling for a variety of research facilities and to have an opportunity to visit with other Laboratory personnel directly involved in a particular field. The overall feedback of the educational activities is very positive.

For the 1996-97 academic year, participating Laboratory divisions included: Materials Science and Technology; Life Sciences; Chemical Sciences and Technology; Computing, Information, and Communications; Physics; Nonproliferation and International Security; Earth and Environmental Sciences; Los Alamos Neutron Scattering Center; Technology and Safety Assessment; Environment, Safety, and Health. Also, each student comes into contact with technicians, post-doctoral students, graduate students, and other Laboratory scientists that provide additional guidance. In addition to the team of researchers that work closely with student participants at their Laboratory sites, the URS Program Coordinator plans weekly educational activities for the students which are led by Laboratory volunteers.

The URS appointment methodology exemplifies a total immersion into a research setting. Students are expected to be part of the research team in their respective laboratories and contribute to the best of their abilities. This hands-on approach to student learning provides valuable training and skills to the participants as well as confidence in their own abilities. Based upon evaluation data collected for 1996-97, participating mentors found 1) students can make a significant contribution in moving the research effort forward, 2) provide new ideas and perspectives, 3) provide additional and valuable experimental time to a project, and 4) explore new research areas. The students are typically eager to learn and contribute, and they ask important questions that allow the researcher to explain and interpret the project and results. The students learn valuable lessons in scientific habits of mind.

The mentoring component of the URS Program continues to play a very important role. Mentors are prepared and supported in a variety of ways. Mentors receive information to help them understand the intricate relationship with the student researcher and appreciate the important role they play in the success of the student.

Students are offered an optional opportunity to take a university course offered through the University of New Mexico - Los Alamos Center for Graduate Studies or Branch College. In both the Fall 1996 and Spring 1997, approximately half of each group attended the Los Alamos campus for coursework. Since the URS Program requires that students take a semester away from their home institution, the university courses help to provide an opportunity for the students to continue to move toward their academic goal of timely graduation.

Program participants must present a technical talk to their sponsoring group (peers and colleagues), design and present a poster display of their research, and submit a technical summary of their research to the program coordinator. These requirements typically occur at the end of the URS appointment. Students are coached on presenting their findings through workshops, by their mentors, and the program coordinator. Students discuss their poster displays with the guests at a special reception.

Evaluation

To study the impact of the Laboratory program on the participants (students and mentors) a variety of tools are used including a student post survey (scaled and open-ended questions), a poster session, technical talks, observations from site visits, student feedback throughout the program, and mentor responses to a post survey.

Responses from the participants indicate that the program continues to be very successful. Some students thought there were too many lectures (not enough site/lab tours) in the supplementary educational activities. This has been changed for the coming semesters with lectures and tours combined and the students preparing mini-courses to better prepare their fellow students for the rigors of a technical presentation outside their field of study. Overall the students found the mentoring relationship and their research experience a positive one with many (21 this year) staying on with their mentors and their research endeavors.

In response to an open-ended question about what influence (if any) the URS Program had on their career/academic plans and goals, the response was quite positive. Most students felt that their URS experience provided clarity and direction in formulating technical career and academic plans. All acknowledged that the program provided much needed experience, knowledge, and opportunities they would not have received at their home university. As one student put it, “Fantastic program, I have never learned so much in my life!”

The mentors were also asked to complete a post-semester program evaluation with scaled and open-ended portions. When asked if students made a positive contribution to ongoing research, all responding mentors stated that a positive contribution was made and in many cases research was conducted which never would have been accomplished otherwise. In many cases, the mentor and student are co-authoring a journal publication. The benefits of working with and mentoring a URS student invoked many positive responses such as “I think the program is a great success” and “over the last

five years the URS candidates have been outstanding." It is clear from both the evaluations and the large number of proposed projects to match with students that mentors find this program both professionally and personally rewarding. It is striking how often a URS student provides a new and refreshing perspective to a project and, as a result, contributes in a significant way.

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

Program Description

The Los Alamos Summer School in Atomic, Molecular, and Optical (AMO) Physics, a joint program of the University of New Mexico (UNM) and the Los Alamos National Laboratory (LANL), has just completed its ninth year. The School targets upper-level undergraduates and first-year graduate students, who will soon be making career or field choices, and recruits nationally to gain the most diverse possible class. We give the students an intense exposure to basic research by concentrating on the fascinating, diverse areas of AMO physics, both through lectures by distinguished scientists on the latest developments and through mentored term projects. AMO physics provides a particularly fertile area for such an exercise since its tenets permeate a diverse set of other disciplines such as astro-, weapons, condensed-matter, plasma, bio-, and laser physics. We also have the broader goal of teaching certain basic physics skills not commonly emphasized in the university curriculum, of introducing high performance supercomputing, and of fostering a personal interaction between research scientists and students. A knowledge of the workings of scientific research, of the frontier discoveries, and of the newest computer techniques will greatly aid students, no matter what their ultimate career choice. For the past six years, the School has been funded by a National Science Foundation(NSF) Research Experience for Undergraduates(REU) site grant to UNM and by the Science Education Programs at LANL through the DOE Defense Programs Office, in addition to in-kind support from the Theoretical Directorate (LANL) and the UNM Center for Graduate Studies and the Department of Physics and Astronomy

The session divides into two complementary activities involving lectures and a mentored student research project. First, the lectures focus on current "hot topics" in the field of AMO physics, motivated from the speaker's own research projects. The lecturer introduces basic physical concepts from the perspective of on-going research endeavors. This mode of presentation gives the students an opportunity to participate in new investigations. Second, each student works on a research project for the whole summer term. A mentor from the senior scientific staff of LANL or UNM oversees and guides the student through this endeavor. A variety of projects are available; most center heavily on high performance supercomputing. The mentors carefully craft each research project to fit the background of the student in order to guarantee the greatest and most effective participation. We have found that this dual track of lectures and research best stimulates the students in an active interest in science and avoids the pitfalls of a program devoted exclusively to one track or the other.

The School typically runs for eight weeks concurrent with the UNM summer semester. The students receive three hours of course credit from UNM as Physics 501. This credit has been readily transferred to home institutions and, in many cases, has substituted for a senior research project. We hold the lectures in the mornings and reserve afternoons for research, attempting to strike a balance between these two activities. Classes and research sessions are held on the campus of UNM at Los Alamos; the UNM computer center has a fast link to the LANL network while providing powerful local capabilities. The common class and computer rooms as well as their close proximity within student housing, all encourage a natural cohesiveness within the class. We further foster this class spirit with tours of Laboratory facilities and of local points of interest. The friendships made during the course of the School form an important, enduring feature of the program as commented upon by almost all students, past and present.

While this basic formula has served the School admirably over its tenure, we continue each year to experiment with new educational projects and approaches. These experiments function on a small enough scale so as not to endanger general student performance, yet with a broad enough scope to provide reasonable extrapolation. For example, last year, we tried a cross-disciplinary mentored project based on the optics of sight in birds that brought the students in contact not only with physicists but also with a ornithologist from LSU. The project proved so successful that we extended to three our cross-disciplinary mentoring for FY97: two in astrophysics and one in biophysics. As indicated above, such projects remain in perfect harmony with the broad scope of AMO physics and its importance to a great variety of other fields. These experiments serve each term to reinvigorate and challenge the School anew.

Program Implementation: FY97

Organization — Reflecting the dual nature of the sponsorship, we have co-Directors with each taking particular responsibilities for various tasks in operation and organization, based on resources, personnel, and location. For example, UNM North has excellent facilities and staff at its several locations(principally Los Alamos and Santa Fe) to handle the vital task of recruiting and to provide classroom and computer access while the Lab has the on-site technical staff from which to draw the mentors and lecturers. Professor Mike Zeilik serves as co-Director for the UNM side, and Dr. Lee Collins for Los Alamos. Prof. Howard Bryant, a co-principal investigator on the NSF grant with Prof. Zeilik, provides invaluable service in many areas of the program. The School could not function without the immeasurable contributions of Norm Magee from T-4.

Mentored Research Project — In 1997, seventeen students from universities in fourteen states participated in the combined curriculum of lectures and individual research projects. Given the charter of the program, most projects emphasized high performance supercomputing both on large mainframe machines such as the CRAY-YMP and on smaller distributed computing networks, which provided experience in parallel computation. We had our largest participation of mentors to date, representing six different Laboratory Divisions and eight Groups. Thirteen projects, supervised by

seventeen mentors, covered such diverse areas as (1) short-pulsed laser interactions with matter, (2) heavy particle collisions and fission, (3) scattering of protons from atoms, (4) quantum computing, (5) X-ray diffraction, (6) the structure of large molecules, (7) observations of binary stars using the ALEXIS satellite, (8) stellar collisions, (9) the chemistry of batteries, (10) diagnostics of plasmas, (11) the folding of proteins, (12) atomic processes in external fields, and (13) transient quantum mechanical processes. The research scientists who acted as mentors included from LANL [Drs. A. Taylor and G. Rodriguez (MST, Material Science), Dr. K. LaGattuta (XPA, Plasma Applications), Dr. S. Cohen (NMSM), Drs. J. Kress and R. Martin (T-12, Molecular and Chemical Physics), Drs. J. Bloch and S. Fletcher (NIS-2, Nonproliferation and International Security), Dr. M. Warren (T-6, Astrophysics), Dr. Angel Garcia (T-10, Biophysics), Dr. G. Kyrala (P-24, Plasma Physics), and Drs. D. James, J. Cohen, J. Keady, G. Csanak, and L. Collins (T-4, Atomic and Optical), and from Cal State Fullerton [Prof. Heidi Fearn (on sabbatical at LANL)].

All students submitted detailed final reports, illustrated with intricate graphics, on their research accomplishments. The papers have been bound into a volume for distribution among the participants. The main emphasis of the School centers on the research experience, giving the students a taste of a hands-on technical project. The span of the program remains generally too short for the production of a finished, polished, and publishable piece of scientific research. However, several of the students plan to continue work on their projects, either as independent endeavors or as a part of their senior research course at their respective institutions. We anticipate at least four publications in refereed research journals from these continuing efforts. In order to give more students a flavor for the publication process, a very important part of the full research experience, we have arranged with the University of Eastern Oregon to publish contributions by at least seven of our participants in their student research journal. This journal publishes more in the line of well-developed progress reports but still gives the student the full measure of paper preparation. The contributions are refereed by faculty members at UEO. One of our participants, Kelly Cline, serves as editor of this journal, making the whole process a total student activity.

Lectures — In addition, the students attended a full set of lectures on an extensive range of AMO topics including quantum optics, quantum and massively-parallel computing, electron-atom collisions, computational physics, propagation methods, interactions with strong magnetic and electric fields, femtosecond phenomena, laser cooling and Bose-Einstein condensates, negative ions, atomic structure, nanostructures, exotic atoms and molecules, atomic processes in astrophysics, fractals, and Planck's development of the quanta. These were presented by distinguished visiting lecturers from outside universities and research organizations [Prof. A. Gaeta (Cornell), Dr. Eddie Timmermans (Harvard), Prof. P. Winkler (Nevada-Reno), Dr. B. Schneider (NSF), Prof. H. Fearn (Cal State), and Dr. R. Fugate (Phillips Lab)] and from the University of New Mexico [Profs. M. Zeilik, H. Bryant, I. Deutsch, S. Seidel, P. Henning, D. Evans, and S. Atlas] and from the Los Alamos National Laboratory [Drs. S. Younger (NWT), R. Hughes (P), R. Clark (XCI), A. Merts (T), A. Redondo (T),

G. Csanak (T), D. James (T), and L. Collins (T)]. Due to the inspired recruiting of Prof. Bryant , we increased our participation from UNM over our record of last year to seven lecturers from the Albuquerque campus. This large contingent further demonstrates the important ties between the University and Laboratory generated by this program. Aware of the importance of scientific role models, we also had five women lecturers - another record.

Our "experiment" this year centered on a tutorial-lecture scheme to take even more advantage of the wealth of seminar and colloquia speakers that visit the Lab during the Summer session. We have recruited some of these speakers to give presentations at the School; however, schedules and the extra preparation demanded of lectures to undergraduate students have limited the number of recruits. Most of these formal Laboratory talks are fairly technical and generally out of reach of most of the students. To bridge this gap, we have this year provided a tutorial on the subject of a particular seminar that introduces the students to the general concepts so that they may garner the essential points from the technical lecture. This scheme was combined into a single presentation by Dr. Robert Fugate of the Starfire Optical Range of the Phillips Laboratory. His talk on adaptive optics to remove the flutter of the Earth's atmosphere in astronomical imaging was a big hit. The next stage would focus on a more formal separation of a pre-lecture tutorial, given by one of the Summer School staff, followed by the class attending the talk, and concluding with a discussion amongst students and staff.

The lecture series has been open to all other Laboratory Educational projects, and we have routinely distributed the schedule to the undergraduate(UGS) and graduate(GRA) programs.

Activities — In addition to the formal lecture and mentor programs, we have arranged for a wide variety of related activities for the students. Two such activities have involved meetings with participants at other REU sites in the immediate area. The students from the REU program at UNM Main campus attended our initial reception and subsequent tour of LANSCE, while our students went for a visit to the Santa Fe Institute. The latter excursion included a tour of the facility, an introductory talk about the many projects of the Institute, and a long discussion session between the two groups of REU participants. We also had tours of various Laboratory facilities such as the Neutron Scattering Center(LANSCE). Finally, we went on several cultural excursions including one to Santa Fe and to Chaco Canyon. The latter, organized by Prof. Zeilik, an expert in archeoastronomy, also included a UNM field archeologist. We continued our traditional Night at the Santa Fe Opera.

Recruitment — Unlike most REU sites, we recruit nationwide with an emphasis on students from schools with little or no graduate research programs. The Center for Graduate Studies at UNM typically handles the recruitment phase consisting of an extensive mailing of fliers to all members of the American Physical Society Divisions of Atomic, Molecular, and Optical Physics and of Chemical Physics (about 2000). In addition, a color poster was sent to most physics, chemistry, and astronomy departments in the

United States. Special mailings went to minority-designated institutions. We worked closely with other efforts within the Science Education area at LANL, including the Historically Black Colleges and Universities program. We have also developed a Web site that gives general information and allows direct applications. For 1997, we received over 100 applications and admitted twenty students, of whom seventeen accepted. This class was very strong scholastically, filled with many honors students. We maintained our high participation of women (45 %), far above university enrollment at this educational level and, this year as last, accepted equal numbers of men and women. We also had two Hispanic students.

Evaluation — Evaluation of such a project has always been difficult. Through a work-studies program at UNM, Ann Brandenberger continued her heroic efforts of last year in contacting as many alumni as possible. So far, fifty past students or about a third of the nine-year enrollment have responded. Of these, 20% have received Ph.D. degrees in the physical sciences, principally physics; 60% are enrolled in graduate studies in science; and 20% have embarked on other professional careers in medicine, computer software, law, and market analysis. The graduate programs involve such diverse locations as the Universities of Colorado, North Carolina, Nebraska, Nevada, Harvard, California, and NYU as well as Imperial College of the University of London and McMaster in Canada. We also performed an impact evaluation, asking the students the immediate importance of their participation in the School. The consensus this year followed remarkably closely that of previous years. The following general findings about the course emerged: (1) well organized and at about the right level, (2) helped improve understanding of basic concepts in the field, (3) required a reasonable amount of work, (4) provided skills applicable to their careers, (5) gave appreciation of high-level computer power, and (6) fostered an informality that nurtured interactions with renowned scientists. We were gratified with the response from most of the students that the School had " renewed their interest in science and computation." Therefore, the short-run effects of the School were clearly very positive. We also participated in a UNM survey for ranking the course among others given at the various campuses. The general level of instruction and material received the highest ratings.

Budget — The FY97 budget ran at $140,000 with $50,000 from the NSF-REU grant and $90,000 from Science Education programs. In addition, considerable in-kind support comes from both institutions including materials, computer time, and staff. The students were paid a stipend of $3400 for the session that covers UNM tuition, travel, and subsistence. Housing costs, always a major expense in Los Alamos county, were borne directly by the School. In addition to being enrolled as non-degree students at UNM, we place them on assignment at LANL so as to utilize the many facilities such as the Library as well as to provide easy access to the mentors.

DP Mission Statement — The School began as an internally-funded project within the Los Alamos Weapons Program to encourage greater participation by outstanding students in AMO research, deemed vital to many DP missions. While the advent of the REU component six years ago has

broadened this mandate to include applied research science in general, the goals remain aimed at many aspects vital to DP initiatives and Laboratory core competency areas. The long-term efficacy of such programs as Science-Based Stockpile Stewardship and the Accelerated Strategic Computing Initiative depend critically on recruiting highly talented young scientists into various DP research projects. The School fosters such recruitment through contact with DP program personnel in lecturers, research projects, and tours. This contact was furthered this year by a special lecture on Science and Weapons by the NWT director, Dr. Steve Younger.

F. Summer of Applied Geophysical Experience (SAGE)

In 1997 the Summer of Applied Geophysical Experience (SAGE) brought 26 undergraduate and graduate students to New Mexico for an intensive, month-long program of classroom instruction and field study in the techniques of geophysical exploration. Students attending SAGE 1997 represented 22 institutions from the United States, Mexico, and Belgium (Table 1). The core program included collection of geophysical data; computer processing and interpretation; and written and oral presentations by all participants. As part of this course, participants spent three days studying the geology of different parts of the Rio Grande valley in order to better interpret their geophysical results. The course stresses the integration of data acquired by several geophysical techniques to solve basic and applied “geological” problems. While students in geophysics programs take SAGE, the course is also designed to attract students from small colleges and universities that do not have geophysics options.

TABLE 1

Institutions Represented by Students Attending SAGE 1997

University of California, Santa Barbara
Yale College
George Mason University
San Diego State University
Colorado College
Vanderbilt University
Bates College
University of Texas at Austin
Humboldt State University
University of California, Santa Cruz
Millersville (Pennsylvania) University
University of Connecticut
State University of New York at Fredonia
University of Oregon
Purdue University
Autonomous University of Mexico
Southern Methodist University
University of California, Riverside
California State University, Long Beach
University of Texas at Dallas
University of Brussels
CICESE

Geophysical techniques which students used in their field activities included seismic reflection and refraction (Fig. 1), DC resistivity, ground-penetrating radar (Fig. 2), magnetics, gravity, and magnetotellurics. Students worked on three separate projects. The first was an ambitious study of part of the Rio Grande rift, imaging subsurface sedimentary units and buried faults to depths of several kilometers. This work was part an ongoing project in which each year's data are integrated with data collected from different areas in previous years. Students have the opportunity to merge their data with that collected by previous SAGE students to interpret the "broader picture." The techniques used during SAGE 1997 for this basin-scale project were seismic refraction/reflection (using a Vibroseis source) and gravity. The Vibroseis technique uses hydraulically driven vibrators mounted on truck or tractor chassis to generate seismic waves. It is an environmentally benign technique, widely used in the petroleum exploration field as a powerful source of seismic energy. The Vibroseis trucks were provided to SAGE on a cost-shared basis by the Colorado School of Mines. The chance to conduct a field project with the Vibroseis technique is a rare opportunity for most students.

Fig. 1. Teaching Assistant and former SAGE student Victor Gonzalez (left) guides SAGE 1997 students Chelsea Buckley (Purdue University) and Robert Bielinski (University of Oregon) through the intricacies of field-processing data from ground-penetrating radar (GPR), acquired just minutes before at a buried Manhattan-era waste disposal site at Los Alamos. GPR was important for defining trenches because of large quantities of metallic debris in them.

Fig. 2. Jennifer Etter (San Diego State University) and John Granville (Vanderbilt University) operate the slide-hammer seismic source at the site of a buried Manhattan-era waste disposal trench at Los Alamos. The seismic refraction technique was able to locate the edges of the trench within ± 1 meter and to demonstrate that only a single wide trench, not two narrow trenches as previously supposed, was present.

The second project was an intermediate-scale study using gravity, magnetics, and magnetotellurics to study subsurface geologic structures in a residential development near Santa Fe, which is plagued by water shortages. This project was undertaken in cooperation with the New Mexico State Engineer's Office to help constrain hydrologic models. Students, many of whom have an interest in hydrological applications, acquired experience with an important applied problem. Finally, a small-scale survey, using seismic refraction (Fig. 1), ground-penetrating radar (Fig. 2), dc-resistivity, and magnetics was undertaken to study a Manhattan-era disposal site at Los Alamos National Laboratory. This study was of considerable interest to the Environmental Restoration project at Los Alamos, which is actively investigating trenches at the site for possible remediation. SAGE was able to provide the project with information regarding the number and geometry of trenches and to accurately define edges of trenches. The SAGE investigation helped establish the feasibility of using geophysical techniques for environmental applications, and provided students with experience in a field in which many are likely to be employed. Every year,

many SAGE students declare an interest in environmental geophysics, because many prospective jobs are in this field. All exercises were well evaluated by the SAGE 1997 students.

In addition to the core program, SAGE held two week-long workshops for selected undergraduate students from last year's SAGE (1996). The workshops were in (1) processing and interpretation of seismic refraction and reflection data, and (2) interpretation of electrical and gravity data. Both were held at San Diego State University, which provided laboratory space, computers, and software at no cost to the SAGE program. The fact that the workshops ran concurrently allowed the two groups of students to coordinate their results for a more comprehensive analysis of the problems. Several SAGE 1997 students are continuing to work with SAGE data for their Master's degrees.

For the past three years, major support for the undergraduate part of SAGE was provided by a grant from the Research Experience for Undergraduates program of the National Science Foundation (NSF). This grant ended with SAGE 1997. Co-Directors George Jiracek and W. Scott Baldridge (for SAGE faculty, see Table 2) have submitted a proposal to NSF for renewal of support. As in previous years, support both in dollars and in-kind from Industrial Affiliates is of key importance for the successful execution of the course. Among the help that was furnished to SAGE 1997 was loan of computers by the University of Texas at Dallas and Sun Microsystems, of state-of-the-art Global Positioning System equipment by Leica, of software by Geomatrix, and of help with field work by representatives of Kennecott Exploration Co. and Zonge Engineering. For the first time, Mobil Oil and Gas Company sent a seismic interpreter to work directly with the students on data gathered by SAGE 1997. Representatives from three oil companies (Mobil, Chevron, and Exxon) visited SAGE, presented talks to the students, and worked with them in the field. Direct contact with scientists from industry is invaluable to students planning careers in geophysics.

Information about SAGE, including photographs, published results, and a list of Industrial Affiliates, is available on the World Wide Web at http://geont1/SAGE/SAGE.htm or through the Los Alamos National Laboratory homepage.

TABLE 2
SAGE Faculty

Dr. W. S. Baldridge SAGE Co-Director	Los Alamos National Laboratory
Prof. S. Biehler	University of California, Riverside
Prof. L. Braile	Purdue University
Prof. B. Gilpin	Golden West College
Prof. J. Ferguson	University of Texas, Dallas
Prof. George Jiracek SAGE Co-Director	San Diego State University

G. Underrepresented Minority/Female Initiative

Program Description

The Underrepresented Minority and Female Initiative (URMF) was conceived to assist underrepresented minorities and females from the Southwest to achieve parity representation in science, mathematics, engineering, and technology. The URMF program focuses on students from New Mexico, Texas, Colorado, Arizona, and California and it currently involves undergraduate and graduate university students and graduating high school students.

College enrollments of women and minorities lag behind those of white males, yet the demographics of U. S. school-age children clearly indicate that the pool of white males is shrinking. The pool of students entering the pipeline to careers in science and engineering must be expanded to include more of those who have been traditionally underrepresented. The principle goal of the URMF program is to encourage students from underrepresented classes to choose careers in science, mathematics, and engineering and to encourage them to excel in these fields, thus helping provide our nation with an essential resource: the next generation of its scientists, mathematicians, and engineers.

URMF believes that education must challenge all underrepresented minority and female students to reach their potential and must involve resources of the Laboratory. To accomplish this, the program provides internships that allow direct experience in and exposure to a wide variety of science and technology at LANL and at local universities and industries.

Program Implementation

During FY97, 39 undergraduate students, 8 graduate students and 1 faculty member were placed in internships.

The URMF had three different components. One was the high school summer program at the University of New Mexico-Los Alamos Branch. Twenty graduating seniors from local area high schools commuted to attend college preparatory classes. The courses were designed to increase their skills in mathematics, present an introduction to technology, give them an opportunity to explore career options, and to provide them with college survival skills.

Another portion of the project took place at the New Mexico State University campus in cooperation with the National Science Foundation/Alliance for Minority Participation (NSF/AMP) Program. Four students from two-year colleges in the state of New Mexico that had completed an associate degree and were in transition to a four year institution were placed in laboratories with mentors and were assigned specific tasks. Based on this research experience, they were required to submit a final paper and to give an oral presentation to their mentors, the staff of the Alliance for Minority Participation, and the staff of URMF.

The final component of URMF took place at LANL. Fourteen undergraduate and eight graduate students from colleges in the southwest were placed in research laboratories with mentors and assigned tasks. Their projects were presented in final papers and twelve of the students were selected at random to present oral presentations. The final papers will be scanned into a database for future references.

During the summer, there were professional development seminars that included training sessions on technical presentations, technical writing, and the seven habits of highly effective people. Social events were provided to encourage interaction among the students of the different programs.

Program Evaluations and Assessments

An evaluation survey was distributed to the participants at the end of the 1997 summer session. Separate surveys for students and mentors were distributed. Evaluations were designed using a likert scale of one to five. An average rating was determined and that rating was turned into a percentile with a 100 percentile meaning all respondents gave that particular question the highest possible rating.

Conclusions

The surveys and final reports filled out by the URMF participants indicate that these internships motivate the participants to continue. Many of the students indicated that as a result of their experience in the programs, they have decided to pursue a higher level of education than they had planned previous to their internship. Mentors as a whole were positive about their experience with the programs. Many had helpful suggestions and were eager to participate again next year. One of the Graduate Research Students was offered and accepted a full-time job at LANL.

Based on preliminary feedback, it is the opinion of the URMF Program staff that the format of the program is on target to achieve its educational goals.

H. Regional Two-Year College Initiative

Program Description

The Department of Energy's objectives for the nation's economic growth build on an investment that support a highly skilled work force, a strong scientific and technological research and development community, and the development and transfer of innovative technologies. DOE is looking to the community colleges to become more involved in technician training. LANL is committed to working with two-year colleges in the state and in other regional academic partnerships. This commitment was demonstrated through the development of the Two-Year College Initiative Program. This year participating institutions included Luna Vocational Technical Institute, Northern New Mexico Community College, San Juan College, Navajo Community College, University of New Mexico - Los Alamos Branch,

Crownpoint Institute of Technology, Santa Fe Community College, New Mexico State University-Carlsbad Branch, Hobbs Junior College, Albuquerque Technical Vocational Institute, United World College, Southwest Indian Polytechnic Institute, Little Big Horn College, Fort Peck Community College, and Salish Kootenai College.

Before the inception of the Two-Year College Program, the two-year colleges identified an area of advanced technology in which their schools could specialize. Technologies targeted for this program have been: advanced manufacturing, environmental restoration and waste management, biotechnology, and computer technology. Under the college initiative program, student and faculty teams have participated in an internship program at LANL. Interns were placed in various technical areas with mentors who assigned specific tasks. Along with this research experience, the program provided a seminar, lecture, and conference series. At the end of the internship, participants were required to submit an abstract as well as give an oral presentation of their research experience.

The objective for student development was to increase the number and quality of students pursuing degrees in these emerging technologies and to motivate the students to continue their academic pursuits. The objective for the faculty was to strengthen the academic environment at the colleges by enhancing the teaching and research capabilities. Experience at LANL gives the interns exposure to the cutting edge technology necessary in this competitive world and it is the exposure that leads to the achievement of the objectives.

This year for the first time, we sponsored a week-long “Molecular Science” summer institute, whereby twelve faculty members from six of the regional community colleges participated. Instruction was provided by the UCLA Chemistry staff, introducing a new curriculum and new methods of using technology in teaching.

Six students worked on environmental restoration/waste management projects gaining field work experience. They had assigned mentors from various environmental clean-up groups throughout LANL.

During FY96, thirty students and four faculty were placed in internships or worked on research contracts.

Two research contracts were awarded to two two-year institutions. They were:

- Northern NM Community College (NNMCC) faculty/students worked on a project for LANL in conjunction with the Federal Highway Administration. The project was to acquire and process high quality data on traffic flow on our nation’s highways using existing electronic laboratory equipment, as well as design and develop newer and smaller measuring instrumentation.

- Navajo Community College (NCC) faculty/students were involved with the Navajo and Hopi Tribal governments in a Geographic Information

System (GIS) mapping project at NCC with the mentoring from LANL EM Division. The goal was to involve the students in the decision-making process in land-use planning utilizing GIS and to develop data to be used by the two tribes and other organizations. As a result of this project NCC will introduce GIS courses as part of their curriculum.

Program Evaluations and Assessments

An evaluation survey was distributed to the participants at the end of the 1997 summer session. Separate surveys for students and mentors were distributed. Evaluations were designed using a likert scale of one to five. An average rating was determined and that rating was turned into a percentile with a 100 percentile meaning all respondents gave that particular question the highest possible rating.

Conclusions

The surveys and final reports completed by the Two-Year College Initiative Program participants indicate that these internships are inspiring for the participants. Many of the students indicated that as a result of their experience in the programs, they have decided to pursue a higher level of education than they had planned previous to their internship. Faculty participants have stated that the program inspired them to incorporate new ideas into the courses that they already teach and to participate in the development of new curriculum. Mentors as a whole were positive about their experience with the program. Many had helpful suggestions and were eager to participate again next year.

Collaborations are developing. The program coordinator and other high tech industries will continue with the two-year institution administrators to further explore research activity at their respective campuses during the academic year. There are plans to create a postsecondary consortium of New Mexico community colleges that will focus on centers of excellence with an emphasis on technologies.

The research contracts have proven to be a very positive way of doing business with the two-year institutions. They have challenged them to develop hands-on projects that have led to enhancing existing educational programs and to new curriculum. They have also provided LANL with a "value added" component.

Based on preliminary feedback, it is the opinion of the program staff that the format of the program is right on target to help achieve the broader educational and economic goals of the Northern New Mexico region specifically and the DOE in general.

I. Historically Black Colleges and Universities (HBCU)

Program Description

In 1981, Executive Order 12320 mandated the development of federal plans designed to achieve a significant increase in the participation by Historically

Black Colleges and Universities (HBCU) in Federally sponsored programs. Driven by this Executive Order, the HBCU Student Program was established and has been continuously funded by the Department of Energy (DOE) to develop and draw on scientific and technological capabilities of students specifically from HBCUs.

Program Objectives

The national HBCU Program seeks to enhance the career prospects of African American students in majors of science, engineering, and technology. This is accomplished as schools and curriculum are strengthened which further produce a positive impact on the schools which expand their capability to excel in technical and scientific research.

There are three components employed by the national program to effect this change in HBCUs participation from less to greater research in science, engineering, and technology. They are: (1) institutional grants; (2) fellowships and research grants to HBCU faculty; (3) internships for Junior and Senior level undergraduate students (UGSs) and graduate research assistants (GRAs) from HBCUs. With the exception of the institutional and faculty research grants and fellowships, all work is accomplished at DOE National Laboratories.

Program Goals

To enhance career prospects of graduates of HBCUs and to increase the numbers of such graduates with degrees, undergraduate and graduate, and careers in science, engineering, and technology.

Program Development

The HBCU program at LANL recruits students to serve as research interns in divisions throughout the Laboratory. Program participants receive full-time appointments ranging from 10 weeks to 1 academic year. Both undergraduate and graduate students are recruited from HBCUs from a variety of technical areas of study such as: mechanical, chemical, and electrical engineering, computer science, physics/material science, chemistry, biology, and human genetics.

Students are then selected by the mentors based on the major field of study, courses completed, and prior experience in their campus laboratory, a prior summer internship, or a National Laboratory environment. From this successful match, the mentor develops the "Student Work Plan" to outline the student's summer research.

Graduate students will also find extraordinary opportunities to expand their thesis research while in the National Laboratory environment. One such physics major is currently compiling data for a master's thesis. He is searching for "Evidence of Muon Neutrino to Electron Neutrino Oscillations from the Pion Decay-in-Flight Process via the Ground State Excitation of Carbon-12 to Nitrogen-12." He predicts conclusive evidence of oscillations will show that neutrinos have mass. This would have a profound impact on

his approach to accounting for the missing mass of the universe, and current cosmological theory. This student is afforded the opportunity to perform his research with a high energy (800 MeV) proton beam at the Los Alamos Meson Production Facility (LAMPF) through analyzing data collected from 1994 through the present in the Liquid Scintillator Neutrino Detector (LSND).

Opportunities abound in which basic and applied research are conducted using state-of-the-art instrumentation, advanced computing, both proven and experimental technology, and facilities and resources unavailable on campuses.

Mentoring

National and world renowned scientists direct projects and serve, voluntarily, as student mentors, thus providing students with unlimited career experience and graduate school advantages. These technologies and experimental projects are sometimes developed into the various campus curriculum to continue and share research knowledge at the campus location.

Mentoring is an integral component of the success of the HBCU Program. Based on research conducted with these world renowned scientists, student research results are reported in professional scientific publications, final research papers, and through formal and poster presentations. In addition, these relationships often times enhance future graduate school recommendations, and placement of students in professional positions. Graduate candidates are provided research tools and state-of-the-art equipment which may not otherwise be available on their campuses.

Program Partnerships

Partnerships with HBCU's and DOE National Laboratories are another invaluable use of government facilities, resources, and expertise. Also, it is an avenue of contribution with which the Laboratories provide improved quality and diversification of the future workforce in science, engineering, and technology.

Additional partnering with HBCUs serves to leverage resources as well. The HBCU Program seeks to fully develop, nurture, and maintain relationships with in-house and external professional organizations who will cost-share elements of the Program.

Program Implementation

In FY97 there were 18 HBCU researchers: 12 undergraduate students, and 6 graduate students. These students represented the following nine HBCUs: Alabama A&M University (AL), Albany State College (GA), Claflin College (SC), Hampton University (VA), Howard University (DC), Lincoln University (PA), North Carolina A&T State University (NC), North Carolina Central University (NC), Southern University & A&M College-Baton Rouge (LA), and Vanderbilt University (TN), a non-HBCU.

Professional Development

During the summer session at LANL, professional development seminars were conducted to include training workshops on technical and resume' writing. Also organized were seminars on the Laboratory environment and general topics of professional development.

Six University Program students participated in the GEM-NIM Summer Institute on Mentoring sponsored by participating corporations with the Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM) National Institute on Mentoring (NIM). The theme was "Adapting and Thriving in an Ever-Changing Environment: Strategies for Success." The Institute provided students with invaluable insight on "how to apply to graduate school", "transition from campus to the workplace", etc.

Students provided the GEM Coordinator with papers indicating how the conference helped them and what it will mean to their futures in science, engineering, and technology.

Summer Speaker's Series

Sonja Ebron, Ph.D., Professor, Electronics Engineering
Norfolk State University, Norfolk, Virginia
Dr. Ebron presented her research on "The Global Trend Towards Privatization of Energy Resources, with an Emphasis on the Need for Power Engineers and Technically-Trained Entrepreneurs."

Joan Packenham, Ph.D., Geneticist
National Institute for Environmental Health Sciences (NIEHS)
Research Triangle Park, North Carolina
Dr. Packenham's chromosomal research provided insight on "Comparative Genomic Hybridization and Spectral Karyotyping: Novel Approaches in Detecting Genetic Alterations in Cancer."

Professionals from various scientific disciplines, campuses, and organizations will be asked to introduce students to new research ventures. This will also serve to provide future contacts for students with respect to research opportunities, graduate school preparation, etc. The Speaker's Series also allows professionals exposure to young future scientists and their interests.

Social Development

Social events were provided to encourage interaction among students of the different Laboratory programs; and the introduction of students from other cultures not plentiful on the East Coast in the HBCU campus environment. Diversity is at its best when students are here for the summer to create an extraordinarily well-rounded experience. This summer experience further served to alleviate misgivings about the capabilities and social adjustments of students from HBCUs.

Not only were students provided opportunities to interact with other LANL students, but to interact with summer interns from Sandia National Laboratory and to participate in a White Water Rafting outing and a University Programs Student Picnic. Students also toured Bandelier National Monument, and experienced camping and hiking. To produce a well-rounded summer, students attended a planned lecture in Albuquerque given by Attorney Johnnie Cochran.

Program Evaluations and Assessment

Seven out of the eighteen HBCU students returned their "University Programs Informal Questionnaire," to date. Questionnaires were designed using a likert scale of one to five. An average rating was determined and that rating was turned into a percentile with a 100 percentile meaning all respondents gave that particular question the highest possible rating. Results are the following from the questionnaires received.

A. **Job Information** — This area covered positive experience, relation to future career goals and current academic studies, and workplan of proposed work. The overall "work experience" was rated with a high.

B. **Mentors** — This area covered communication, information and meaningful activities, and mentor effectiveness. Students rated the mentoring experience somewhat high.

C. **Program** — Information covered the value of University Programs (UP), summer workshops, communication with the program coordinator, UP staff, and other UP students, and the number of social events. The value of UP is rated very high. Students also indicated, very highly, their interest to return to the Laboratory next summer.

D. **Housing** — The issue of adequate housing was evaluated here. This is an on-going issue to be reckoned with in Los Alamos. Availability of housing is a serious concern due to the very large number of students and faculty that come to LANL in the summer, and due to the fact that Los Alamos is a small town. However, students indicated an overall high response to housing.

Program Summary

The surveys and final reports completed by the HBCU participants indicate the students' overall satisfaction and the positive benefit of the summer experience at Los Alamos National Laboratory. Many of the students gained greater insight into their chosen major and future career expectations. All of the students who completed the "Questionnaire" expressed a great interest to return the following summer.

Long-Range Program Planning

Students will continue to be provided technical training in the areas of technical research and writing, and presentation skills. An added seminar or workshop series will focus on ethics in science. Further, the "Speaker's

Series" will introduce new findings in science each month during the summer internship period.

Campus Collaborations

Funding — The leveraging of campus partnerships will increase student participation tremendously. This will also allow an added commitment from the campus to ensure a place for their students and faculty involvement in enriching scientific exploration and the use of state-of-the art equipment.

Research Capabilities — This component will further enhance shared research knowledge on the HBCU campuses. Students and faculty will return with enhanced knowledge in their respective fields of science, engineering, and technology.

Curriculum — Involvement in the development of curriculum will enhance the prospects of the HBCU student regarding the summer internship and future employment here and at any DOE National Laboratory. Course preparedness is an added component when mentors review and select student applicants to participate in the summer internship experience.

J. Mentored Collaborative Research Project

Description of Program

The Mentored Collaborative Research Program (MCRP) was conceived to provide student and faculty teams an opportunity to work alongside Laboratory researchers on “target” project areas that have a direct relevance to LANL’s stockpile stewardship mission. The MCRP program focuses on undergraduate and graduate students and faculty from New Mexico and regional universities. Faculty and students work as a team that is “project” oriented. The teams are usually made up of students from multiple disciplines, for example computer science, engineering, material science, and technology. This provides additional experience of working together in a multi-discipline manner, much like the common work experience at LANL.

In FY97 there were three MCRP research project teams in which a total of five undergraduate students, two graduate students, and two faculty members participated. The projects included:

- The Microstructure and Properties of Erbium Oxide (Er_20_3). The purpose of this investigation was to develop a fundamental understanding of the structural and mechanical properties of both polycrystalline and single crystal Er_20_3. The synthesis of Er_20_3 included the development of techniques for the fabrication of single crystal and polycrystalline samples. The properties of these materials were then investigated. This project was a continuation of the FY96 MCRP project.

- Implementation and testing of a state-of-the art computer-based manufacturing process planning system at LANL. The object of the

system was to enhance manufacturing capabilities and operations by providing advanced technology and the accompanying knowledge and skills to manufacturing process planning. The project was limited to the evaluation of MetCapp, ToolCat, and N-See computer software programs. The evaluation will be performed by identifying user needs and satisfying the requirements through software capabilities for the purpose of manufacturing operations.

- Non-destructive materials testing as part of a weapons stockpile stewardship program. Methods used included light in the range from 175-1500 nm, and x-irradiation. Experiments were conducted at temperatures ranging from 7° K to approximately 300°K (ambient). Test equipment included Thermo Luminescent Dosimetry tester (TLD), Cary 5-E UV-VIS-NIR Spectrometer linked to a computer with OS.2 operating system. Other test equipment included an optical Helitran, X-Irradiation system, high temperature furnace 1200° C, a high vacuum pump station, and liquid helium and nitrogen to achieve the low temperatures. Specimens investigated included estane, pure and with nitro-plasticizer, micaceous iron oxide, and potassium dihydrogen phosphate.

Program Evaluations and Assessments

As part of the evaluation process, MCRP student research projects were presented in final papers and at oral presentations to their student peers and mentors. The success of the projects were determined by an evaluation form distributed to both the intern participants and the mentors. This form is based on a Likert scale which is turned into a percentile rating for the various aspects of the program. The project was monitored on an ongoing basis. Students and mentors provided feedback, via questionnaires, for each of the major program components. The purpose of the monitoring evaluation was to determine whether or not the program components were accomplishing the project's goals and what strategies should be taken to fine tune the program. Evaluation surveys were designed to address: orientation sessions, student workplan, and student evaluation of the project.

Conclusions

One graduate student from the Microstructure and Properties of Erbium Oxide (Er_20_3) team remained at LANL working on the research project for one year. The host technical organization cost-shared the student's salary at a 50% level. It is expected that future participating university faculty will continue their LANL research experience at their home institution, with technical support from LANL staff. One of the Graduate Research Students was offered and accepted a full-time job at LANL as a technical staff member.

Based on preliminary feedback, it is the opinion of the program staff that the format of the MCRP program is right on target with regard to working with Laboratory researchers on "target" project areas that have a direct relevance to LANL's stockpile stewardship mission.

K. Faculty and Student Teams (FAST)

Description

The FAST Program provides Laboratory researchers the opportunity to develop new collaborations or expand current collaborations with a university faculty and student team. Teams include two faculty members (one a science professor actively involved in research, the other a professor from the college of education actively involved in a science teacher preparation program) and two graduate or upper-division undergraduate students (one a science major, the other a science education major). Both faculty have primary responsibility for guiding the students.

The program is designed to (1) increase university collaborations with Laboratory researchers, (2) provide Laboratory research opportunities for students and faculty, (3) increase dialogue and collaboration between faculty from Colleges of Education and Colleges of Arts and Sciences, and (4) increase the number of students and faculty that are exposed to areas of research related to the Defense Program mission.

The FAST Program continued as a pilot program in the Summer of 1997 with three university teams. The program consisted of an in-depth summer research experience for each team, supported and extended by ongoing, academic-year research with an increased academic component . During the summer, the university teams collaborated on a research project with a Laboratory scientist. During the academic year, the teams will continue the collaborative effort begun at Los Alamos National Laboratory using the same interdisciplinary and collaborative approach used during the summer experience.

For FY97, three teams were selected to participate and, for the first time, two of the teams were collaborations between neighboring universities. The selected teams were: (1) New Mexico Highlands University, (2) California State University at Hayward with University of California at Berkeley, and (3) Carnegie Mellon University with Chatham College.

Goals

The goals of the FAST Program are to (1) increase collaborations between the Laboratory and institutions of higher learning nationwide, (2) increase communication and collaboration between the Colleges of Education and Colleges of Arts and Sciences within universities or between neighboring universities, (3) increase awareness and practice of a multi-disciplinary approach to teaching and learning of science and science education, and (4) increase understanding of science process and research at a DOE Defense Programs laboratory.

Implementation

Recruitment — The FAST Program expanded to nationwide university participation and with neighboring university participation within a team. Prospective teams were asked to submit an application in order to participate. An invitation to prospective PIs was mailed electronically to a large number of staff members and management at LANL. There was a modest response by interested Laboratory PIs. Interested PIs submitted a brief written proposal for review.

Laboratory PIs that participated in the FAST Program for Summer 1997 worked with their teams to ensure that the appropriate research content fit both the interests of the science team members as well as the education team members. In addition to collaborating with the team, most PIs also attended one or more of the special lectures.

Summer Experience — Participant meetings were scheduled throughout the summer so that each team and all the teams could discuss both educational and science research issues. These meeting promoted dialogue between scientists and educators; they also promoted dialogues between the education team members from different universities. Each team delivered a technical presentation to the other teams and guided a site tour of each Laboratory facility and state-of-the-art equipment like the SEM and TEM microscopes in the Materials Science Laboratory. One team designed and built a Magneto Optical Trap which only 16 years ago won a Nobel prize in physics.

Academic Year Grants — Guidelines for academic year proposals were provided to each team. The program coordinator facilitated brainstorming sessions with each team to focus the proposal content and value to all team members. The proposals emphasized developing content area curriculum to enhance the teaching of the overall research topics for the science and education professors. Each team produced an excellent proposal for follow-on work.

Evaluation

As this was the second summer of piloting the FAST Program the evaluation is principally formative. With the information gathered we can continue to refine the program structure and implementation to better meet the program goals and better suit the Laboratory PIs, the faculty, and the students. The FAST program is unique and at this time we are developing a profile to determine the "best practice" for the program.

Principle Investigators — Responses indicate overall enthusiasm for the program. The PIs observed and participated in the dialogues between the professors; research progressed very rapidly with four-member teams; technical contributions were made which otherwise might not have occurred; and collaborative connections between universities were strengthened. Without exception the PIs wanted to participate again.

Faculty — Responses again indicated overall enthusiasm for the program. The science professors all had existing collaborations with LANL researchers before arriving, yet each found the team approach moved their research along rapidly and gave them new perspectives on content delivery in their own teaching. The education professors learned about the research process first-hand and how multi-disciplinary science is conducted at a national laboratory. All faculty, and particularly the education professors, had difficulty leaving their universities for 8-weeks in the summer. This also affected team recruitment into the program. Many professors simply could not leave their institutions for 8-weeks. There were also comments that the stipend and housing allowance were too small and in one case, the hosting scientist covered the perceived shortfall. Without exception faculty members said that they would seriously consider participating again and that their respective universities supported the program.

Students — Responses likewise indicated overall enthusiasm for the program. They found the research experience to be a great learning opportunity. One student said he had worked at the Lab three other summers and never got to do "real research" like he did in the FAST Program. Another said, "simply the best professional experience I have ever had; I want to come back."

IV. EDUCATIONAL TECHNOLOGY

A. Teaching Hearing-Impaired Students to Speak

In collaboration with the New Mexico School for the Deaf, we are developing ways to use advanced technology to teach hearing-impaired students to speak. In doing so, we are developing new technology as well as applying existing technology. Our primary focus is on developing the animated display of articulatory motion (ADAM), which is designed to provide visual feedback of vocal tract motion that is driven by a student's actual speech acoustics. Due to their disability, hearing-impaired children do not receive normal acoustic feedback of their speech production process. Thus, the feedback provided by ADAM is intended to replace or supplement the feedback normally supplied by hearing. With the aid of visual templates, ADAM also shows the child what to do to produce particular speech sounds.

The system we have developed works well for vowel sounds, for which it is a clear improvement over existing systems. Our focus is now on consonant sounds, which present a variety of interesting and difficult challenges. One of the more interesting challenges is to find a way to correctly distinguish consonant sounds from vowel sounds. This may seem like a trivial problem with obvious solutions, but it is not. In alphabetically written speech (i.e., English, as opposed to Chinese), the letters follow one another in orderly sequence. In fluent spoken speech, the reality is that consonant and vowel sounds overlap one another. This is also true for the movements entailed in speech production. (You can see this for yourself by observing the "k" sound at the beginning of the word "key" in contrast to the "k" sound at the beginning of the word "coo." You will see that the placement of the tongue is different for the two "k" sounds, and that, correspondingly, they sound different from one another. Consonants can even overlap each other, which you can see with the "s" sound at the beginning of the word "sweet," in contrast to the "s" in the word "seat." For the "s" in "sweet" your lips are rounded, showing the influence of the upcoming "w" sound.) From this perspective, speech sounds can be essentially simultaneous, differing only by speed of articulator movement or by which articulator is primarily responsible for the formation of the sound. Thus, in view of these physical realities, the apparently sequential nature of speech sounds may be considered an illusion fostered by an abstract writing system.

Figure 1.1
Articulator positions for the /g/ sound in /ugu/

Figure 1.2
Articulator positions for the /g/ sound in /igi/

Figure 1 shows the differing articulatory configurations for the /g/ sound in different contexts. Whereas previously we were considering the differences between the two /g/ sounds to be contextually conditioned by the vowels on either side of the /g/, our new approach is to consider the differences to be the result of the simultaneous production of the vowels and the consonant. Accordingly, we have two different computational neural networks — one for vowels and another for consonants — running simultaneously, to infer the vocal tract positions for consonants and vowels, with their results blended. So far, this approach has yielded improved results where it has been applied, and we are hopeful that it can be extended successfully to other consonant sounds.

As in previous years, our work has had implications that go beyond education. Because we are tackling very difficult problems, we have had to develop new mathematical approaches, which turn out to be applicable to diverse phenomena. For example, we have previously mentioned that MALCOM (Maximum Likelihood Continuity Mapping), a mathematical technique developed largely for this project, was successfully applied to Medicare fraud analysis. It is now also being applied to speaker identification. We believe that developments in that application will in turn be applicable to further enhancing ADAM.

In general, the techniques we have developed may be considered "data driven," and we have proposed applying them to the analysis of the data from nuclear tests. In that application, they are complementary to the first-principles modeling on which Los Alamos has traditionally developed its computational reputation.

In collaboration with Marie-Francoise Castaing, a Visiting Guest Scientist from INSRI (France), we have developed icon-based exercises to stimulate conversational interaction. With these exercises, students take turns putting icons together to make "puzzles" that challenge story-telling skills. For example, a student can choose a symbol for a drink of liquor and a car. The other student might respond with, for example, "Don't drink and drive," or might tell a story about drinking and driving. The symbols, of course, are designed to stand for words the students have learned previously.

A former LANL employee who has suffered a cerebral hemorrhage and consequent stroke has been using ADAM and the icon-based exercises on an informal basis. It appears that the results have been extremely gratifying. Whereas at the beginning of her efforts, she was largely unintelligible, she can now engage in simple conversations, explaining her needs and relating where she is going on vacation, etc. How much of her progress is due to ADAM we cannot be certain, but we know that her initial stroke occurred approximately a year ago, during which time she made little progress in speaking, but that she has made dramatic progress in the last three months, during which time she has been working with ADAM.

B. Educational Networking Support (EduNets)

Program Description

The LANL Educational Networking Support Program (EduNets) was developed to support the national goal to have every school connected to an "information highway" by the year 2000. Our mission is to help school classrooms, libraries, and offices get connected to Internet resources for science, math, engineering and technology and to provide teachers, administrators and technical teams training to use and support these resources.

The LANL EduNets project is designed to use Laboratory technical expertise and experience to help school districts plan and implement networking infrastructures for connecting their schools to the Internet and its resources. It is designed to provide a coordinated networking consulting resource for school districts in the program and to share materials and models developed with other schools and programs nationwide. It is also designed to establish partnerships with and provide support to community colleges and departments of education to help establish regional training and technical support centers for school districts to ensure continued future support.

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 Texas, Colorado, Arizona, and Oklahoma that are partially funded through partnership efforts and research grants. Requested advisory, technical, and training support is also provided as much as possible for BIA and other schools in related LANL networking and support projects for the Northern New Mexico Pueblos, the Navajo Nation, the National Indian Telecommunications Institute, the LANL Teacher Opportunities to Promote Science (TOPS) program, the DOE Laredo Energy Research Project, 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 include: 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. Principal efforts include: networking and computing advisement and support; establishing regional training and support centers/hubs and Internet computer labs; forming school, regional, and district Internet Education Working Groups (IEWGs); providing on-site support for schools and hub sites, teacher and staff training and support, and Internet education resources support; and sharing information gained.

EduNets Scope: Sites Supported - Current Support and Partnerships Scope: 38 School Districts (24 public and 14 non-public), 11 community colleges, 30 other (2 departments of education, 3 regional technology centers, 4 support cooperatives, 6 related LANL networking programs, and 15 non-program school districts/schools for requested workshops attendance). Based on requests and current progress, we would expect to increase these numbers by another 25-30% in FY98. Current data indicates that in current program public school districts over 80% of the students are in national minority populations, with 10 districts with over 90%.

	K-12 Edunets Districts	Regional Training and Support "Hubs"	Total Districts, Hubs & Related Programs Sites	K-12 Schools in Program in NM School Districts	K-12 Sites Provided On-site Support
FY95	9	5	17	102	> 50
FY96	16	11	37	124	> 80
FY97	38	19	79	194	>160

Networking and Computing Consulting for School Districts — One of our main goals is to provide school districts in the program advisement and support on networking and computing. We work with the District Superintendent's office, technology planning committees and school administrations to help them develop their technology plans and grant proposals to obtain funding for internetworking their schools and to implement valid networking infrastructures and internetworking design. Primary support activities include: providing input and support for technology plans and for grant proposals for Internet access and infrastructures; conducting site surveys and needs analyses; providing wide-area network (WAN) and local area network (LAN) consulting; helping determine hardware and software needs; providing contractor liaison and estimates support; reviewing proposals and bid specifications; and, providing on-site support, integration support, and testing as needed. We are currently working with 25 district offices, 21 in New Mexico, 2 in Texas, 1 in Colorado, and 1 in Oklahoma in an advisory and support capacity.

Providing On-site Support and Training — The LANL EduNets team made site visits to schools and administrative offices in more than 30 school districts and college campuses this year. The team teaches and/or helps technical support staff install software, set up networks, and configure workstations and servers. We spend approximately 75-80% of our time "in the field" with "on-site" support and training. Having the technical support and training provided at the sites on the equipment the district uses allows us to test the network and equipment as we do the training and feedback indicates that it helps promote a smooth and effective implementation for the site.

Internet Access: EduNets New Mexico School Districts
(at end of fiscal year)

	# K-12 Sites with Internet Access	Sites with Direct Access	Site Internet Workstation with Dial-up Access	K-12 Internet Training Labs
FY95	33	7 (56Kb)	26	0
FY96	86	26 (21 - 56Kb; 1-2MB; 4 T-1)	60	16
FY97	117	55 (48 - 56Kb; 1-2MB; 6 T-1)	62	31

A primary goal is to assist schools to establish working and reliable Internet access.

In FY95, dial-up accounts and e-mail accounts were provided or obtained primarily through LANL and commercial and state Internet providers, sometimes with long-distance rates and poor access, or at high cost to the providers or the district. In FY96 and FY97, we made special efforts to work with hubs and districts to set up modem servers for local dial-ups and mail servers with accounts for IEWG members. Now, for many of our sites, dial-up access is a local call through their district or college hubs. This year approximately 30 sites were able to move up from dial-up to a direct line and approximately 30 new sites were able to get dial-up access.

Encouraging Future Self-Reliance for Sites - Internet Education Working Groups, Site Support Teams, and Technical Support Teams — Another primary goal is to form school, district and regional Internet working groups, technical support teams, and training teams. The "advance" teams for the school districts are made up of teachers, administrators, and technical support staff recommended by the district offices. These teams are provided temporary dial-up accounts, basic workshops, and on-site training during the networking development phases and as the district Internet connections and infrastructures are installed. As district or school Internet training labs become operational and as direct lines and wide-area networks are established, the support teams take over the roles of training and site support. As sites and districts go "on-line" and their LANs and WANs are established, the site support teams are our primary contacts and we work with them closely on-site. After the sites are connected, they contact us when they need special help or advice via electronic mail or by phone and much of our support can be done remotely while we are working at other sites. This "phased" support shift helps us balance our work load and provides the sites with the basic skills needed to promote site self-reliance and independence. This way, we are able to add new districts while still providing emergency and ongoing assistance to districts in progress.

Community working groups have representatives from the school districts, the colleges and other Internet support hubs, and volunteers from other community organizations like the libraries, Indian Pueblos, and government agencies. We try to hold periodic meetings and workshops for these groups and encourage them to meet independently.

Over 800 teachers and administrators are actively involved now in our regional and district educational working groups for Internet training and support. Internet Education Working Groups (IEWGs) and Internet support teams have been formed in all of the participating districts and at hub sites. Direct participant data collected to date indicates that approximately 44% of IEWG teacher, staff, and administrator participants are male, 56% female, and approximately 51% are in national minority populations. Based on data gathered from 662 participants, approximately 54% are classroom teachers, 26% administrators, 13% technical support staff, 6% librarians, and 1% counselors.

Regional Training and Support Centers — We work with interested local community colleges and university sites to help them develop support and training centers and staff for their regions. These sites become valuable "Internet resource hubs" for their communities.

In order to ensure future support and assist with staff training, we are currently working with 19 sites (eleven community colleges, two departments of education, two partner support programs, and four technology centers) to establish training labs, regional servers, and-support bases or hubs for their regions. We have formed partnerships with these sites to help develop the support and training centers for local school districts and to combine and coordinate efforts and networking support for the schools in their regions. We provide support for these sites and provide regional training, access, and resource servers at some of the sites for our school districts.

EduNets Regional Training Centers — Hubs (End of Fiscal Year)

	No. Regional Sites	Internet Connections	Internet Labs
FY95	5	2 direct 56Kb, 3 dial-up	4 at 2 centers
FY96	13	5 direct T-1, 7 direct 56Kb, 1 dial-up (CIT)	19 at 8 centers
FY97	19	9 direct T-1, 9 direct 56Kb, 1 dial-up (CIT)	34 at 15 centers

Current sites include: UNM-Gallup, Gallup, NM; Crownpoint Institute of Technology, Crownpoint, NM; Northern New Mexico Community College (NNMCC), Española, NM; Northern New Mexico Community College (NNMCC), El Rito, NM; Navajo Community College (NCC), Shiprock, NM; Navajo Community College (NCC), Tsaile, AZ.; UNM-Zuni, Zuni, NM.; Laredo Community College, Laredo, TX.; the Jicarilla Apache Department of Education (JADE), Dulce, NM; La Plaza Telecommunity, Taos, NM; the Technology Learning Center (TLC), Santa Fe, NM; the Kirtland Technology Center (KTC), Kirtland, NM; Cooperative Education Services, Albuquerque, NM; the National Indian Telecommunications Institute (NITI), Santa Fe, NM; Western Oklahoma State College (WOSC), Altus, OK; and the New Mexico State Department of Education, Santa Fe, NM. This year we helped with networking design, server and network support and software installations, upgrades, and/ or lab setups at WOSC, NITI, NNMCC, UNM-Gallup, UNM-Zuni, NCC-Shiprock, the Santa Fe TLC, the

Kirtland KTC, and the JADE Jicarilla Community Education Center. We use those labs for our regional teacher training sessions and meetings.

In all centers, other DOE, government, and college programs have used the labs for classes using the access almost immediately after they are set up. We provided support, help set up initial accounts, and provided training for the faculties and staff at the college campuses and assisted with planning classes now offered at three of the college hubs. We also partnered with the community colleges on several funding proposals for helping the school districts and the communities in planning and implementing networks.

Schools in the projects' districts in New Mexico alone are now spread out over 28,000 square miles and many of the areas are very remote and hard to reach, but the establishment of the central training centers enables us to get teachers from the district together for workshops and meetings. This has proved very helpful.

Teacher and Staff Training and Support — A program goal is to provide on-site and regional training support for school technical support teams; basic training workshops (i.e. web overview, browsers and tools, electronic mail) for all IEWG members; and advanced technical training opportunities for the district support teams (i.e. NT, Novell, web, and e-mail server support training; HTML, education applications, troubleshooting, networking, and security training). We provide advanced initial training workshops for site support teams and help the training support teams provide workshops for all teachers and staff when they get direct connections established. Through the EduNets program, we provide training for teachers, staff, and administrators on using systems, software, and resources for education.

On-site training and small group instruction was provided for staff and teachers at more than 90 school sites and regional support centers. In addition to on-site technical support team training, we held 44 regional workshops and district inservices this year; 13 half-day, 13 one-day, 17 two-day, and one 5-day workshop. Our workshop topics are selected and the workshops are designed or selected each quarter based on participating districts needs. We held several workshops in sets - seven mini-conferences - this year. Sessions are primarily hands-on and are held in Edunets hub training centers or school labs. Class size ranges from 5-30. Participation this year included 572 workshop participants from 39 districts and hubs.

Workshop topics for FY97 included Basic Novell 3.12 , Advanced Novell 3.12 , Basic Novell 4.1, Advanced Novell 4.1, NT Network Administration, Introduction to Networks, Networking Fundamentals, Internet Research for Educators, HTML - Designing and Developing Web Sites, Internet Overview and Electronic Mail, Computer Assembly and Internet Software Installation and Use, and Basic Internet for Educators. Instructors for workshops are drawn from LANL and our hub sites. Instructors this year included: Paxton Robey, NNMCC; Chris Holden, UNM-Gallup; M'Hammed Jebannema, JADE; Kurt Trahan, CNE, CES; Jerry Lopez, CIC-4, LANL; Ken Brown, CIC-2, LANL; and, Pat Eker, CIC-6, LANL.

Technology conference presentations and support this year included the K-12 Networking Conference, Consortium for School Networking (COSN),Washington, DC, and the Four-Corners Technology Conference, Shiprock, New Mexico, March, 1997. We also participated in the Western Oklahoma State College distance learning demonstrations for their Technology Building Dedication and Open House and did Internet video-conferencing demos with some of our New Mexico sites in September. We estimate that a total of approximately 350 participants attended our sessions at these events.

Education Resources and Research Support — Another EduNets goal is to provide education resources support. We have continued to provide networking support and consulting for the New Mexico State Department of Education and we also continue to work with other regional support agencies in New Mexico to better coordinate support services and efforts.

We are working with eleven community colleges and university sites to help develop support and training centers for their regions (listed above). Part of our arrangement with the districts and hubs in the Edunets program is that, as we help them complete implementation phases, they help provide dial-up access, server space, and/or use of training facilities that we help them set up for helping nearby new districts just starting in the program and help us test and evaluate new software and hardware configurations.

Other education support sites and community support partnerships include the New Mexico State Department of Education, Santa Fe, NM; the Technology Learning Center, Santa Fe, NM; LaPlaza de Taos Telecommunity Foundation, Taos, NM; the Golden Apple Foundation, Albuquerque, NM; the National Indian Telecommunications Institute, Santa Fe, NM; Cooperative Educational Services (CES), Albuquerque, NM; the Jicarilla Apache Department of Education, Dulce, NM; and the Kirtland Technology Center, Kirtland, NM.

Research and testing of networking software and hardware, video conferencing, and electronic mail servers at our sites is established based on specific needs, product availability, and readiness; the information we gain is then passed on to other sites and compiled for site documentation. We have provided both hardware and software companies information that has led to modifications that have improved educational use. We have continued to provide direct support for developing educational resources for access like the Solar System Tour available through the LANL WWW homepage.

Many of our school districts have expressed an interest in using Internet video and audio conferencing as they pursue their Internet connections and develop their long-range technology plans. We have started three evaluation teams for testing and providing feedback on Internet conferencing software in three areas: teacher and administration team communications, homebound teaching and interaction, and conference presentations (6 districts and 5 college hub sites). A variety of connection methods - dial-up, 56Kb, and T-1 access - are also being tested for each

conferencing package and application. We have also established a reflector on a SUN workstation for Edunets participants to use and plan to establish another at NNMCC.

A variety of reference books were also distributed this year to IEWG members for review and basic reference sets are being provided to school district libraries for use by their support team and other teachers and students.

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. The resources available through the websites of all of the National Laboratories, the United States Department of Energy, the U.S. Department of Education, NASA, other federal sites, and state departments of education have been pointed out to teachers and administrators at all of our hubs and districts. 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. Other national laboratory and university outreach programs are following us into districts, using the new site capabilities for communications and to provide access to program resources and information. We have provided technical education support for other LANL initiatives involving school sites and we were requested again to partner with several new projects this fiscal year.

Ultimately, these resources will produce students that are better educated in all areas of science and math, but especially in computers and networking. These students will be potential future employees of LANL.

EduNets — New Mexico K-12 Public School Districts

Aztec Municipal Schools
Bloomfield Public Schools
Central Consolidated Schools
Chama Valley Independent Schools
Cuba Independent Schools
Dulce Independent Schools
Española Municipal Schools
Gallup-McKinley School District
Jemez Mountain Public Schools
Jemez Valley Public Schools
Las Vegas City Public Schools
Las Vegas West Public Schools
Mesa Vista Consolidated Schools
Mora Independent Schools
Pecos Independent Schools
Peñasco Independent Schools
Pojoaque Valley Public Schools
Questa Independent Schools
Santa Fe Public Schools
Taos Municipal Schools
Zuni Public Schools
Farmington Municipal Schools*
Las Cruces Public Schools*
Los Alamos Public Schools*

* Partial Support: 1-2 School Research/Support Sites

EduNets — New Mexico K-12 Nonpublic Schools

McCurdy High School, Española
Pine Hill Schools (BIA), Pine Hill
Rio Grande School, Santa Fe
Santa Fe Preparatory School, Santa Fe
Shiprock Alternative School, Shiprock
St. Bonaventure Mission Schools, Thoreau
St. Francis School, Dulce
To'Hajilee Community School (BIA), Canoncito
Wingate Schools (BIA), Wingate

EduNets — Other K-12 Public School Districts

Laredo Independent Schools, Laredo, TX
United Independent Schools, Laredo, TX
South Conejos Schools, Antonito, Colorado
Frederick Schools, Frederick, OK

University Sites and Community Colleges

Northern New Mexico Community College, Española, NM
Navajo Community College, Shiprock, NM
UNM-Gallup, Gallup, NM
Navajo Community College, Tsaile, AZ
UNM-Zuni, Zuni, NM
Crownpoint Institute of Technology, Crownpoint, NM
NM Highlands University, Las Cruces, NM
Laredo Community College, Laredo, TX
Northern New Mexico Community College, El Rito, NM
College of Santa Fe, Santa Fe, NM
Western Oklahoma State College, Altus, OK

Other Education Support Sites and Community Support Partnerships

New Mexico State Department of Education, Santa Fe, NM
Technology Learning Center, Santa Fe, NM
LaPlaza de Taos Telecommunity Foundation, Taos, NM
The Golden Apple Foundation, Albuquerque, NM
National Indian Telecommunications Institute, Santa Fe, NM
Cooperative Educational Services (CES), Alb., NM
Jicarilla Apache Department of Education, Dulce, NM
Tops, Pueblo, Navajo Nation, and Laredo Energy Research Programs, LANL, Los Alamos, NM

Additional K-12 Schools — 1997 Workshop Participation

Blair Schools, Blair, OK
Duke Schools, Duke, OK
Eldorado Schools, Eldorado, OK
Granite Schools, Granite, OK
Navajo Schools, Navajo, OK
Olustee Schools, Olustee, OK
Dzilth-NA-O-DITH-HLE (BIA), Bloomfield, NM
Jemez Day School (BIA), Jemez Pueblo, NM
Native American Prep, Pecos, NM
San Juan Day School (BIA), Española, NM
Santa Clara Day School (BIA), Española, NM
Santa Rosa Public, Santa Rosa, NM
St. Catherine's Indian School, Santa Fe, NM
Red Mesa Schools, Red Mesa, AZ
Shonto Schools, Shonto, AZ

Projected Impact or Scope for Internet Connections
Impact EduNets New Mexico K-12 Public School Districts
and
Non-Public Schools

EduNets Program Scope — New Mexico School Districts August 1997 Updates	Projected Scope/Impact:				
School Districts	# Schools	# Students	# Teachers	# Communities	# Square Miles
Public Schools:					
Aztec Municipal Schools	6	3,383	200	1	413
Bloomfield Schools	8	3,468	209	1	1,508
Central Consolidated Schools	15	7,357	446	5	2,819
Chama Valley Independent Schools	6	626	42	3	1,178
Cuba Independent Schools	3	746	50	1	1,764
Dulce Independence Schools	3	700	47	1	1,294
Española Municipal Schools	14	5,129	297	1	712
Gallup/McKinley County Schools	31	14,225	815	10	4,957
Jemez Mountain Public Schools	6	459	33	4	1,655
Jemez Valley Public Schools	3	526	40	1	1,115
Las Vegas City Public Schools	8	2,827	155	2	1,261
Las Vegas West Public Schools	9	2,171	128	3	3,065
Mesa Vista Consolidated Schools	5	630	36	3	1,740
Mora Independent Schools	3	777	47	1	753
Pecos Independent Schools	3	905	54	1	383
Peñasco Independent Schools	3	776	47	1	262
Pojoaque Valley Schools	4	2,018	110	1	309
Questa Independent Schools	6	714	41	1	659
Santa Fe Public Schools	27	13,373	756	2	1,016
Taos Municipal Schools	8	3,490	175	4	637
Zuni Public Schools	5	1,756	109	1	506
Non-Public Schools:					
Pine Hills Schools (BIA)	3	472	70	1	(Boarding)
Santa Fe Preparatory School	1	294	43	(1)	(Subset)
Santa Fe Rio Grande School	1	120	14	(1)	(Subset)
Shiprock Alternative School	1	330	53	(1)	(Subset)
St. Bonaventure Mission Schools	3	285	16	(1)	(Subset)
St. Francis Elementary School	1	80	4	(10)	(Subset)
To'Hajilee Community Schools	1	376	35	1	(Est. 250)
Wingate Schools (BIA)	2	1,265	81	1	(Boarding
Other NM Research Sites	5	3,448	212	3	(Est. 125)
Totals	194	72,726	4,365	54	28,381

C. Systems Modeling for Education

Program Description

The Systems Modeling for Education (SME) Program is an initiative to create a computer-based learning tool that will allow middle and high school students to construct a computer model of a physical phenomenon, such as heat transfer, and simulate the phenomenon, compare simulated results to real world data, investigate the mathematics of modeling the science, consider the effects of the assumptions within the simulation model, and research the history of accumulated understanding of the phenomenon. Teachers and students will have access to classroom-tested curriculum and an array of laboratory, home, and simulated experiments by which to move through the core concepts underlying the current understanding of a physical phenomenon.

The ability to simulate an experiment has many advantages. It supports classroom science experimentation in schools with limited funding for laboratory materials. It allows for comparisons between the real-world and simulations. It provides access to the mathematical description of the phenomenon as well as the simulation. It facilitates the consideration and discussion of the underlying assumptions and limitations of computer modeling, and it allows for the study of phenomena which happen too quickly, too slowly, or are too hazardous to be practical in a school laboratory.

This innovative technology is based upon extensive research that suggests students can best develop their abilities to understand and apply core science concepts by creating a model, conducting appropriate work-bench activities to gather experimental data, analyze the parts of the model and their relationships, and refine the model for new applications. The SME technology will embed learning objectives "in context" providing both the teachers and students with a set of unique technology tools to support effective classroom teaching and learning.

The physical phenomenon of heat transfer continues as the initial topic for development. Heat transfer is particularly well suited as an initial topic because it is frequently misunderstood by students and teachers alike. Other topics under consideration for future modules are acoustics, light and optics, electricity, ionizing radiation, etc.

Goal

SME is a research and development project that will enhance science and mathematics teaching and learning by producing an innovative computer-based technology that supports increased student understanding of physical science concepts, principles, and their applications.

Implementation

Work continued during FY97 in several ways. Laboratory computer scientists continued the development of the core JAVA structure and data

exchange protocols. The material properties and units of measure database structure was designed, implemented, and tested. A prototype graphic user interface to access the materials and units of measure databases were developed and tested. The graphic user interface workbench area was prototyped and the software made ready to receive and present comparisons of simulated and real-world data. And finally, software modules were developed to support animation, videography, and sound to dynamically present simulation results and visually/audibly present a diverse range of information on the physical phenomenon of heat transfer.

However, FY97 strategic planning produced two significant shifts in this project: 1) a focus on software development and 2) a redirection of the application for use on the World Wide Web. Since the original concept of the SME project was developed, advancement in computer speed, storage capacity, and access to the World Wide Web have increased so markedly that the original distribution plan became obsolete. For the widest range of students and teachers to have ready access to this unique education tool, the World Wide Web is the place for SME. The SME Site will be a unique place to go for physical science knowledge, curriculum, and laboratory, home, and virtual (simulation) experiments.

Evaluation

In FY97, program evaluation was limited to internal review of software development, the reconsideration of the long range application distribution, and the restructuring of the program to meet new long range objectives and evaluation. Self-evaluation of the program and its developmental history with teachers and students suggested that a significant change was necessary in the program's direction while the core concept remains sound.

The software development proceeded well with the completion of most of the core components including: (1) the material properties and units of measure database structure; (2) a prototype graphic user interface to access the materials and units of measure databases; (3) the graphic user interface workbench area was prototyped and the software made ready to receive and present comparisons of simulated and real-world data. Software modules were developed to support animation, videography, and sound.

The reconsideration of the long range application distribution resulted in a shift from commercial distribution on magnetic or laser media to dissemination over the World Wide Web and on laser media for more remote schools. Many laboratories, universities, and the DOE have "educational sites" on the Web, but none offer the dynamic and diverse pedagogy on the fundamental physical science concepts which form the foundation of advanced scientific investigations world wide.

The restructuring of the program to meet new long range objectives will result in the SME Site being unique in its application of national laboratory technology to the presentation of core scientific concepts with the curriculum to teach them. Students can construct a computer model of a physical phenomenon, simulate the phenomenon, compare simulated results to real world data, investigate the mathematics

modeling the science, consider the effects of the assumptions within the simulation model, and research the history of accumulated understanding on the phenomenon. Teachers and students can access classroom-tested curriculum and an array of laboratory, home, and simulated experiments by which to move through the core concepts underlying the current understanding of a physical phenomenon.

D. Robotics Challenge Workshop

For three years Los Alamos National Laboratory has conducted a Robotics Workshop, intended to introduce school students to the accessible BEAM (a multiple use acronym, with one meaning being "Biology, Electronics, Aesthetics, and Mechanics") technologies. For the most part BEAM concepts include reusing discarded electronics, and solar power, and the kits provided for the workshop are designed around these premises.

1995 and 1996 BEAM Workshops (Review)

For the four days, May 4-7 1995, we conducted a BEAM Games and Workshop. During the workshop we had more than 250 youths participating, most with their parents. In the course of the four days we gave away more than 120 kits (at two students per kit). Although the competition side was sparse, the mini-competitions among the local builders was exciting.

In order to reach more potential roboticists, in 1996 we held a 3 day workshop (April 18-20) for over 65 junior high, high school and college students. Many students were complete beginners, and started with the simple solaroller kit. Others, with more experience, began with the two motored photovore, that uses sensors to chase the light around. A few advanced students got to build the Hextile Walker. It was heartwarming to be in the large workshop room, and see and hear the buzz of excitement as students bent over their robotic kits, soldering, gluing, and designing.

1997 Workshop

The BEAM Robotics Workshop had a great 3rd year. We had over 70 youth put together several hundred robotic "creatures", from wheeled rollers to flapping insects. The number of minority groups involved in the construction increased, both gender and race. We are excited by the number of young women that are recognizing that they can have a career in robotics or electrical engineering. For the second year in a row we held the workshop in a Los Alamos Schools Facility. Again we found this works well. We had a graded series of robotic kits for the participants to build, from simple solarollers and solarflappers to rather sophisticated walking robots. On the third day of the workshop we had competitions/demonstrations, in which robots built during the workshop were able to compare their efficiency and ability against other workshop robots.

The informal robotics group has held several workshops throughout northern New Mexico, instigated by previous participation in the BEAM Workshops. Schools throughout the area are purchasing BEAM kits.

E. International Conference on Technology and Education

The Laboratory, in partnership with the University of New Mexico will co-host the 15th Annual International Conference on Technology and Education (ICTE) in Santa Fe, New Mexico from March 8 – 11, 1998. The Santa Fe Institute and the New Mexico Institute of Mining and Technology are also hosting sponsors. ICTE 1998 will focus on A Worldwide Network of Learning: Opportunities, Challenges, and Contrasts.

ICTE provides a forum for both educational futurists and pragmatists, and looks at alternative processes, procedures, techniques and tools for creating learning environments appropriate to the twenty-first century. There will be ten sub-themes, each examining a particular aspect of developments and progress. For the past fifteen years, ICTE has attracted participants from every sector of our worldwide educational community, including teachers, professors, researchers, trainers, administrators, and resource providers (curriculum developers, publishers, and suppliers). Participants typically come from as many as 55 countries.

As a co-host, the Lab has a major role in the planning, organizing, and execution of the event. A major aspect of the conference preparation is participation on the program committee and the reviewing for acceptance of over 450 abstracts. After paper selection, grouping of papers and marrying with appropriate keynote speakers is essential to highlight the technologies involved and ensure a strong thread for science education.

F. Program Technology Support

Description

Program Technology Support creates and maintains an electronic infrastructure and telecommunications environment to support the collaborative networks required by the Science Education Programs offered at Los Alamos National Laboratory. Ongoing technology support is necessary for LANL to continue to offer quality science education programs that include real and ongoing interaction with Laboratory scientists and technicians to an audience primarily located in rural New Mexico, and an increasing national audience, as well. New Mexico is a rural state, and in order to ensure program success, 80% of LANL science education programs utilize electronic technologies. Telecommunications allow program participants to conduct collaborative research with Laboratory scientists; exchange and compare data; maintain communications among students, teachers, scientists and Laboratory education specialists; and make information about Laboratory research available to the educational community locally, as well as nationwide.

Impact

In FY97, Los Alamos National Laboratory's science education programs reached over 350 teachers and students throughout the state of New Mexico and the Southwest. LANL conducted many programs that addressed

complex national issues tied to the DP Mission. The Critical Issues Forum, for example, involved nine high schools, fifteen teachers, and one hundred fifty students around the state of New Mexico in the study of the Laboratory's 'Global Nuclear Visions Project'. Sixty-five New Mexico middle school teachers in the TOPS program conducted weather research to aid in the determination of an astronomical study center. Sixteen high school teachers participated in the TEAM program working collaboratively with Laboratory personnel to develop computer models and to increase knowledge in the modeling process. Students in the PAYS program utilized computer technology to investigate their assigned areas and to produce multi-media presentations for use in the Bradbury Science Museum.

Goals and Objectives

The goals and objectives of this program are to

- continue an ongoing technological infrastructure to support LANL science education programs;
- integrate computers and telecommunications into science and mathematics instruction;
- model appropriate use of educational technology in science and mathematics classrooms and pursue evidence of effective practice;
- provide appropriate training to all LANL program participants: students, teachers, Laboratory mentors, and LANL science education program coordinators;
- provide teachers and students, locally, state wide and nationally with access to Laboratory technical resources and information;
- maintain constructive and productive partnerships among teachers, students, university staff members, Laboratory technical staff and education specialists through electronic communication;
- increase interest in and enthusiasm for science and mathematics.

This program supported the Laboratory's mission (Reducing the Nuclear Danger), science-based stockpile stewardship to advance scientific methods and technologies that include highly reliable computing capabilities and secure networks. Program Technology Support applied these Laboratory technologies (used to support the DP Mission) to education by

- allowing teacher and student involvement in science education programs dealing with highly-technical Laboratory research and information that would be impractical without a strong telecommunications capability;
- increasing involvement of educational communities locally and nationwide in Laboratory science education programs by utilizing telecommunications to disseminate program related information;
- increasing dialogue between Laboratory and educational communities by providing a conduit for scientist to interact with teachers and students;

- providing a technology environment where telecommunications and computer technologies can be introduced, developed, applied, and tested to enhance program effectiveness.

Implementation

Program Technology Support provided a link to Laboratory scientists through the creation and maintenance of an electronic support network. This network includes: (1) a web server; (2) electronic mail; (3) a research component, (4) technology training; (5) data base for sharing of information, and (6) links to relevant Laboratory research. Four FY97 programs in particular - TOPS, TEAM, PAYS, and the Critical Issues Forum - illustrate the crucial role of technology in LANL's science education programs. These programs would not be practical or cost effective without the telecommunications component. A centralized platform within a technology environment used for development and exchange of educational information allows these programs to be a presence in the rapidly evolving educational technology arena.

Evaluation

The Technology Support Program worked closely with all LANL programs to model an effective educational technology environment. Each program that was impacted by Technology Support conducted its own evaluation which included metrics for how the technology was used. Evaluation is being designed to identify the functional aspects of this support program. These are tied to two areas: How programs effectively use and model technology, and how the technology is used and modeled by teachers. Beginning in FY98, we will (1) look at the effective use of computer networks; (2) conduct effective research utilizing electronic data bases, (3) troubleshoot and maintain computer hardware, and (4) plan and implement effective educational technology.

G. Equipment for Education Program

Description

The Equipment for Education program was developed to meet the technology needs of specific science education programs sponsored by the Laboratory. The 1993 Presidential Executive Order 12812 requiring all federal agencies to give the highest preference to K-12 schools in the transfer or donation of excess Laboratory equipment allowed the Laboratory to create the Laboratory's Gift Program.

Goals

While the Laboratory Gift Program makes available equipment to New Mexico schools through an MOU with the New Mexico State Department of Education, the Equipment for Education program was developed to meet the technology needs of specific science education programs sponsored by the Laboratory. The goal of the program is to meet the technology needs of

science and technology education programs at the Laboratory through the gifting of equipment, particularly computers, that are excess to the Laboratory's needs.

Objectives

The program is intended to provide schools with equipment, such as computers, that will create instructional opportunities for K-12 classrooms. Such opportunities allow for

- teachers and students to communicate with each other and with Laboratory staff, thereby helping to reduce the isolation so prevalent in northern New Mexico;
- the contribution of field data for specific program research, thereby enhancing the quality of math/science education; and
- the understanding of Laboratory research and technology.

Impact

In 1997, the Laboratory's Science Education programs provided excess equipment to 72 teachers in 46 schools across 19 New Mexico school districts. Equipment, primarily computers, was provided through the K-12 Equipment for Education program to schools that have participants in five Laboratory sponsored science education programs statewide. Working within the Laboratory's Equipment Gift Program, we provided excess equipment gifts to the schools of participants in science and technology education programs as follows:

Critical Issues Forum (CIF)
1 personal computer, 3 printers, 1 scanner
Value - $8860.80
3 Schools in 3 Districts - 3 Teachers

Navajo Translation Project
5 personal computers
Value - $13,110.86
5 Schools in 5 Districts - 5 Teachers

TOPS '97 (TOPS, RTEP, Science 2000)
65 personal computers
Value $203,533.19
39 Schools in 15 Districts - 63 Teachers

TOTALS

Total # of Teachers	72
Total # of Schools	46
Total # of Districts	19
Total # of Districts Out of State	4
Total # of Programs	5
Total Pieces of Equipment	75
Total Value	$225,504.85

In designing the FY97 program, we developed a component that allowed us to use students to troubleshoot and configure the computers and accessories, and to provide training and technical assistance for program participants who received the equipment for their schools. We were able to hire an undergraduate student with advanced technology expertise who was also a teacher. He made a significant contribution not only to the program but also to other Science Education Team activities. A second undergraduate student became his apprentice to learn how to service the equipment. This arrangement was successful for both the teacher and the apprentice, and provided the program a very important function that has consistently contributed to its quality.

A secondary impact of this program will be a study proposed by the technology student to evaluate the ways in which excess Laboratory equipment can be used in a technology laboratory where students can learn about electronics, computer repair, and computer maintenance. This study will provide important data on how students at the high school level learn technical aspects of computer work and how we prepare them for technical careers.

Implementation/Evaluation

The goals and objectives of the Equipment for Education Program are achieved through its alignment with the technology goals and objectives of individual programs, and ensuring that program participants are involved in activities that reflect the science and technology of the Laboratory. In addition to providing individual programs with equipment, program participants receive technical assistance in the form of training in the use and maintenance of the equipment, as well as pedagogical strategies for classroom use, how to use bulletin board systems and various networks, and how to access and appropriately navigate the Internet.

Evaluations of the effectiveness of the use of this equipment are embedded in the evaluation plans for each program in which equipment is gifted. In general, this involves looking at how computer/technology applications support program goals, contribute to teachers' and students' computer networking capability, enable program participants' technological skills development and literacy, and contribute to a district's overall technology plan.

Evaluation of the study will be conducted as a separate spin-off activity.

V. PUBLIC UNDERSTANDING OF SCIENCE

A. Practical Applications for Young Science Communicators (PAYS)

Program Description

Practical Applications for Young Science Communicators (PAYS), a program for high school students, has the unique opportunity to address two pressing issues: improving public understanding and awareness of science (public literacy) and tapping the talents of the "second tier" of students. Students in the "second tier," that is, students who do not choose to pursue graduate education or careers in science, represent a wealth of untapped talent in linking science and "real life" in ways that will make science important and accessible to the general public. As the rate of change in science accelerates, the public will increasingly rely on communicators who can translate cutting-edge science into understandable terms and demonstrate its relevance to everyday life. The public will receive most of their information about science from the media, museums, and libraries.

PAYS brings high school juniors and seniors interested in science and communication to the Laboratory for a semester session and a summer session to learn science and practice science communication skills. PAYS culminates in the production of a communication "product", which in the past has consisted of articles published in area newspapers; a museum exhibit, "Living with Radiation", at the Bradbury Science Museum: a multimedia project on radiation that was distributed to museums, libraries, and other educational institutions throughout the state; a series of hands-on demonstration activities that will be used at the Bradbury Science Museum to educate the public on the concept of "sound"; a CD-ROM on the use of benthic macroinvertebrates in water quality analysis that will be distributed to interested teachers throughout the state; and the creation of World Wide Web (WWW) page for the Laboratory's Teacher Research Associates (TRAC) and Nonproliferation and International Security-Teacher Enhancement (NIS-TEP) teacher programs. In FY97 the students created an electronic newsletter, and activities for the Bradbury Science Museum "tech room".

PAYS has an excellent track record of helping fulfill the DOE's Office of Defense Programs mission to "apply the unique resources of our national laboratories and facilities to improve understanding of science, mathematics, engineering, and technology." PAYS also takes advantage of unique LANL resources: Los Alamos has an excellent forum for public communication in the Bradbury Science Museum, which receives more than 120,000 international visitors yearly. In addition, PAYS taps LANL's cadre of experts in the field of science communication.

During the 1997 PAYS program academic year component, students learned and then practiced science communications skills working on Laboratory-related content such as making an Environmental Science electronic newsletter on the World Wide Web. In the 1997 summer session, PAYS students learned about Laboratory research in the area of Environmental Science.

Goals

Ultimately, the goal of the PAYS program is to increase public understanding and awareness of science. The objectives of the 1997 PAYS program were:

- to enhance students' communication skills in science;
- to increase students' knowledge of science;
- to increase students' knowledge of science communication careers.

To meet these objectives, during the academic year students received instruction in how to improve their skills in written, graphic, and multi-media science communication and learn and practice effective teaming skills. During the summer, PAYS students worked as communications teams to create science communications products, (1) a series of hands-on activities that will be used at the Bradbury Science Museum "tech room" to educate the public on the concept of Environmental Science; and (2) an Electronic Newsletter on the World Wide Web (WWW).

Implementation

The 1997 PAYS Program consisted of two components: an after school, semester-long series of two-hour sessions, and a three week intensive summer session. While it is not required that students in the academic year program participate in the summer program, participation in the academic-year component is required for participation in the summer program. Because the program is not residential--participants must commute to/from the Laboratory--participants must live within a relatively easy driving distance of Los Alamos.

During the academic year, the students participated in a variety of activities designed to help them increase their knowledge and ability in communicating science to the public. Participants came from several area high schools: Los Alamos (2); Española (6); Pojoaque (3); Mesa Vista (1); Santa Fe(2). The majority of the participants in the academic year program were female (63%): 72% of the participants were Hispanic, 28% were Anglo.

Many Laboratory scientists, staff, and technicians worked with the PAYS students and discussed their work in the area of science communication during the summer program. While the academic-year component was designed to introduce PAYS students to important elements and skills of science communication, the summer PAYS sessions focused primarily on creating a science communication project. Participants came from several area high schools: Española (6); Los Alamos (2); Pojoaque (3); Santa Fe (2). The majority of the participants were female (63%); 72% of the participants were Hispanic, 28% were Anglo.

Evaluation

Several tools were used at various points throughout the PAYS program to ensure that the program continued to meet both programmatic goals and participants' expectations:

- The PAYS program design was assessed to ensure it reflected best-of-practice components before the program began and as the program was delivered. Program design was informed by a program profile template.
- The PAYS program was evaluated for its impact on: (1) student ability to communicate about complex science issues; (2) student knowledge of and interest in science content/issues, and; (3) student awareness of science communication careers at the Laboratory.

Data from pre/post Evaluations indicate that the PAYS program met its designated objectives. On a scale from 1="stongly disagree" to 5="strongly agree," the PAYS students responded as follows:

- "I gained new perspectives on how to communicate about complex science research/programs/concepts – 4.6
- "The PAYS summer program increased my ability to communicate about science" – 4.74
- ""The PAYS summer program increased my ability to plan and develop a communication project" – 4.34
- "I increased my knowledge of science" – 4.32
- "interest in science in general" - increased from 3.9 to 4.1 in pre/post program ratings.
- "Overall, how would you rate your PAYS summer experience" – 1.23, where (1="Excellent" and 5="Poor").

Anecdotal evidence confirms participants' positive experience with the 1997 PAYS summer program:

- "I gained knowledge, and a great experience!"
- "I changed my mind and now want to be a marine biologist or a scientist because I enjoy the type of work I did during PAYS."
- "I enjoyed the opportunity to learn about real science and the ability to increase my computer knowledge."
- I enjoyed working with HTML and learning HTML, plus I gained a better perspective towards science."

B. Science Education Information On-line

This Education Information On-line project maintains a World Wide Web (WWW) Server (http://education.lanl.gov/) for education program descriptions and content information from Los Alamos National Laboratory. We support the Education Program Office by maintaining updated information on the funded education programs for each fiscal year. The server also provides a central focus for all Laboratory information that might be of interest to the education community.

The principle objective of the project is to provide information to the DOE and the general public about the many education projects at Los Alamos National Laboratory. This is accomplished via the World Wide Web over the Internet. Additional objectives of the project are to:

- educate program leaders & participants on the WWW & Internet capabilities.
- assist programs in providing program content information via the WWW.
- provide training on how to maintain your own WWW and other Internet servers.
- assist K-12 education with the creation and maintenance of Internet services.

The project strives to work closely with all education programs at the Laboratory and has been able to support and complement other education projects. These efforts have also formed strong working relationships with K-12 schools in New Mexico and the New Mexico State Department of Education.

This ongoing information service is available 24 hours a day, 365 days a year. The server requires weekly maintenance but daily responsiveness to support the projects and participants who want to update their program information. Reports on the usage of the server during the current month are updated every day and are available for viewing over the WWW (http://education.lanl.gov/webstat.html)

Accomplishments in FY97

The project completed its third year and is currently serving an average of almost 2000 requests per day, representing an average daily transfer of over 30 Mbytes of data. During FY97 over 84,000 distinct hosts from over 102 countries have been served, and currently contains over 3000 files containing nearly 500 Mbytes of information. The top eight subject areas of interest on the server for FY97 are:

1. Science at Home
2. Education Program information & reports
3. NTEP 95 project information
4. Hydrogen Project
5. NM On-line Internet Institute (OII)
6. Critical Issues Forum
7. New Mexico Supercomputer Challenge information
8. Model-Nets project information

Several workshops were presented to a variety of K-12 education groups including the Southern New Mexico Technology Conference, the New Mexico Super Computing Challenge Kick-off meeting, the New Mexico State Department of Education, TOPS program participants, CIF program participants, and TEAM program participants. These presentations included:

1. A basic introduction workshop on HTML
2. The basics of technology in education.
3. Creating WWW servers using the Apple Macintosh
4. The Internet
5. Model Nets: A nation-wide study of networking in K-12 education

Continuous improvement to the system and server software were made in FY97. A major upgrade to the server software is planned for early FY98.

C. Hydrogen Education Outreach Activity

Program Description

The Hydrogen Education Outreach Activity at Los Alamos National Laboratory organized and implemented a special conference theme: **Hydrogen and the Materials of a Sustainable Energy Future,** at the National Educators' Workshop: Update 96, that took place October 27 - 30, 1996, at LANL. Funding for this activity came from the Hydrogen Program of the Office of Utility Technologies at the U.S. Department of Energy.

The National Educators' Workshop (NEW): Update 96 was held October 27-30, 1996, and was hosted by Los Alamos National Laboratory. This was the 11th annual workshop/conference aimed at improving the teaching of material science, engineering and technology by updating educators and providing laboratory experiments on emerging technology for teaching fundamental and newly evolving materials concepts. Sponsors included: U.S. Department of Energy, NASA, Norfolk State University -- Schools of Technology and Science (HBCU), and National Institute of Standards and Technology -- Materials Science and Engineering Laboratories.

Over 120 people participated in the conference activities. Conference attendees came from 23 states. Women and minority participants were well

represented. The hydrogen component of the conference was fully subscribed.

Goals

Goals of this special theme were:

- provide educators with up-to-date information about hydrogen production, storage, utilization, and related materials;
- stimulate classroom and informal educational opportunities in the development and diffusion of hydrogen technologies;
- complement the technical mission of the DOE Hydrogen Program; and
- satisfy one of the key mandates of Public Law 101-566 to accelerate wider understanding of hydrogen and to provide a broad approach for information exchange.

The hydrogen component of the NEW:Update 96 offered the opportunity for educators to have direct communication with scientists in laboratory settings, develop mentor relationships with laboratory staff, and bring leading edge materials/technologies into the classroom to upgrade educational curricula. Lack of public education and understanding about hydrogen is a major barrier for initial implementation of hydrogen energy technologies and is an important prerequisite for acceptance of hydrogen outside the scientific/technical research communities.

Conference Agenda

The Hydrogen Education Outreach Activity at LANL organized the following special component:

PLENARY

HYDROGEN -- THE FUEL OF THE FUTURE
James MacKenzie, World Resources Institute

EXPERIMENTS/DEMONSTRATIONS

NEW participants attended conference sessions in which speakers demonstrated experiments that can be duplicated in their classroom.

A MODELING CODE FOR EVALUATION OF HYDROGEN POWERED VEHICLES Salvador Aceves-Saborio, Lawrence Livermore National Laboratory and Norman Johnson, Los Alamos National Laboratory

EXPERIMENTAL INVESTIGATION OF HYDROGEN TRANSPORT THROUGH METALS Rob Dye and Tom Moss, Los Alamos National Laboratory

ELECTROLYTIC PRODUCTION OF HYDROGEN UTILIZING PHOTOVOLTAIC CELLS Mark Daugherty and Christine Zawodzinski, Los Alamos National Laboratory

MINI-WORKSHOPS

State-of-the-art technology at a major research facility was presented by Los Alamos National Laboratory technical staff members

MATERIALS FOR HYDRIDE BASED BATTERIES Ricardo Schwarz

HYDROGEN FUEL CELLS FOR UTILITY AND TRANSPORTATION APPLICATIONS Shimshon Gottesfeld

ENGINEERING MATERIALS FOR HYDROGEN SEPARATION Rob Dye and Tom Moss

Conference Related Deliverables

Experiment Notebook

The LANL Hydrogen Education Outreach Activity prepared and published an "experiment notebook" based on the papers presented at the National Educators' Workshop. In addition, supplementary materials, viewgraphs, and materials on safe handling of hydrogen were included. This notebook has been distributed to conference attendees and appropriate other mailing lists including faculty at universities and secondary schools as well as industry representatives and members of national and local governments. The notebook was completed January, 1997. These notebooks are available upon request to the Laboratory.

Scholarships

Twelve scholarships were awarded to teachers for attendance at the conference. This included leveraging of funds from the Science Education Program Office to increase attendance by New Mexico teachers in the hydrogen program -- many of whom work with minority students.

In addition, registration fees were paid for thirteen students from Los Alamos High School to attend the conference.

Non-Contracted Activities

The Hydrogen Education Outreach Activity took the initiative to develop several additional activities:

Web Site — A web site was developed by undergraduate volunteers in order to promote and provide conference materials prior to the event. All available papers and abstracts were put on the web. In addition, a "green links " page, containing links to other hydrogen, sustainable energy and/or environmental information, was created. The web site was updated immediately following the conference to serve as a stand alone information source. The Science Education Information On-Line Project at LANL assisted in the development of this WWW site.

Survey/Evaluation — The Hydrogen Education Outreach Activity worked with the National Center for Research on Evaluation, Standards and Student Testing at UCLA to create an on-line survey used to identify teachers' skills and knowledge of hydrogen technology.

WEB ADDRESS: http://education.lanl.gov/RESOURCES/h2

Web Conference — A real-time world wide web video conference for the hydrogen component of the National Educators' Workshop was conducted by LANL. Each program during the hydrogen component was captured through CU-SeeMe software (made available at no cost to any interested remote participant) and sent out through the Internet. Each conference site had an e-mail address, and many remote participants were identified and some communicated with us. Remote participants were encouraged to down-load conference papers and viewgraphs from the web site in order to better follow the presentations. This project was done in conjunction with the Education Networking Support team at LANL.

The Hydrogen Technology Kit (Solar hydrogen energy generation unit and radio-controlled fuel cell vehicle) — Staff members at LANL built a solar hydrogen energy generation unit that was demonstrated during the experiment section of the conference. The unit contained a photovoltaic array (built with government surplus solar cells obtained at no cost), an electrolyzer (machine tooled for easy and inexpensive duplication), and a hydrogen storage vessel.

As a way to demonstrate how the renewably generated hydrogen could be utilized, a small, radio-controlled vehicle powered by a proton exchange membrane fuel cell, built at LANL, was shown along with the hydrogen technology kit.

Solar cells are being sent to teachers who have indicated interest in building the hydrogen generation unit.

Local Educational Support— The Hydrogen Education Outreach Activity has been supporting an extra-curricular activity developed by Los Alamos High School. A group of chemistry students are meeting on a weekly basis to learn about hydrogen and prepare to build the hydrogen energy generation unit. We have presented lectures on fuel cells and hydrogen safety at the high school; e-mail messages are exchanged. We provide additional printed materials for the teacher -- which includes a curriculum outline **Make Your Own Energy** - specially developed at LANL. The students and their teacher attended the conference on scholarships.

Future Projects

Based on the above activities, the LANL Hydrogen Education Outreach Activity is developing the following two activities:

1. **Make Your Own Energy — A Proposal For A High School Curriculum**

   Concept
   A curriculum module on hydrogen technology and renewable resources will be aimed at high school students. Implementation of this module will involve development, design, evaluation, testing and distribution. The module will, in part, build on activities prepared for and presented at the NEW -- including mini-workshops and experiments/demonstrations for production and utilization of hydrogen as well as world wide web activities such as the home pages and Internet conferencing.

   During the NEW, a prototype solar hydrogen energy generation unit was displayed -- showing the educator participants how to build a small solar/hydrogen energy unit. This unit, utilizing a water electrolyzer powered by photovoltaic cells, was developed at LANL during Summer, 1996. Written instructions and drawings, viewgraphs, supply sources, etc. were provided to those who participated in the conference. It is our intention to expand this initial activity into the focal point of a curriculum module. "Make Your Own Energy" will be a multi-week activity that will give students a variety of resources and information about hydrogen and renewable energy systems -- with particular attention to production, storage, and utilization.

   A module production team will be created utilizing members of LANL staff as well as a curriculum developer that will be identified. Additional team members could come from industry, academia and/or other national laboratories. The team will also include high school teachers, and it is expected that a small number of participants from NEW could be involved.

   A curriculum outline, "Make Your Own Energy," was written and will act as an initial draft/guide for the development of the module. The module will address the issues of future energy usage and how new technologies can be utilized to create an energy economy that is more efficient and sustainable than current systems. The module will allow students to become familiar with additional choices for new technology applications now in early stages of testing and demonstration.

2. **Make Your Own Fuel/Drive Your Own Car — The Solar/Hydrogen Energy System And Vehicle Competition**

   "Make Your Own Fuel/Drive Your Own Car" is a proposal for a student competition. The unique premise of this new competition will be the generation and storage of hydrogen fuel as well as the construction of a hydrogen fueled radio controlled vehicle by teams of students. Students will not only build the fuel cell powered small vehicle, but they will also build the system that will supply the hydrogen fuel. The structure of the

competition will, in part, be modeled after similar educational activities sponsored by the Office of Transportation Technologies at The U.S. Department of Energy (DOE). Each competing team could be given solar cells, a hydride storage cylinder and/or a fuel cell. During the development phase of this project, competition guidelines and regulations along with instructional/educational materials and information about handling hydrogen safely will be prepared. Some of these materials will come from activities already completed by the Hydrogen Education Outreach Activity at LANL and the proposed curriculum. As with other competitions, each team will have a "mentor"' or technical supervisor such as a LANL staff member or an appropriate expert from research or industry. A competition planning group will be made up of teachers, LANL staff, liaisons from DOE, industry, and appropriate other representatives. This project will begin with a small number of teams (3-4) in order to carefully develop and grow the foundation, regulations, guidelines and cooperative relationships necessary for a larger, nationally based activity.

Both programs are designed as national activities. For the curriculum module, our intention is to utilize electronic methods of distribution for as much of the information as possible. Our primary goal is to disseminate this information easily and inexpensively. We plan extensive revisions and additions to the web site developed (by undergraduate student volunteers) last year for our preliminary conference. Printed workbooks and hands-on materials will be available through a centralized educational distributor. Because of its more complex and time consuming nature, the student vehicle competition will involve a smaller number of schools. The competition component will grow as the curriculum enters more schools. There will be prerequisites that any student team must first study the curriculum and also have a mentor.

These two activities are aimed at older high school students who already have some advanced science education. It is our intention to trigger further educational opportunities for these students either through university studies or technical/vocational training. We would anticipate a second phase in which the scope of information is broadened and activities would be designed for younger students. Based on our experience with our existing web site, there already is significant international interest in these subjects which could be expanded upon in the future.

It is expected these projects will take 18 months to implement. Once beta testing has been completed, national distribution will begin. Because of the changing nature of these technologies, we anticipate regular updates to be available.

Benefits

We believe these activities will have an impact on the way young people view their future. A curriculum and a student competition based on sustainable solar/hydrogen/fuel cell technologies would be new and dynamic tools to stimulate interest in science and environmental education and begin to prepare students for the challenges of the future.

In addition, these activities will involve scientists in experimental educational programs, present the U.S. in a leadership role of public awareness and education outreach, and develop public/private partnerships to encourage the advancement of science education and public outreach.

Program Development

Following the conference, the Hydrogen Education Outreach Activity has been actively engaged in program development. With the assistance of the DOE Hydrogen Program Office, we have identified contacts at the City of Palm Desert (California) and the College of the Desert. In the new fiscal year, we anticipate working with these and other outside parties in the development of the educational module and the vehicle competition mentioned above.

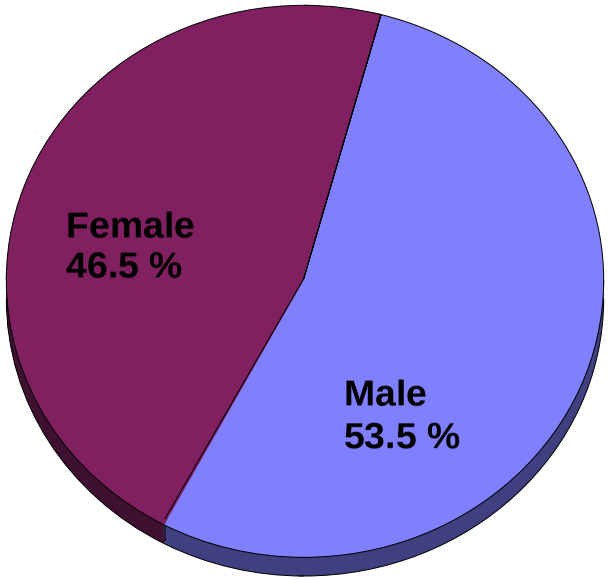
VI. STATISTICS

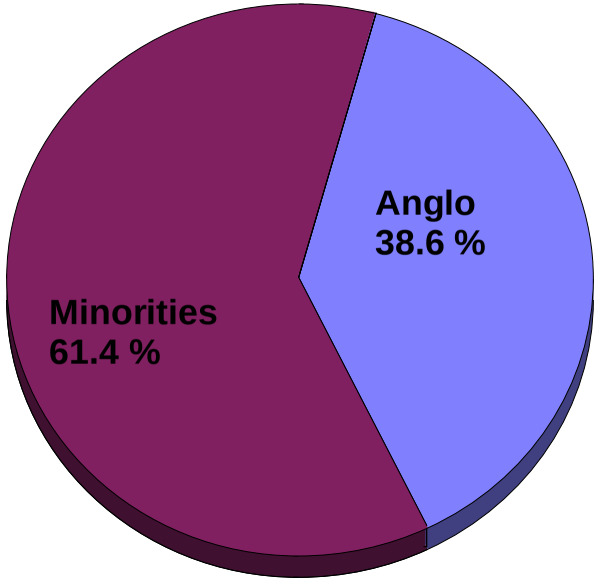
A. “Gender and Ethnicity Are Important Considerations in Our Programs”

B. “Diversity in Science Education Programs at Los Alamos”

C. “Diversity Statistics FY97”

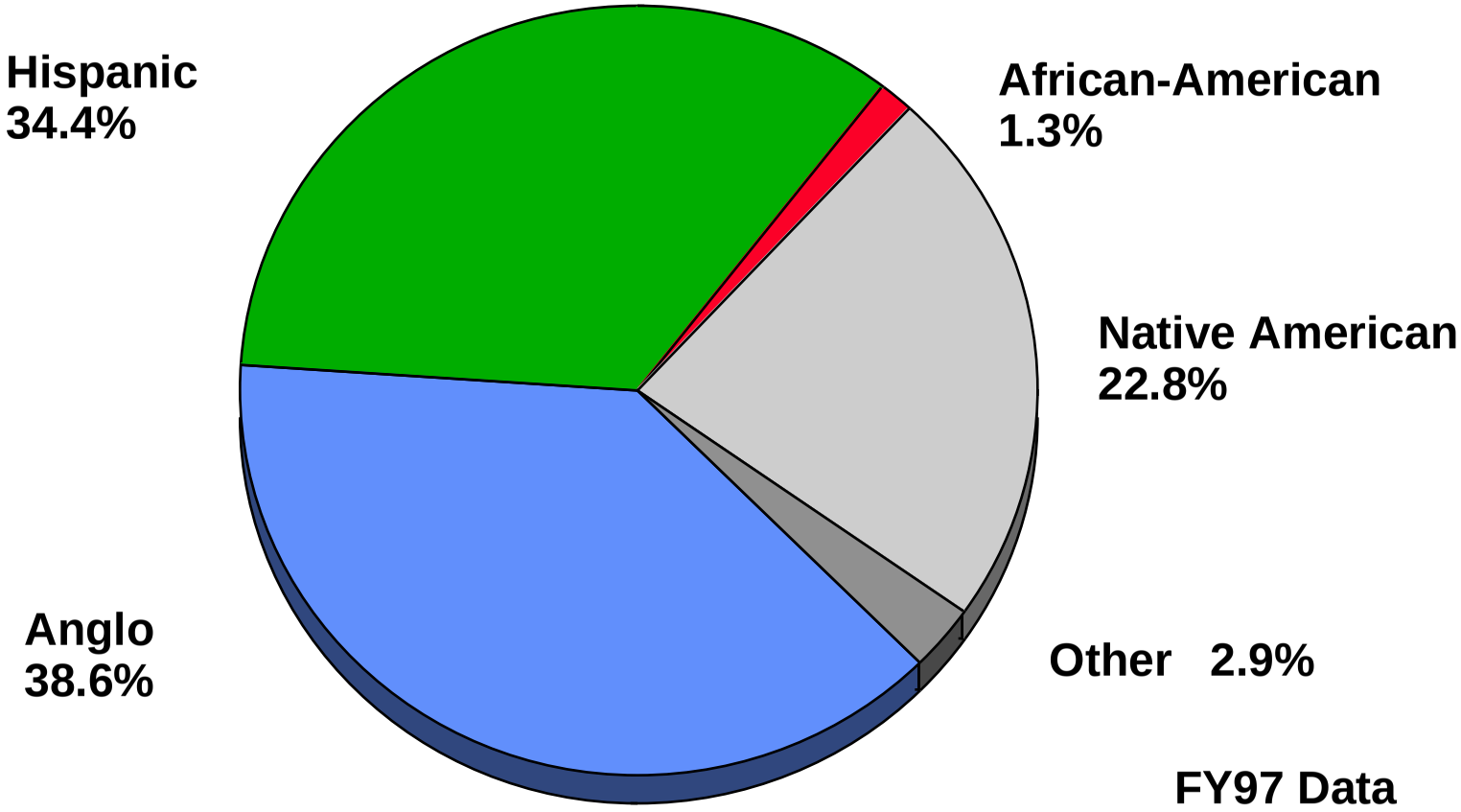
Gender and Ethnicity Are Important Considerations in Our Programs





FY97

Diversity in Science Education Programs at Los Alamos



Diversity Statistics FY97

Program	S/T	Total	Male	Female	Anglo	Hisp	Afr-Am	Nat Amer	Other	% Min	% Fem
K-12 Programs											
Teacher Opportun Promote Sci	T	27	4	23	18	6	0	3	0	33.3	85.2
Regional Teacher Enhancement	T	25	6	19	19	4	0	2	0	24.0	76.0
Science 2000 - Summer Scien	T/S	76	41	35	43	28	0	5	0	43.4	46.1
Critical Issues Forum	S/T	158	86	72	82	67	1	3	5	48.1	45.6
Supercomputing Challenge	S/T	581	417	164	387	115	4	51	24	33.4	28.2
Summer Exp for Econ Disad	S	13	3	10	0	7	0	3	3	100.0	76.9
Educational Networking Support	T	1100	440	660	150	499	0	445	6	86.4	60.0
Pract Appl for Young Sci	S	9	5	4	0	4	0	2	3	100.0	44.4
Hydrogen Workshop	T/S	119	97	22	84	15	5	5	10	29.4	18.5
Robotics Workshop	S	69	61	8	47	11	0	6	5	31.9	11.6
Totals		2177	1160	1017	830	756	10	525	56	61.9	46.7
Program		Total	Male	Female	Anglo	Hisp	Afr-Am	Nat Amer	Other	% Min	% Fem
Post-Secondary Programs											
Atomic, Mol & Opt Phy Sum Sch		16	9	7	13	2	0	0	1	18.8	43.8
Historically Black Coll/Univ		18	8	10	0	0	18	0	0	100.0	55.6
Two-Year College Initiative		34	24	10	5	19	0	10	0	85.3	29.4
Undergraduate Research Sem		46	28	18	35	3	4	0	4	23.9	39.1
Summer Appl Geophy Exp		26	13	13	19	1	0	0	6	26.9	50.0
Underrepresent Min/Fem Init		48	21	27	6	35	0	7	0	87.5	56.3
Faculty/Student Teams		11	6	5	8	2	0	0	1	27.3	45.5
Mentored Collab. Research		9	6	3	4	3	0	2	0	55.6	33.3
Totals		208	115	93	90	65	22	19	12	56.7	44.7
Total All Programs		2385	1275	1110	920	821	32	544	68	61.4	46.5

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