Los Alamos National Laboratory

Science Education Program

Annual Report

October 1, 1999 *through* September 30, 2000

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Los Alamos National Laboratory

Science Education Program

***Annual* Report**
October 1, 1999–September 30, 2000

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Report Submitted by

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Executive Summary

Los Alamos National Laboratory has unique and important contributions to make in the fields of science, mathematics, engineering and technology education. The 1999–2000 Annual Report summarizes one year of progress in the Science Education Program, coordinated by staff from the Laboratory.

The mission of the Science Education Program is to apply the scientific and technical resources of the Laboratory to critical needs in workforce development and education. Our goals are the following:

- Serve as a national model to improve the quality of science, mathematics, engineering and technology education;
- Identify, develop, and inspire future scientific leaders;
- Enhance the technical literacy of the public;
- Facilitate systemic change in mathematics and science education; and
- Ensure a highly trained, diverse workforce.

With this mission and these goals in mind, the Laboratory conducts a wide variety of science education projects, funded primarily by the Office of Defense Programs (DP) of the Department of Energy (DOE), with additional funding from other DOE offices, the National Science Foundation, 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.

We conducted 25 separate projects that engaged 1,412 direct participants. The indirect impact of our programs involved approximately 80,000 faculty and students. As summarized in this report, 1999–2000 was an active year and a time of significant change. A primary impetus for the change came from the March 1, 1999, document generally referred to as the "Chiles Commission Report."

As referenced in the Chiles Commission Report, the development of "scientific, engineering, and technical personnel" requires education programs that target critical skills and that build upon unique Laboratory resources and capabilities. The Los Alamos education program utilizes Laboratory professional expertise to improve the quality of the workforce. This is accomplished by developing and disseminating effective education initiatives and through the recruitment and retention of a quality and diverse group of students.

Recommendation 7 of the Chiles Commission report states the following:

> Establish and implement plans on a priority basis for replenishing essential technical workforce needs in critical skills.

This Laboratory Education Program Annual Report directly addresses the plan to replenish the essential scientific, engineering, and technical workforce by recruiting high-quality candidates

and by providing training in essential disciplines. Laboratory scientists and education professionals work together to implement each initiative. Students, teachers, college faculty, scientists, industry professionals, and Laboratory employees benefit from the strategically aligned and focused education program.

Section 1 of this report covers scientific disciplines supported by the Department of Energy Office of Defense Programs (DP). These projects are especially linked to Chiles Commission recommendations and critical skills areas of interest to DP and the Laboratory. Section 2 includes information about the Diversity Working Group. With guidance and direction from DOE/DP Office of University Partnerships and Laboratory management, the diversity group is working to increase the quality and diversity of the employment pool. Section 3 summarizes the Postdoctoral Program, which also serves a vital function in meeting Chiles Commission recommendations. The final section of the report includes updates about education programs funded by the DOE Office of Advanced Automotive Technologies, NASA, private industry, universities, volunteers, and others.

The Science Education Program at Los Alamos is highly valuable to the Laboratory and to DOE. We are very proud of our accomplishments recorded here and look forward to future work with enthusiasm.

Section 1

Mathematics and Science Critical Skills Development Programs

Supported by the
Department of Energy
Office of Defense Programs

Critical Issues Forum

Program Description

The Critical Issues Forum (CIF) focused on students' abilities to examine issues surrounding the nuclear world. This year's program included topics covering nonproliferation, storage and disposition of nuclear materials, terrorism in the nuclear age, and historical and future perspectives of the nuclear age. These topics were offered to actively engage students and teachers in interdisciplinary discovery and construction of understanding for the science conducted by the Department of Energy's research laboratories.

The Critical Issues Forum targeted high school teachers and students throughout New Mexico. Focusing on issues facing our nuclear world, students and teachers examined every facet of this complex subject area using a number of resources, including Laboratory personnel. The teams researched the scientific, economic, social/cultural, and political domains of the critical issues. The results of their research were published on the Critical Issues Forum Web site. In addition, they developed various dissemination products including information dissemination games, poster session materials, PowerPoint presentations, and documentary videos that were demonstrated at the culminating "Student Conference on the Nuclear World" held in Los Alamos.

The program drew upon the unique capabilities of Los Alamos National Laboratory by providing participants an opportunity to interact with Laboratory staff and to participate in a culminating student conference where individual teams presented their positions on the nuclear world to Laboratory personnel. Scientists at Los Alamos National Laboratory interacted with schools throughout the state through a Laboratory maintained Web site.

Dissemination of the program was accomplished through partners implementing CIF at their own sites. The Monterey Institute of International Studies and the University of Texas at El Paso were partners in the program this past year. In addition, the Sister Cities Project, a collaborative effort between LANL's Education Program Office and Los Alamos Middle School teacher Mike Johnson, used the Critical Issues Forum material in Russia and California. Thus the Laboratory leveraged its DOE Defense Program Office (DP) funds and more widely distributed vital information that builds public understanding of the DP mission.

Costs were reduced through the use of the Internet and the World Wide Web. These costs would otherwise be incurred through frequent site visits and face-to-face workshops. In addition, the curriculum designed for the program is used at sites beyond the original scope of the program, demonstrating the potential for future national impact on science, mathematics, and technology education. Furthermore, because the program objectives were designed to develop critical thinking and problem-solving skills, CIF contributed to the development of a highly skilled future workforce, and to the development of public literacy.

Program Goals and Objectives

- Increase public understanding of issues relating to the nuclear world;
- Increase content understanding in the science and history of nuclear materials and security safeguards;
- Increase public understanding of safeguarding nuclear materials;
- Develop connections between scientific concepts and everyday life.
- Increase understanding of, and model the scientific process;
- Provide opportunities to develop and apply critical thinking and problem solving skills on complex problems of global significance;
- Promote cooperative and collaborative learning through successful teamwork;
- Model the use of technology for research purposes; and
- Increase content understanding by using a problem-based approach to learning science.

Program's Value to the Laboratory

Science Education's capabilities and resources leveraged the efforts of the Laboratory's DP-based divisions to inform the pubic of the importance and need for continuing research in the nuclear field, specifically nuclear materials management, stockpile support, and stockpile stewardship. The Critical Issues Forum supported the Laboratory's missions in the area of national security in the following ways:

- Enhanced public understanding of safeguarding nuclear materials;

- Provided opportunities for staff to share knowledge of the Laboratory's defense mission by bringing it to the attention of the educational community in a positive way;
- Developed a critical thinking population of New Mexico students who can potentially be recruited for the workforce;
- Provided the Laboratory the means to meet the University of California (UC) contract requirements; and to interact with the educational community; and
- Provided Laboratory personnel the opportunity to demonstrate and explain current research in the areas of computer modeling, security, monitoring and detection methods, storage and transport of nuclear materials, etc. that are appropriate to the research topic areas.

Implementation Strategy

Students and teachers applied to the program as research teams. The participating schools provided support to the program by providing administrative resources and provided the students with an academic credit for completion of the program. Program quality was assured in the following ways:

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 helped to ensure that students had access to computers and other necessary resources, were provided with time to pursue the critical issues and that any on-site problems relating to the program were addressed.

Task Assignments
Teams were required to demonstrate learning and understanding through task assignments that combined content information, critical thinking, problem-solving skills, and telecommunications.

Each team produced topic-oriented dissemination products based on their work. The students selected and examined a specific real-world problem and cooperated to formulate group consensus and various written and presentation documents. These student-produced dissemination products included press releases, fact sheets, information-dissemination games, poster-session materials, PowerPoint presentations, and documentary videos that were demonstrated at the culminating "Student Conference on the Nuclear World."

Table 1. Demographics for Critical Issues Forum			
Gender Breakdown:			
Total Male Participants		68	54.8%
Total Female Participants		56	45.2%
Ethnicity Breakdown:			
Total Caucasian		64	51.6%
Total minority		60	48.4%
	Total Hispanic	47	37.9%
	Total Native American	9	7.3%
	Total Asian American	3	2.4%
	Total African American	1	0.8%

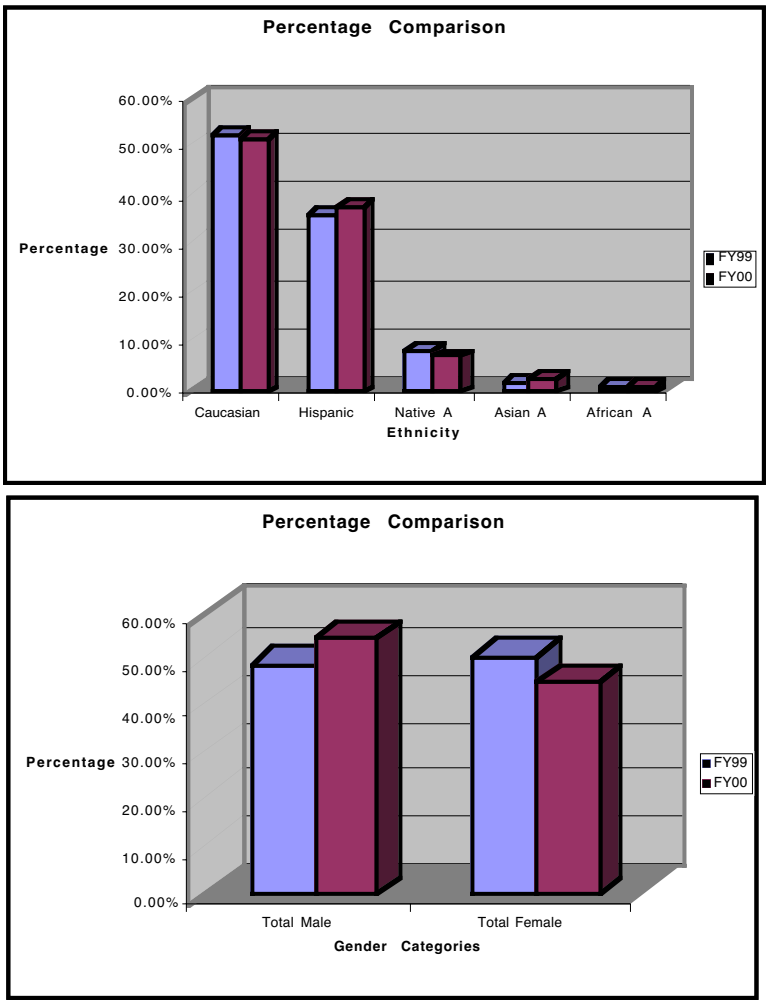


Figure 1. Participant percentages.

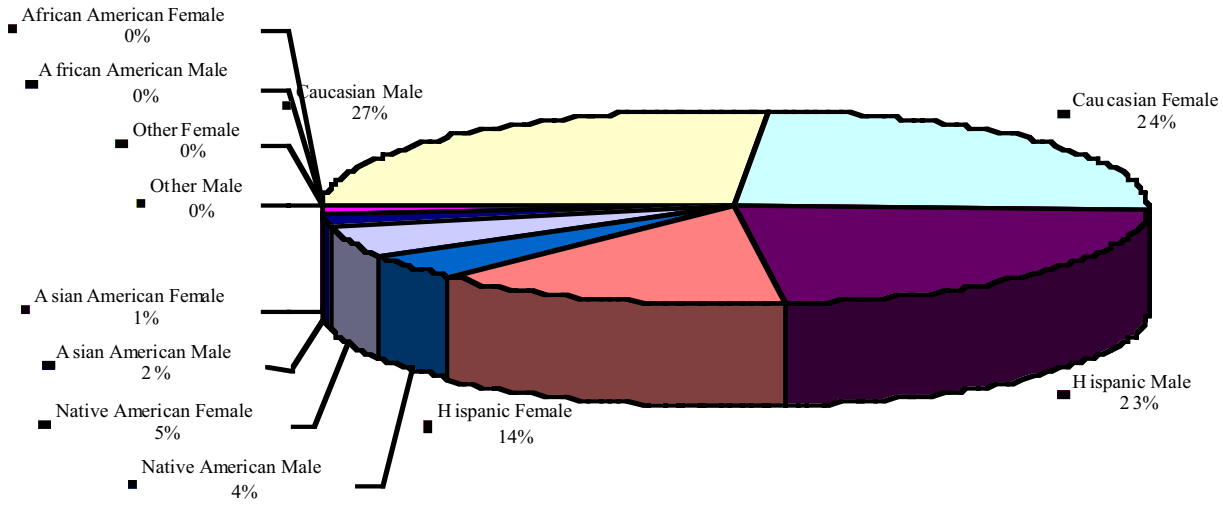


Figure 2. Demogrpahics—FY00 Participant Data

Evaluation

The evaluation was composed of a combination of formative and summative strategies, including facilitated monitoring of students' use of the Internet and analysis of student products developed during the program by the selected teachers. Analysis of student products determined the extent to which the students developed their critical thinking skills and their abilities to work cooperatively in teams. A variety of evaluation tools were used to measure how well the program met its objectives. These tools included process feedback forms, student and teacher surveys, evaluation of student written papers and oral presentations, evaluation of student products, and observations by the program coordinator.

Review of the teacher and student surveys demonstrated that the CIF was successful in meeting its overall goals. The students indicated they enjoyed interacting with other students within their schools, as well as meeting students from other schools. Teachers generally agreed that the students learned a lot about their selected topics and about the use of computer technology, as well as how to work cooperatively in determining how and what to research and how to prepare presentations.

In evaluating the program, students and teachers demonstrated significant positive increases in the following areas:

- Understanding information content about nuclear materials;
- Understanding of science content developed through the use of a problem-based approach to learning;
- Increased cognitive ability to research complex, in-depth issues;
- Understanding how to research critical issues;
- Understanding the role of telecommunications;
- Understanding the use of technology for research purposes; and
- Small-group work.

Dr. William H. Robertson conducted an additional independent evaluation for inclusion in his doctoral dissertation on the Critical Thinking Curriculum Model (CTCM), the educational framework of the Critical Issues Forum program. This study measured student attitudes toward science and technology and the changes that result from immersion in the CTCM. It also assessed the differences in student learning in science content and problem solving. Overall, the results indicated that the CTCM did help to

Table 2. Ethnic Breakdown by Educational Level

	AfM	AfF	CaM	CaF	HiM	HiF	NAM	NAF	AsM	AsF	OtM	OtF
Grades 9-12 Level	0	0	24	22	21	13	4	5	2	1	0	0
Under Graduate Level	0	0	0	1	1	3	0	0	0	0	0	0
Graduate Level	0	1	2	1	2	4	0	0	0	0	0	0
# teachers/ faculty	0	0	10	4	2	1	0	0	0	0	0	0

Table 3. Milestones		
Sept. 1999	Recruiting FY00 cohort (increase participation)	Active recruiting cancelled due to lateness of funding—previous participants contacted
Oct. 1999	Conduct site visits at participating schools	Conducted in February/March
Sept.–Nov. 1999	Development of benchmarks and activities	Completed in November Web site revised
Dec. 1999	Teacher Introductory Workshop	Cancelled due to lateness of funding
Jan. 2000	Program Implementation Workshop	Conducted during site visits
May 2000	Student Conference on the Nuclear World	Conducted May 5, 2000

increase science content understanding and problem-solving skills for students, thereby positively effecting critical thinking. No matter if the students liked science or not, or enjoyed computers or not, the CTCM approach helped to increase science content understanding and problem-solving skills. The CTCM has clearly provided an educational framework that can aid all students in the development of critical thinking skills.

Chiles' Commission Report

The Critical Issues Forum addressed the Chiles' Commission Report by increasing knowledge and interest in the science areas, specifically in issues surrounding the nuclear weapons complexes and the nuclear world in general. Many past participants have pursued scientific careers based on their experiences in the CIF program and their visits to the Laboratory and the Los Alamos community.

Teacher Comments

"I think that my participation with you and CIF has had a great impact on my students and me. As you know, I have used CIF/CTCM with high school as well as college level students. It has changed me and the way I approach teaching. I believe that learning is the students' responsibility and this approach is conducive to establishing this as a tenet of teaching. The process that students and teachers go through using the CTCM model is a practical experience in constructivism. This whole two-part method also allows for motivating students to learn in areas that make sense to them. All of this is what is being called for in science education reform.

"One of the most important components of my years in the program was that it was supported with sound theory, money, technology, patience, and continued support over time. These are the necessary ingredients of a meaningful program of change for teaching in the age of information. A one-time workshop is not enough, even with the best of intentions. There is too much resistance in the school cultures where tradition and efficiency are the norm. Teachers, like myself, took years to change and to make changes at our schools. I was lucky in that I was getting my doctorate during these years and so much of what I read was made real by my participation.

"During the 1990s we have come to a better understanding about how the human learns. The elements of brain-compatible learning based on this research found a home with the CTCM model. These are: adequate time, meaningful content, immediate feedback,

absence of threat, choices, enriched environment, collaboration, and mastery at the application level.

"I have two Web sites that students have made since you came down. The second was on a much larger scale than the first (you came down to help kick off the first one). The first was an elementary curriculum based on a water theme. The latter was done in conjunction with a summer project called TRIO. It dealt with teachers using the CTCM model to develop a curriculum on a Colonias theme. I am now 'infusing' the method into most of my courses and I will be sharing this with our Teacher Education Department. I will be receiving a Mavica still/movie digital camera, a photo quality printer, a state-of-the-art Dell computer with CD burner, a 250 meg Zip drive, Adobe PhotoShop Deluxe software, a video camera, and a scanner because I was able to articulate a need and the ability to use the technology to teach as well as enhance our teacher education efforts.

"I hope to continue the dialogue and wish you the best. Thank you and SET for all of your support."

Miguel M. Licona, Ph.D.
University of Texas at El Paso
Teacher Education Department

"I was involved in the CIF program for two years. The program was beneficial for my students and me. The program impacted both my teaching techniques and my attitudes about the teacher's role. My students learned new skills. Approaching learning from new and differing perspectives has had a lasting effect on my teaching and me. My students learned new techniques of learning about themselves and the world around them.

"The training and experience learned while involved in the CIF program will continue to have a lasting effect on the way I teach, my role as a teacher, and the skills I use in the classroom. One of the most useful ideas I was exposed to was the Critical Thinking Curriculum Model, which added depth to my teaching. I was so impressed with this curriculum model that I have designed the rest of my classes to incorporate most of the elements of the CTCM. Attending the summer workshops brought together educators with different background and experiences. I learned a great deal about the role of the teacher from working with other educators. One dramatic change I have made is in the role of the teacher from an information source to that of a facilitator. Through the CIF program I also developed valuable skills in the area of technology. I have taken the Web page making skills and used them to put most of my other courses online.

"The CIF program had a bigger influence on my students. My students functioned at all levels of learning, from gifted to special education. The great thing about the CIF is that any student regardless of their abilities were challenged and learned. The only difference was the level of understanding of one student might not be as in-depth as another student, but both gained in knowledge and understanding. The students gained confidence in knowing they were learning and understanding areas and content that most people, even college graduates, did not fully understand or appreciate. They also gained pride in their work because they knew what they learned was relevant to their lives today in Floyd, NM. The students also increased their skills in technology. They became proficient in the making of Web pages and using the Internet as a tool and a resource. The skills they learned in researching and making connections to different areas of society will

stay with them the rest of their lives. My students learned how to think, not just learn.

"The CIF program has made a lasting impression on my students and me. I will never look at a classroom or course the same way. I will never view my role and philosophy as a teacher the same way. My students will never look at an issue or topic the same way."

Gary Gill, Instructor
Floyd High School
Science Department

We will continue to use the CIF curricula here at San Andres because we believe they are powerful tools for improvement in critical thinking skills for our students. Listed below are just a few of the benefits we have experienced.

1) Research skills and technology skills are greatly enhanced in our experience. Our students work on the benchmarks by using the Internet, libraries, and other research options. In producing their papers they become familiar with the use of digital cameras, HTML editors, and other sophisticated technology tools.

2) Students become much more culturally literate by examining historical events and contemporary events. They learn to view these events from several perspectives and interpret them from various points of view.

3) Critical thinking skills are greatly enhanced. The platform of collaborative learning allows students and the mentor teacher to examine the benchmark questions and synthesize true understanding. We found that students began with a rather juvenile, concrete view of the situations posed in the benchmarks and moved to a complex, mature analysis of the problems. They learned to appreciate cultural and historical influences and context as features of problems like terrorism which liberated them to analyze contemporary occurrences of terrorist acts in a much richer way.

4) Our students learned a great deal about working in groups to produce papers and products. This collaborative approach allowed them to use each other's strengths and improve the finished product as a whole. Issues of group dynamics are important for all students to explore since most work in the adult world is done in groups rather than as individuals.

5) Students really enjoy examining these problems in this "real" way. We have had several students take more than one of the CIF areas during their time here at San Andres. In fact, the class is so popular that we offer it both in the fall and spring semesters. Many students have commented that they both enjoy the format and also emerge with a much greater understanding and appreciation of the curricular areas after completing the work."

Sue Ann Dobbyn, Instructor
San Andres High School
Las Cruces Public Schools
Science Department

Conclusion

This is the final year the Critical Issues Forum is to be funded by DOE-DP. Interest in the program and our pedagogical approach was beginning to be viewed from outside sources as a valuable resource conducive to positive student learning. Veteran CIF teachers were sharing the program concept with colleagues and at conferences they attended. Pre-service teachers were being trained to use the CTCM model in developing lessons and curricula. The Critical Issues Forum was beginning to have an affect on educational systems in New Mexico, California, and west Texas.

We hope that future funding can be found to continue the dissemination of the Critical Issues Forum and the Critical Thinking Curriculum Model forming the framework for successful change in the delivery of science concepts. The program was developed to meet the needs of the Office of Defense Programs, the Department of Energy, and Los Alamos National Laboratory. It successfully met these needs while providing a meaningful learning experience for all students and teachers involved.

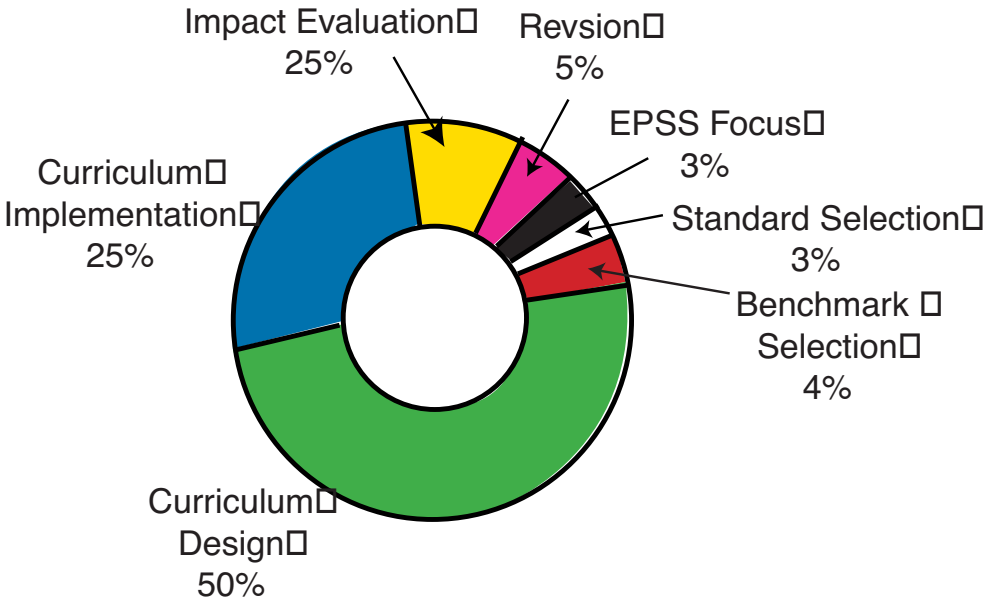


Figure 3. Amount of Effort.

Developing Information System Careers

Program Description

The Developing Information System Careers (DISC) is a three-year program in partnership with local education and industry alliances, designed to meet the critical and growing deficit of trained computer technicians and computer scientists. The DISC proposal is based on research data from industry that clearly indicates a growing need for career professionals trained in information technologies (IT). Specifically, DISC addresses how to attract and induct people into the field, how to train them for the rapidly growing and advancing market, and how to support and retain them as Laboratory employees, once they are hired.

The DISC Program acknowledges and supports the need for development of skills in students in five cluster areas as well as in academic preparation and technical applications. The five clusters, identified in a 1996 report by the Advisory Committee to the National Science Foundation Directorate for Education and Human Resources, are interpersonal skills and teaming, proactive approach to work, technical competence, experience in the workplace, and basic skills. The DISC program is specifically designed in alignment with the Chiles Report to locate employment gaps, both now and future, locate young talent to fill these gaps, and work with the participating students to keep them in the employment pipeline.

The DISC program is designed to improve both the applicant pool and the retention rate of IT personnel at Los Alamos. DISC is designed to recruit students statewide as early as high school who have a demonstrated interest and aptitude for working with computers, and to provide rigorous opportunities in pre- and post-secondary training that include early induction into the industry through internships and apprenticeships that lead to employment and retention. Working through the high schools to find students who are planning to attend two- and four-year colleges, Los Alamos will alert teachers, administrators, counselors and other points of contact from the state's vast network of educators to ensure that we offer the broadest number of students, opportunities that meet or exceed industry standards in preparing for and performing in a professional work environment. Furthermore, through the DISC Program, LANL will draw attention to career opportunities in computational science and encourage students to enter the field.

Performance Objectives and Milestones

The goal of the DISC Program is to develop a diverse pool of individuals with IT skills that can be drawn upon, locally and beyond, to assist the Laboratory in building a workforce to meet current and future needs. The four primary objectives are to

- Launch an aggressive recruitment campaign in high schools, colleges and universities, particularly in New Mexico, to attract and recruit students into the information technology field, especially targeting those who are interested in technical training and computer science, and to develop and/or nurture their interest in the computer industry;

- Establish and support an IT learning environment that allows students to effectively cope with the rigors of academic life (faculty, pedagogy, grading systems, pace, workload, and course level), thereby improving retention, especially for those students who are from at-risk and underrepresented populations;
- Provide local two-year and four-year colleges, pre- and post-secondary technical academies, and other training facilities assistance to develop and improve their programs where IT training is offered through collaborative ventures; and
- Develop students' capabilities specifically to be successful in an industrial environment through internships and apprenticeships at Los Alamos National Laboratory, and promote a high rate of employment from this group.

Recruitment will focus on graduating high school students planning to attend two- or four-year colleges throughout northern New Mexico. Students will be selected based on their interest and aptitudes in IT work. The students will work independently or together depending on the program design requirements. The intent is to have DISC students acquire competence across the full range of skills and attributes, from computer architecture to programming languages.

Highlights of This Year's Accomplishments

The underlying purpose of the DISC program is to begin the process of addressing employment shortfall predictions identified in the Chiles Report. To do this, relationships with internal groups, divisions, external educational agencies, and businesses needed to be created. Thus, this year's efforts to address the Chiles Report predicted shortfalls in the information technology and computer science areas. The DISC program primarily focused on the following:

1) Establishing and building links to and recruiting efforts with the local two- and four-year colleges;
2) Minimizing contact with local high schools until FY01;
3) Locating and placing a few extraordinary students from top national universities with an interest in working and living in the Southwest;
4) Creating strong partnerships with our computing initiative groups;
5) Getting as many students here for the FY00 summer in as broad a range of technical areas and divisions as possible; and
6) Using lessons learned from student and mentor participants to create a customized FY01 program interweaving the needs of the Laboratory with the current academic graduate skill bases.

Student Placement

When we submitted the semi-annual report, we were learning quickly and recruiting even faster. In the end, we succeeded in placing 13 students representing a wide diversity of age, ethnicity, and academic and professional experience from a wide range of schools both locally and nationally (see Table 4).

These students were placed into an equally wide range of assignments throughout our technical divisions, which contributed funding equivalent to 62 percent salary leveraging. While a substantial effort was made to engage our computer groups, particularly those groups that identified employment shortfalls, the majority of students were placed directly into technical groups.

Table 4. Demographics for DISC					
1	High School	1	Native American	3	Female
2	Pre-college	5	Hispanic	10	Male
2	Two-Year College	5	Caucasian		
6	Undergraduate	1	Asian/Pacific Islander		
2	Graduate	1	Unspecified		

We met with the team leaders and staff of Desktop Computing (CIC-2), Computer Research and Applications (CIC-3), Network Engineering (CIC-5), Scientific Software Engineering (CIC-12), Business Information Systems and Enterprise Programming (CIC-13), and Advanced Database and Information Technologies (CIC-15). In addition, we met with the Alternative Recruiting Task Force of the CIC Division. In the end, however, we placed only four of 13 students within the CIC groups, two in Desktop Computing, one in Computer Research and Applications, and one in Scientific Software Engineering.

The participant demographics are academically interesting as well. Kevin Lacker (Figure 4) is a Junior at Duke University, a member of the third-place 1998 US Mathematics Team Olympiad, a member of the third-place team in the William Lowell Putnam Mathematical Competition, and a Top 5 individual scorer on the William Lowell Putnam Mathematical Competition. Kevin continues to work on his Laboratory project while back at school. His mentor and team said of him, “One of the technical staff members on the GENIE project gave a presentation outlining a ‘voting’ strategy for combining solutions from separate runs of GENIE. The presentation sparked a fair bit of discussion, though most of it speculative, since the results were preliminary and had not been quantitated. Kevin, new to the project, was tasked with investigating the idea further.

Figure 4. Kevin Lacker.

“Within two weeks, Kevin gave an impressive presentation with his own more quantitative results, and backed up his empirical findings with a mathematical discussion that identified the issues and assumptions that had only been intuitively discussed at the previous meeting. To do this required not only a facility for developing a good theoretical argument, it also took a lot of work to learn how to use the GENIE system (Kevin even made a few minor improvements to the system during this time), and a lot of foresight to design the empirical experiment that properly tested the voting idea.

"Since then, Kevin has been an active developer of the GENIE software, and has lately been working on the new 'Support Vector Machines' (SVM) component. This is a very sophisticated algorithm, and in a very short time Kevin has learned the basic ideas, and has started to contribute both to the software development and to the understanding of the algorithm's performance."

Another noteworthy addition to the DISC group was Tomokazu Sato (Figure 5). He was a member of the US Physics Olympiad team, and he received an honorable mention in the William Lowell Putnam Mathematical Competition as well as early admission to Massachusetts Institute of Technology (skipping his senior year in high school). We very much wanted to recruit Tomo to do neural network analysis for the detection of deception and the analysis of sensor data for underground facilities construction, both projects within our Computer Research and Applications group. We hope to get Tomo back next summer in one of the intended positions.

Figure 5. Tomokazu Sato

Tomo and Kevin were both exceptional performers who, when they arrived here, met fellow top-quality students from the US and Mexico recruited through other, non-DP-funded, programs in the Education Program Office.

Other DISC students included the following:

- Natalia Toro—USA Today All-Academic First Team; first-place winner, Intel Science Talent Search; Lucent Global Science and Technology Scholar; member of the 1998 and 1999 United States Physics Team; silver medallist, 1999 International Physics Olympiad; and National Merit Scholar;
- Alexander Ho—Gold Medal winner at the 31st International Chemistry Olympiad, 1999; FMC Award of Excellence Scholarship; and the GPPA Award for Excellence in Academic Achievement Scholarship;
- Joel Briones Hernandez—winner of the prestigious Leon Lederman Award in Physics; and
- Oscar Martinez Palafox—the top scorer on the National Physics Examination of Mexico.

All of these students were housed close to one another, and being several cuts above the norm, became friends in a very short time. Indeed, most had heard of or met one another before.

Top academic performance is certainly one measure of excellence, but underlying the excellent work of our top computer/mathematics performers are the computer support people that keep the systems running smoothly. The DISC program is designed to locate and support these people too. It is the mission of the DISC program to support the

overall computing effort in creating a seamless operation of expertise. Ty Lujan and David Duran joined the DISC team after one successful summer of desktop support at the Laboratory. Because of DISC funding, these two excellent students had another successful summer and are now working part-time during the academic year as they finish their associate's degrees at Northern New Mexico Community College. With more experience under their belts, they should become regular employees very soon.

Between the Kevins and Tomos and the Tys and Davids lie the nine other DISC participants, each doing an excellent job in his/her own way. Two are in graduate school working in areas directly related to their theses. Two are fresh out of high school on their way to computer design careers, and without question, graduate school. One has his associate's degree already, and is now enthused and targeting a bachelor's degree in computer science, mathematics, and electrical engineering. Three are just finishing their bachelor's degrees in computer science this year and then will be off to graduate school. One young lady is a college-bound high school junior with enthusiasm for building Web pages. The diversity of our participants was delightful and energetic and makes the DISC program a powerful contributor to the overall computing needs of the Laboratory.

Relationships Initiated

A large part of the DISC program aims to create relationships with the local and regional educational institutions and information technology businesses. These relationships are intended to ease the flow of the best students to the Laboratory and surrounding businesses that support the community and the Laboratory, to influence the nature education and training available at these organizations, and to build collaborations between the Laboratory and the regional information technology community.

Because we needed students as our primary focus in this start-up year, we focused on making contacts with local and regional educational institutions; we did very little with businesses. At the high school level we met with staff and students of the Santa Fe Academy and the Native American Preparatory School. We placed students from Los Alamos High School, Pojoaque High School, and the Native American Preparatory School. In the area of post-secondary recruiting we made trips to Northern Arizona University, Eastern New Mexico University, New Mexico Tech, and Northern New Mexico Community College. These trips were made to get students and meet staff members as we begin to build programmatic infrastructure. We succeeded in placing students from Eastern New Mexico University, Northern New Mexico Community College, and the University of New Mexico. External to the region we used techniques and contacts built over the years to locate the "best and brightest." From these efforts we recruited students from Massachusetts Institute of Technology, Duke University, Carnegie Mellon University, and Colorado State University.

It is also imperative that we develop relationships within the Laboratory. Never before in Education Program Office history has the emphasis been so focused on computer/mathematics career paths and estimated employment shortfalls. Our initial focus was to build new relationships with the five computing groups with clearly predicted shortfalls and needs. This led to many meetings with the leaders and staff of Desktop Computing (CIC-2), Computer Research and Applications (CIC-3), Network Engineering

(CIC-5), Scientific Software Engineering (CIC-12), Business Information Systems and Enterprise Programming (CIC-13), and Advanced Database and Information Technologies (CIC-15). In addition, we met with the Alternative Recruiting Task Force of the CIC Division. Interestingly, only four students were placed within these groups with the other nine students being placed directly in the technical organizations using largely existing contacts from previously established relationships.

Contact with the ASCI Alliance Center and the LASCI program staff lead to some interesting students, but not to any placements.

Lessons Learned

Since this is the first year of a multi-year program, the lessons learned are arguably as valuable a set of accomplishments as the actual students placed and relationships initiated. There were many lessons learned, new paths uncovered, roadblocks discovered, and strategies developed with ideas revisited and revised in the FY01 proposal. As an introduction to what was learned let's look at the following situation.

Positive contact was made with the five computer science groups regarding the most critical needs of students and future employees. These groups are identified earlier in this report. Each group had different needs ranging from world-class academics to technically trained, people-oriented students to do various assignments. This makes recruiting both challenging and fun. What was encountered, however, was that the groups were, despite appearances and expressed enthusiasm, unprepared to receive students. Indeed, they took only four of the 13 students recruited into the DISC program and, in hindsight, had we separated ourselves sooner from pushing heavily upon these groups, we could have placed more students in valuable contributing assignments at the Laboratory.

In one group there were eighteen identified unfilled positions, yet they could not mentor more than two students nor fund more than one student we located. In discussions we had, it was revealed that they are so short staffed it is difficult to slow an effective person to train an uncertain candidate. The question remains, however, why the issue of funding. A conclusion that can be drawn, and this is an unverified thought, is that what they have identified as "shortfalls" are due to a lack of funding in conjunction with, or rather than, locating strong candidates.

In another computer group we identified five potential positions, office space, and funding. In the end, this group took only one student although there were at least five application packets of budding world-class students sent to them. Two of these five were readily placed elsewhere directly into the technical groups. Anecdotally, the problem would appear to be three-fold:

- They wished to proceed cautiously because they had negative experiences in the past where they invested in students who left for more money and less isolated (geographically) locations;
- They are, again, so understaffed that providing the necessary mentorship was not possible; and
- Much of their work requires clearances.

In just these two specific stories there is a rich amount of cross-cutting situational conditions which, among other factors, are discussed individually and in more detail below. However, it is worth noting that the new DISC program of FY01 must be prepared to address these situations head-on and to support these

groups through their transitions from workforce shortage to balanced staffing. If we cannot synchronize our efforts with them, indeed educate and support them through their process, then we do a disservice both to them and to the students we recruit.

Funding and Employment Packages

Retrospectively and as predicted in our semiannual report, a 30 percent cut in LDRD funding and a redirection of existing funds to improved security caused tentativeness in hiring students. Moreover, it manifested in a hiring moratorium that made students (and others) concerned that investing their time and energy at the Laboratory might not be in their long-term best interest. These factors together with security issues, forest fires, and low morale resulted in overall student hiring at the Laboratory being down by 20 percent. This situation is expected to change in FY01 as current congressional allocations are above last year's allocations at this time, and the final results of the "hard drive" investigation are now complete without any criminal charges. While there will undoubtedly be more changes to come, it would appear the worst is over.

The identification of employment gaps and shortfalls in information technology and computer science positions results from not only difficulty in locating good candidates, but also from a shortage of allocated funds within the Laboratory to address these shortfalls in a timely manner. For example, the computer group that identified a shortfall of 18 positions was likely looking solely at the gap between what they are asked to do and who they have to do it. They can see a need for 18 people. This does not mean they have the funding for these people nor the existing staff to groom and train these 18 people if found. Thus when the DISC program located many local students interested in staying in the area and working in their field, they took only two stdentds and paid only for one.

The question of how one closes these gaps long-term is substantially influenced by the short-term situation, both internally and externally, and the willingness to take the risks in the current global market to recruit and groom young people to fill these positions. Resources are a key factor in the supply and demand equation when it comes to recruiting and retaining of information technology and computer science candidates whether they be students or experienced people from the existing workforce. The Internet, high speed desktop computing, and the literally thousands of computer "start-up" companies with extremely high starting salaries, benefits, and incentives are creating a climate in which, to be honest, our national laboratories cannot compete. Traditionally, when the private sector is doing well, the government sector struggles, and vice versa. The international situation of the new millennium is that the private sector information technologies are highly successful, and we are hurting to get good people.

(On the brighter side for the Laboratory, and the government in general, the private sector is training and educating a tremendous information technology workforce and attracting a phenomenal wave of students into the information technology disciplines. As with most "booms," the private sector investment will likely wane, there will be too many good people on the market, and our initiatives in information technologies that support our national security will benefit.)

The pay scale at the Laboratory is 30–50 percent lower than industry. As a result, a program like the Advanced Summer Curriculum for Emerging Network Technologies (ASCENT), which targets the high-end computer science students, or programs like DISC, which are more cross-cutting, and the overall retention of existing staff is significantly hampered by the low pay, low mobility, and low visibility. For several recent years, our computer and information technology divisions had a half-time recruiter who was highly effective at getting top quality resumes, yet this effort was discontinued because the cost/benefit ratio was unacceptable in the current market. There remains much concern about bringing students here and investing in and training them, only to lose them upon their graduation to the large salaries, benefits, and incentives in the private sector.

In this regard, it seems we must educate our existing staff to realize that the long-term solution rests with student ambassadors whom we train and perhaps lose to industry, but who remain steadfast in their knowledge that Los Alamos is a great place to work. Yes, our salaries need to go up to be more competitive, but we must not make the mistake of matching the current market for it is not stable, it is booming. Our interest is in the long term, not following the short-term market fluctuations. Private sector companies hire and fire staff as the market drives them. Since we as a government agency cannot do this, we must keep our eye on the long-term situation; thus, we suffer during private sector booms and flourish during private sector collapses. While in the short run we may be grooming people for industry, in the long run it is industry who will train these people for us! In all likelihood the longer-term global market will collapse from its current growing state to its stable condition. When this happens, if we have invested wisely in getting our work done with students who remember us as "the best," the best will return to the fold. There will be a glut of information technology people and computer science people, just as there was a glut of engineers in the mid 1980s, and the Laboratory will be in a prime place to take back the best, trained first by us and later by industry.

Our internal salary structure for students now has a "bandwidth" to ensure we can attract more students in market areas that are booming such as information technology and computer science. We can work this to our advantage in the DISC program next summer and throughout the year to get good students with an interest in Los Alamos National Laboratory and living in the Southwest.

Training and Grooming

In a climate of existing and projected employment shortfalls, the existing staff is burdened with excessive work and little motivation to train assistants who might leave for a more favorable financial market elsewhere. This speaks to a mindset of immediate need and crisis management that is a hole that once dug, is hard to escape. Nevertheless, we must take on the challenge of training and grooming staff for the future even if it slows us down now and even if we might lose them to industry. The DISC program staff must educate the overburdened mentors and group leaders that to not make the financial and time investment in a future workforce is certain long-term failure. Indeed, their own jobs as workers, future leaders, and current leaders rely heavily upon a consistent flow of qualified staff. Through the DISC Program, Education Program Office, and Human Resources staff we are being heard by the Education Initiatives Council and the Student Programs Advisory Council. We

intend to educate our managers, our mentors, and our leaders that we must invest in the future, and the longer we wait to do so, the harder the task will become.

Los Alamos is sometimes referred to as the "town that never was." It is fairly well documented that if given the choice of a six-digit income and living life in the fast lane of Silicone Valley, most young people are not going to come to Los Alamos. But there are other attractions here. In our work with one of the computer science groups we met a team leader who said to us, "I would not be here doing computer science if I did not like the outdoors; find me the best who also like the Southwest." And so we found him one. The DISC program recognized and continues to emphasize this factor. The Laboratory is a long way from the nearest "vibrancy of life" that so many young people seek.

For most positions, we look intensively at our local region, seeking students who grew up here, who came to school here, and who have a value system and priorities that encourage them to stay here. For some positions the academic and professional qualifications are much higher, and we tempt/market them to give us a try. One of our students, now in his eighth month here, was a fast tracker to Silicone Valley, big bucks, fast car, and stock options. We asked him why he came back, to which he answered, "I had no idea that this kind of computer science existed; I am more challenged than I ever imagined, and I am doing something important as well." Not much more needs saying. We have to make the initial investment to get "them" here in top-notch facilities, doing cutting-edge work, and giving them lots of responsibility and visibility for what they do. We must ensure the quality of their experience through these challenging times. Then their desire for the "vibrancy of life" can be in great part filled with what they do and how they contribute at the Laboratory.

Clearances

Security clearances for students have always been an issue at the Laboratory. Because we bring about 1500 students each year to our projects and because we have many physical sites that do not require clearances, our security offices are not prepared to process students in a timely manner.

In FY00 this has been a problem due largely to lack of time. In the past year there have been significant improvements in turnaround rate on clearance acquisitions, and we anticipate that this will get even better in the future. In FY01 this will be less of an issue for the DISC program because we can begin recruiting in the fall and, should clearances be needed in some cases, initiate the process right away. The three-year component of the program will also improve this deterrent as we can target returning students and initiate the clearance process early, even while the student is still here.

Frontiers in K–12 Science and Mathematics Education Workshop

Program Description

Navajo traditional educators use a concept-based method to teach and learn science and mathematics ideas. The workshop provided a unique opportunity for the Navajo K–12 science and mathematics teachers to test the application of Navajo traditional teaching and learning practice to the teaching and learning of modern science and mathematics. In general, the Navajo concept-based method for teaching and learning science is not well supported by Navajo education administrators.

Based on Navajo, German, and Japanese concept-based teaching and learning methods, key science concepts were selected and demonstrated in each of the four sessions. Results from the Third International Mathematics and Science Study (TIMSS) show that the German and Japanese educators use a concept-based method to improve the performance of teaching and learning processes in K–12 classrooms. Furthermore, the TIMSS study shows that American educators use a rules-based method rather than the concept-based method to teach science and mathematics in K–12 classrooms. The rules-based method for teaching and learning science and mathematics limits the performance of American K–12 students.

The purpose of the Science and Mathematics Education Workshop is to improve the quality of K–12 science and mathematics education in Navajo schools. The workshop was held at the Dine College (formerly Navajo Community College) on August 3–4, 2000. The content of the workshop was driven by the Navajo Bilingual Life Sciences/Earth Sciences/Space Sciences Education Program developed by Gloria Grant and David Begaye at the Chinle Unified School District.

Four Workshops

1. Session A, Navajo Bilingual Education in Life Sciences, Earth Sciences, and Space Sciences;
2. Session B, Astronomy;
3. Session C, Water Science & Geology; and
4. Session D, Atmospheric Sciences. (Sessions B-D complemented the work done in Session A)

The Bilingual Education Session included computer-based interactive investigation of selected concepts in the life sciences, the earth sciences, and the space sciences; the Astronomy Session included the design, fabrication, and testing of a Galileo telescope; the Water Science and Geology Session included the use of the GEMS River Cutting Kit and a visit to the Canyon de Chelly; and the Atmospheric Sciences Session included the analysis and testing of a demonstration unit on how the rainbow works.

Session Faculty

- Session A, Gloria Grant and David Begaye, Chinle Unified School District;
- Session B, Professor Christopher P. Leavitt, Department of Physics and Astronomy, University of New Mexico;

- Session C, Dr. Steve Semken, Dine College; Paul Blanchard, Linda Weiss, and Nathan Myers, US Geological Survey; and
- Session D, Professor Howard Bryant, Department of Physics and Astronomy, University of New Mexico.

Thirty Navajo K–12 science and mathematics teachers were recruited: 10 teachers from the K–4 grades, 10 teachers from the 5–8 grades, and 10 teachers from the 9–12 grades. Five teams were selected with six teachers per team, where each team was uniformly represented by K–12 grades. This latter condition provided an opportunity to test the "systemic process," which has been advocated by the National Science Foundation. The NSF systemic-based programs are State Systemic Initiatives, Urban Systemic Program, and the Rural Systemic Initiatives. In addition team members were selected with uniform representation from Utah, New Mexico, and Arizona public schools, and the Bureau of Indian Affairs schools. Approximately 160 Navajo schools are managed by the States of Utah, Arizona, and New Mexico; the Department of Interior's Bureau of Indian Affairs; and church institutions. There are approximately 3000 certified school teachers and 70,000 Navajo students.

In order to test the performance of the teachers, each team was required to design a lesson plan for each of the four sessions. In addition each lesson plan was described by a concept that was developed in each session. Lesson plans were evaluated by workshop faculty to determine the outstanding team. Each member of the outstanding team was awarded $100. Furthermore, an outstanding teacher was selected based on recommendations from the workshop faculty and the teacher's school principal. The outstanding teacher was awarded the Seaborg Award for Excellence in Science and Mathematics Teaching and a $1000 award for use at the teacher's school. Plans are in progress to submit the outstanding teacher to compete in the NSF-sponsored Presidential Award for Excellence in Mathematics and Science Teaching.

Seaborg Award

The Seaborg Award for Excellence in Science and Mathematics Teaching was awarded to Amy J. John, who is an eighth grade science teacher at the Tse Bit Ai Middle School, Shiprock, New Mexico. Amy J. John was selected for the Seaborg Award based on recommendations from the Workshop faculty, her school principal, Chris Pash, and her work on workshop lesson plans. The Seaborg Award included $1000 and the following citation "Amy J. John, Tse Bit Ai Middle School, is recognized for her distinguished contribution to advancing the progress of Navajo K–12 science and mathematics education, and for her participation in the Frontiers of Navajo K–12 Science and Mathematics Education Workshop, Dine (Navajo) College, Tsaile, Arizona, August 3–4,2000." The $1000 was donated by the Arizona State University.

Amy J. John's Team was awarded the outstanding team award. The team members include Michael A. Badoni Sr., K grade, Many Farms BIA School, AZ; Martha White, grades 3–4, Tsaile Public School, AZ; Teresa Howard, fourth grade, Navajo Pine Public School, NM; June Lano, grades 9–12, Fort Wingate BIA School, NM; and Raymond Holtsoi, grades 9–12, Fort Wingate BIA School, NM.

Evaluation reports were submitted by both the workshop faculty and teachers. A general comment was that more time was needed to comprehend concepts that were presented at

the workshop. Because of limited funds it was not possible to increase the duration. Most faculty and teachers requested similar presentations at future workshops. Most teachers requested college credit for their work. Most teachers met the tasks with dedicated effort and commented favorably on the innovative design. Comments focused on comparative analysis of Navajo and modern views of nature, the K–12 systemic process, and the mix of state and BIA K–12 teachers in each team.

The evaluation of the workshop performance will be summarized in a 15–20 minute video entitled *The Sacred Depths of Nature.* The video will be produced by staff at the Center for Research on Education in Science, Mathematics, Engineering and Technology, Arizona State University. The video will illustrate selected Navajo science concepts.

Performance Objectives and Milestones

A key performance objective was for the teachers to comprehend both the Navajo and modern perspectives of science concepts developed in the four sessions. The design of the four lesson plans reflected the level of concept comprehension.

A key milestone was the recruitment of faculty who were willing to work in a teaching and learning environment that focused on both the Navajo and modern views of nature.

The concept development process is key to the advancement and diffusion of science at the Laboratory. We expect the Navajo students to learn the concept development process and effectively participate in a quality technical workforce for the twenty-first century.

The Frontiers in K–12 Science and Mathematics Education Workshop provided a unique opportunity to investigate with a hands-on inquiry-based approach the parallels between Navajo and modern scientific thought. In order to understand these parallels, abstract levels of thought are required to understand the structure and meaning of the Navajo and modern perspectives of nature, and valid connections between the two structures of knowledge. Ancient Navajo Hataaliis devised an abstract language of nature to describe and explain the properties of connections between thought, language, and reality. On the other hand, the architects of modern scientific thought have devised a complex abstract mathematical language to reason about the structure and meaning of the laws of nature.

Highlights of This Year's Accomplishments

A highlight of the FY00 workshop experience is that it happened. Tribute should be paid to the distinguished faculty from the K–12, college and university, and the US Geological Survey community that supported the workshop with their unique competencies in science.

This excerpt illustrates a workshop presentation from the Navajo Bilingual Space Sciences section where we show the star cluster Pleiades. The stars of Pleiades, Dilyehe, consists of seven bright stars that can be seen with the naked eye. Dilyehe depicts a mother walking with her six children. These stars appear in the fall and are seen throughout the winter. The word "Dilyehe" in Navajo literally translates to mean or refer to the planting of seeds. Planting of the seeds begins after Pleiades sets in late spring.

In the Navajo language the discussion on Pleiades translates into:

> Dilyehe ei tsosts'idgo so' ayoo daat'iigo yikah leh. Dii ei ama ba'alchini hastalt'eego yil yikahgo at'e. Ak'eego haakah, doo daango altso iikah. "Dilyehe" jinigo saadigii jozhiigo ei k'I'dilye jinigo oolye. Dii Dilyehe altso iikahgo iinda k'ida'dilye'.

The workshop provided a unique opportunity for the teachers to experience details directly in the concept development process. Other programs and activities besides workshops need to be supported to fully realize student benefits of the concept development process. These benefits can be applied toward maintaining a quality technical workforce for science and technology institutions such as the Department of Energy.

MATHEMATICS CONTEST

Program Description and Objectives

On October 9th, 1999, 75 students participated in the Four Corners "Go Figure" math contest, which was held at San Juan Community College and at the Los Alamos National Laboratory and was sponsored by the Los Alamos National Laboratory. Other "Go Figure" contests were held in central New Mexico and California and were sponsored by Sandia National Laboratories in New Mexico and California. A banquet honoring the winners of the Four Corners "Go Figure" math contest was held on November 20th in Farmington, New Mexico. The goal of the "Go Figure" competition is to identify young people with talent in mathematics. Many of these students did not demonstrate a latent talent in math in the usual ways, and their talent went unrecognized. Mathematics and algebra are the building blocks for all the scientific disciplines. Without the foundation that includes mathematics, a student's opportunities are limited.

These students accepted the challenge of a two-and-half hour test on problems that ranged from easy to very difficult. Many students said they enjoyed the contest and found it mentally stimulating and challenging. Some of the students were working on problems out in the hall even after they turned in the tests.

Students who continue to struggle with the problems they found to be difficult during the contest have what it takes to progress in solving real-life problems for themselves, their jobs, their communities and their country.

DOE/DP Mission Benefit

Programs that strengthen and promote student learning in mathematics support the Defense Programs mission. "Go Figure" is designed to enhance the supply of well qualified mathematicians, especially at LANL, by providing tools and resources to prepare students for induction into the workforce pipeline. The goal is to create renewed interest in mathematics and foster the connections between content knowledge of math and its application to national security.

"Go Figure" brings value to LANL by developing qualified individuals who are competitive and who can handle the demands of technical and scientific jobs. Ultimately, by preparing our own students better, we expect to reduce the country's reliance on foreign talent to fill those positions. The "Go Figure" Web site will link directly to ongoing work at Los Alamos National Laboratory.

Critical Skill Area Development

"Go Figure" works to include critical skill area #3 HPC: High-performance Computing and Simulation operations, computer and computational science and math, code development and code maintenance, and advanced codes and computation.

Partners/Leveraging of Resources

Dr. Abraham Hillman, a co-author of *Algebra through Problem Solving* and founder of the math contest format, contributed his time to proofread, create the index, and perform similar tasks to complete the work of putting the text on the Web. He also wrote and graded the mathematics contest in the Four Corners region.

We expect the New Mexico Department of Education to contribute time to the math contest in the Four Corners region and the newly adopted schools recruited through the northern New Mexico network of superintendents. San Juan Community College will contribute time and space for the math contest in the Four Corners region.

In order to expand "Go Figure" in northern New Mexico, some school districts participating in the Northern New Mexico Council for Excellence in Education's (NNMCEE) Mathematics and Science Academy will be recruited to participate in next year's "Go Figure" events. The following paragraph describes this Mathematics and Science Academy project, which is currently under construction. "Go Figure" will provide an enriching activity for the students and teachers of this program, which places an emphasis on mathematics, science and technology.

The Northern New Mexico Council for Excellence in Education (NNMCEE) was created by the University of California and the Laboratory to support and collaborate with two-year college presidents, school district superintendents, the University of New Mexico, Highlands University, business leaders and community representatives. The council serves as a catalyst and advocate for quality educational improvement in northern New Mexico. In February 2000, NNMCEE adopted a plan for the Mathematics and Science Academy (MSA). Subsequently, NNMCEE's Goal #4 Working Group was charged to "start small and proceed with a timeline to open the pilot academy in fall 2000." The Network is a consortium of 23 school districts that include the seven counties identified in the University of California management contract for the Laboratory. The mission of the Math and Science Academy will be to produce students who are soundly prepared in core academic subjects. Emphasis will be placed on mathematics, science, and technology; decreasing the number of students dropping out of school; increasing the pool of qualified teachers; and supporting a flourishing economy by supplying a trained workforce. At a strategic planning session on August 5, 1999, NNMCEE established four (4) goals. Goal #4 is to design and implement a pilot middle-school-level academy with emphasis on mathematics, science, and technology education. Student test scores and teacher competency surveys reveal a tremendous need for improving student achievement and teacher preparation in northern New Mexico.

The Academy is, therefore, designed to

- Utilize master teachers and research-based best practices to significantly improve math, science and technology education;
- Initiate systemic change in northern New Mexico schools and colleges; and
- Serve as a national model for improving mathematics, science, and technology education in rural communities.

Development of the academy is viewed, by northern New Mexicans, as a very positive and necessary "good neighbor" initiative with the Laboratory.

Highlights of this Year's Accomplishments

The "Go Figure" Mathematics Contest, held in October of 1999, was held at San Juan College in Farmington and was a success. The event had a 25% increase in participants over the previous year. The banquet, which was also held at San Juan College, was again a huge success due mainly to a mathematical presentation by Vernon Willie, a professor at San Juan College. We had a student winner whose father works for the New Mexico Representative Udall's office. When Mr. Valencia spoke about the opportunity the program has given his son for recognition in mathematics, he was quite moving. He offered to help the Laboratory by being an advocate with Congressman Tom Udall. All the teachers were proud of their students, and so were the parents who were invited.

The following books were awarded as prizes to the winning students from each grade level for their achievement in the 1999 "Go Figure" Mathematics Contest:

"Enjoyment of Mathematics: Selections from Mathematics for the Amateur," by Hans Rademacher and Otto Teoplitz,. IBSN 0-691-02351-4.

"What is Mathematics? An Elementary Approach to Ideas and Methods," 2nd Edition, by Richard Courant et al., ISBN 0-19-510519-2.

"Mathematical Discovery, Combined Volume," by George Polya, IBSN 0-471-08975-3.

"How to Solve It," by George Polya, IBSN 0-691-02356-5.

"Number Theory and Its History," by Oystein Ore, ISBN 0-486-656209-9.

"The Wohascum Country Problem Book," by George Gilbert et al., ISBN 0-88385-316-7.

Dr. Hillman was involved in every aspect of creating the "Go Figure" test, planning, grading, and recruiting. It is important to capture how Abe Hillman works so that we can scale up the implementation of this effort as it grows in popularity.

This summer all "Go Figure" winning students from each grade level were invited to the Laboratory to participate in a "Go Figure" day. The students were invited to meet at the Laboratory's Bradbury Science Museum where they received a tour of the Laboratory's projects, specifically those projects requiring the use of mathematics. The Bradbury Science Museum information can be found at the following Web site: http://www.lanl.gov/external/museum/visiting.html After touring the Los Alamos Historical Society Museum, which gave the students a historical account of the Laboratory, they met with educational

program coordinators and Los Alamos National Laboratory mathematicians at the Otowi Cafeteria for lunch. Parents were invited and attended the luncheon with their children. Students received information on how to build an educational Web site and received instructions on how to recruit students back at their schools for the next "Go Figure" math contest on November 4, 2000.

Implementation/Evaluation

The FY01 project expands on preliminary efforts in FY00 to combine mathematics-related content areas with a deeper, more comprehensive treatment of the topic.

We expect to assess impact in various ways, including online surveys, embedded devices that measure Web site use, and student evaluations. Ultimately, we expect to see an improvement in the attitudes of students, teachers, and other parents toward the ability to do mathematics.

The most recent participant survey given at the 1999 "Go Figure" event provides these statistics in reference to how participants felt about the contest:

- 100% stated they enjoyed the "Go Figure" math contest. All participants rated this question a perfect 4 on a scale of 1–4, where 4 is a very positive response and 1 is a negative, based on their participation in the contest.75% strongly disagreed (1) with the statement that the facilities at San Juan College were very uncomfortable while 25% disagreed (2) on a scale of 1–4, where 1 is strongly disagree and 2 is disagree.
- 100% stated they would recommend this contest to a friend, rating this a perfect 4 on a scale of 1–4, where 4 is a very positive response and 1 is a negative response, based on their participation in the contest.
- 80% stated that they liked the questions on the "Go Figure" contest rating this question a perfect 4 while 13.4% rated this question a 3, and 6.7% ranked this question a 2 on a scale of 1–4, where 4 is a very positive response and 1 is a negative. (Most students who rated this question a 2 or 3 thought the test was too hard with a couple of students stating that the test was too easy).

Student evaluations and matrix showing how students did on each question were shared with Professor Hillman in order to ensure the quality of next year's test.

Technology

Throughout the "Go Figure" experience students and teachers have developed a Web-based communications network with the intent of creating a strong educational support network among the program participants and their surrounding higher learning institutes such as the Los Alamos National Laboratory and San Juan College. Students are encouraged to take the practice tests and view previous years' tests on the Web site in order to better prepared for the contest. This Web site can be found at http://set.lanl.gov/programs/learning/Math/Contests/contests.htm

Milestones

- "Go Figure" Mathematics Contest October 9, 1999
- "Go Figure" Mathematics Contest Banquet November 20, 1999
- "Go Figure" Mathematics Contest LANL summer experience August 8th, 2000

- "Go Figure" Mathematics Contest November 4th, 2000
- "Go Figure" Mathematics Contest Banquet late November, 2000

Anecdotal Data from Participants

"I have been involved in a lot of math competitions but this contest is great and I got to come to the Los Alamos National Laboratory for a day."

"I don't usually do all that great in math but I was able to do pretty good on this test and my parents enjoyed the banquet."

"Professor Vernon Willie's talk at the banquet was really good and showed us how math is in everyday things like the nautilus shell."

"My teacher gave me extra credit in math for participating which was the best part."

"I think 'Go Figure' was fun and it was a great experience to be able to see what goes on inside the Los Alamos National Laboratory and to do work using mathematics. I can't believe how close the fire came to the Laboratory.'

"The books we got for awards for the 'Go Figure' contest were good books on math. I shared them with my sisters and brother at home, my math class at school and students in my math club."

Anecdotal Data from Parents and Teachers

"Thank you so much for the nice banquet honoring my students. The students here are not my best students but are solid students who with this recognition could become top notch math students and could go on to college and excel in mathematics."

"I am so proud of 'mi hita'. We love her very much and want the best for her. I want her to do better than I did in school. Thanks for your support of our children."

"The food was good and the talk by Vernon Willie was very interesting and cultural."

"I would like to meet this Professor Abe Hillman and shake his hand."

The Los Alamos Dynamics Summer School

Program Description

Over the last 20 years there has been a 20% decline in the number of engineering degrees granted while university degrees in general have increased approximately 20%. Engineering dynamics, which encompass areas such as flight dynamics, vibration isolation for precision manufacturing, earthquake engineering, blast loading, signal processing, experimental modal analysis, etc. are naturally affected by this decrease in numbers. The competition for talented individuals with the background necessary to replace those leaving the field of engineering dynamics necessitates a pro-active approach of identifying, motivating, and educating students who are embarking on their graduate school careers. The Los Alamos Dynamics Summer School (LADSS) was designed with this pro-active approach in mind. The program is designed not only to benefit the students through their educational experience, but also to motivate them to attend graduate school and to make them aware of career possibilities in DOE laboratories after they have completed their graduate studies.

The summer school had two focus areas. First, the multidisciplinary nature of research in engineering dynamics was emphasized throughout the summer school. To this end, the students were assigned to multi-disciplinary teams and assigned a project where a coupled analytical/experimental approach to dynamics problems was required. Second, the program was designed to develop the students' written and oral communications skills. To develop these skills, the students were required to give numerous informal oral presentations of their work as it progressed throughout the summer, culminating in a formal presentation and a paper written for a technical conference.

Student body profile

The summer school was taught for the first time in the summer of 2000 to 13 students from nine universities who were selected from an applicant pool of 17. Four of the students are starting graduate school in the fall, two of the students have complete their first year of graduate school, and seven will be seniors next year. The students were mostly mechanical (7) or civil engineering majors (5), although there was one computer engineering/ math major. The average GPA for the students was 3.5 on a scale of 4.0. Undergraduate institutes that were represented by these students included Rose-Hulman Inst. of Tech., Virginia Tech, Univ. of Houston, Michigan Tech., Harvey Mudd, Univ. of Texas at El Paso, Univ. of California-Irvine, Montana St., and New Mexico St. Univ. Graduate schools represented by these students include Univ. of Texas at El Paso, Univ. of Southern California, Georgia Tech, Virginia Tech, Stanford, and New Mexico St. Univ. Four of the students were women or from underrepresented minorities.

Projects

The centerpiece of the summer school was an eight-week project having both an analytical and an experimental component. Students were placed in teams and assigned a project. An attempt was made to make the groups as multi-disciplinary and diverse as possible. The

experimental component was a critical aspect of the program because practical experimental activities in engineering dynamics are almost nonexistent at the undergraduate level. Students were assigned to multi-disciplinary teams consisting of three or four students. Each team had a mentor from Los Alamos or Sandia National Laboratory. The mentors worked closely with their groups providing guidance, encouragement, and technical expertise. All of the projects resulted in papers to be presented at the 2001 International Modal Analysis Conference. The titles of the resulting papers and their abstracts are listed below:

Characterization of Damping in Bolted Lap Joints

The dynamic response of a jointed beam was measured in laboratory experiments. The data were analyzed, and the system was mathematically modeled to establish plausible representations of joint damping behavior. Damping was examined in an approximate, local linear framework using log decrement and half-power bandwidth approaches. In addition, damping was modeled in a nonlinear framework using a hybrid surface irregularities model that employs a bristles-construct. Experimental and analytical results are presented. A picture of the lap joint studied is shown in Figure 6.

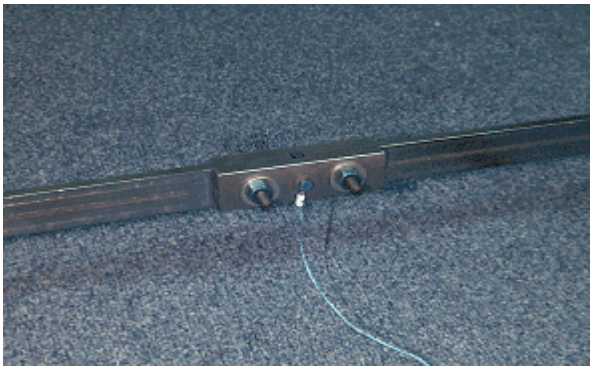


Figure 6. Instrumented lap joint.

Damage Detection in Building Joints through Statistical Analysis of Auto-Regressive Models

Using a physical model of a three-story building, accelerometer data were acquired to detect vibrations induced by a shaker. Data were collected on an undamaged model and a damaged model. Autoregressive models were fit to the data from the undamaged structure. These same models were used to predict the response of the damaged structure. Changes in the residual errors from these predictions were used as damage-sensitive features. Determining the presence of damage and its location was done using procedures from statistical process control. A picture of the instrumented structure is shown in Figure 7.

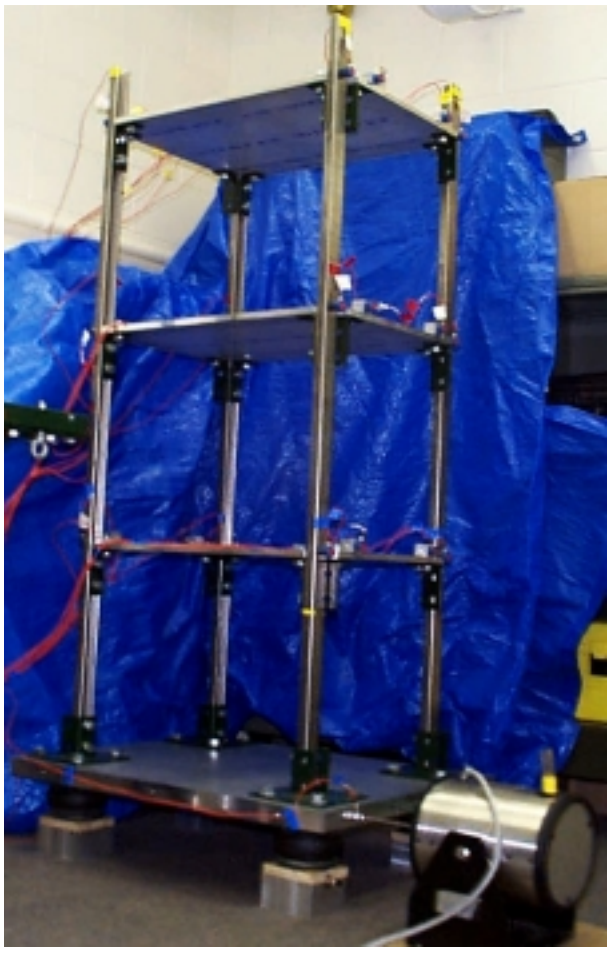


Figure 7. Simple model of a three-story building.

Identification of Nonlinearities in an 8-DOF System through Spectral Feedback

The accurate detection and characterization of nonlinearities associated with damage in structural systems is an area of vibration analysis that is being widely researched. In this study, nonlinear behavior is considered a potential indicator of damage. Most conventional damage detection methods, such as those based on resonant frequencies and mode shapes, do not accurately identify the location and extent of nonlinearities present in a given structural system. As an extension of previous work at the Los Alamos National Laboratory, an effort is made to validate a damage detection method proposed in the technical literature. This method states that the frequency response function (FRF) matrix obtained from a low-level vibration test approximates the underlying linear FRF matrix of the system. The nonlinear systems' responses to high-level excitation are combined with the linear FRF in a classic feedback loop to obtain the contributions of nonlinear internal forces. The temporal and spatial characteristics of the nonlinearities present in a structural system are identified. An eight-degrees-of-freedom (DOF) system is used as a test case to validate the aforementioned method. Results of the tests and important issues concerning the method are presented. A picture of the experimental setup is shown in Figure 8.

Figure 8. Eight-DOF System.

Design of a Personal Airbag Spinal Protection Device

Each year there are approximately 11,000 cases of spinal injuries that result in partial or complete paralysis. A significant number of these cases are the result of sports-related injuries that possibly could have been prevented with proper protection. The project undertaken was a preliminary investigation of the feasibility of a personal air bag spinal trauma protection device. A mock torso was constructed of wood, instrumented, and subjected to a 1-meter drop. The impact accelerations were measured for trials with and without a prototype air bag attached to the mock torso. Using a finite element commercial code ABAQUS/Explicit, students subjected a model of the mock torso to a simulated 1-meter drop. The model was refined to match the results from the experimental drops without an air bag. Then the analysis was performed with springs and dampers inserted to simulate the air bag. Pictures of the mock torso and the finite element model used are shown in Figures 9 and 10.

Figure 9. Mock torso constructed from wood.

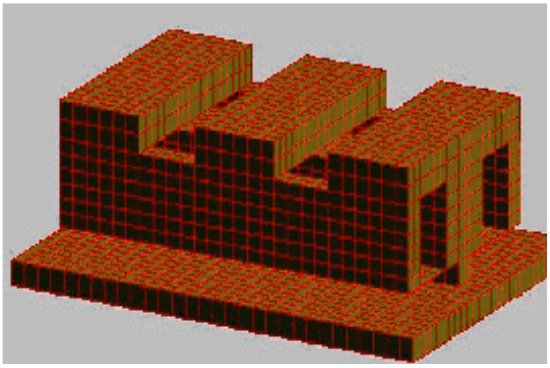


Figure 10. Finite-element model of the mock torso.

Experimental equipment

Students each had their own high-end PCs with numerical analysis and signal processing software donated by a leading mathematical software company. Each research group had access to a multichannel data acquisition system. Finite element analysis software was made available to each research group as necessary. Equipment on hand at the start of the summer school included the following:

1. 14 PCs with MS office and numerical analysis and signal processing software;
2. 40-channel data acquisition system, 2-channel data acquisition, 4 channel digital oscilloscope;
3. Data acquisition/signal processing software;
4. Experimental model software packages (MEScope);
5. Various sensors, impact hammers, small shakers that will depend on the identified projects;
6. Finite element software (implicit and explicit) packages as needed; and
7. Rigid-body dynamics software package.

A photograph of one of the summer students and the 40-channel data acquisition system used for two of the projects is shown in Figure 11.

Figure 11. One of the summer students using the data acquisition system.

Field trips

Several field trips were taken throughout the summer. These trips included tours of the Aging Aircraft Facility, Robotics Facility and Micro-Electromechanical Systems Facility at Sandia National Laboratory. Another field trip to see a Patriot missile test on the rock sled at Holloman Air Force base had to be cancelled as the test was made classified at the last minute.

Visiting Distinguished Lecturers

Each week a prominent guest lecturer in the field of engineering dynamics gave a talk to the students about "cutting edge research" in structural dynamics. These lecturers and the titles of their talks are listed in Table 5.

Most of the lecturers spent two to three days in Los Alamos. In addition to one formal presentation to the students, visiting lecturers spent time with the students discussing their projects, and providing suggestions and additional motivation.

Additional lectures

In addition to the project and the lectures by and interaction with the visiting distinguished scholars, the students received instruction on a variety of topics in engineering dynamics. This instruction took the form of lecture series on fairly general topics such as random vibrations or computational structural dynamics and single lectures on more specific topics such as bridge aerodynamics. The titles of these talks are listed in Table 5.

Table 5 – Distinguished Lecturers

Name	Title, University	Title of Talk
Dan Inman	Director of Center for Intelligent Material Systems and Structures; George R. Goodson Professor of Mechanical Engineering, Virginia Tech	Smart Structures for Vibration Reduction
David Zimmerman	Associate Professor of Mechanical engineering, University of Houston	Structural Dynamic Model Validation and Verification
Pete Avitabile	Assistant Professor in Mechanical Engineering; Founder and President of Dynamic Decisions; Developer of the Multimedia Format Modal Handbook, University of Massachusetts, Lowell	Introduction to Experimental Modal Analysis and Design Optimization by Inverting Targets
Anne Kiremidjian	Professor of Civil Engineering; Director of the John A. Blume Earthquake Engineering Center, Stanford University	Seismic Probabilistic Risk Assessment
Dave Brown	Professor of Mechanical Engineering; Director of the Structural Dynamics Research Laboratory, Univeristy of Cincinnati	Experimental Modal Testing Techniques
Geof Tomlinson	Professor; Director, Division of Aerospace Engineering; Director of Research, Engineering and Physical Science Division, University of Sheffield, UK	Novel Approaches to Structural Damping
Robert Nigbor	Associate Research Professor, USC	Earthquake Simulation Testing, Civil Structure Monitoring Examples

Table 6 – Additional Instruction Received by the Students			
Title	**Presenter**	**Title, Organization**	**Number of Lectures**
Rigid Body Dynamics	Phillip Cornwell	Associate Professor, Rose-Hutman Institute of Technology	4
A Rigid Body Dynamics Code – ADAMS	Scott Doebling	Staff Member, Los Alamos National Laboratory	1
Signal Processing	Norm Hunter	Staff Member, Los Alamos National Laboratory	3
Wavelets	Amy Robertson	Staff Member, Los Alamos National Laboratory	2
Applications of Wavelets	Cris Brislawn	Staff Member, Los Alamos National Laboratory	1
Random Vibrations	Tom Paez	Staff Member, Sandia National Laboratory	5
Improving Your Chances of Getting Valid Date	Bill Baker	Professor, University of New Mexico (retired)	3
Computational Structural Dynamics	Joel Bennett	Staff Member, Los Alamos National Laboratory	5
Practical Application of Vibration Analysis and Testing	Chuck Farrar	Staff Member, Los Alamos National Laboratory	3
Confinement Vessel Blast Analysis	Bob Stephens	Staff Member, Los Alamos National Laboratory	1
Bridge Aerodynamics	James Brownjohn	Associate Professor, Technological University, Singapore	1
Satellite Testing and Analysis	Tom Butler	Staff Member, Los Alamos National Laboratory	2
Environmental Testing	Norm Hunter	Staff Member, Los Alamos National Laboratory	1

Assessment

Students were required to provide written feedback regarding their experiences in the summer school program. This written feedback included evaluations of each speaker, field trip, guest lecturer, and a final overall evaluation of the summer school. The assessment of each speaker and guest lecturer will be used to decide which speakers to invite back next year as well as to give the individual speakers suggestions on how they can improve their contributions to the summer school. Overall the distinguished lecturers were rated very highly with an average score of 4.51 and a median score of 4.46 on a scale from one to five where a one is “poor” and a five is “excellent.” The average rating of the speakers giving the additional lectures was a 4.13, and the median score was 4.5 using the same scale. The average score for the additional lectures was pulled down significantly by one particularly bad speaker (who will not be invited back next year). The field trips to the Aging Aircraft Facility, the MEMs Facility and the Robotics Facility at Sandia National Laboratory received ratings of 4.35, 4.70, and 4.40, respectively, using the same scale discussed earlier. The average rating of the mentors was a 4.8. Based on the written comments, one of the strongest aspects of the program were the project mentors. The mentors are listed in Table 7.

Table 7. Summary of Mentors	
Mentor, Affiliation	**Area of Expertise**
Joel Bennett, ESA-EA	Computational Mechanics
Phil Cornwell, Rose-Hutman Institute of Technology	Rigid-body Dynamics
Chuck Farrar, ESA-EA	Structural Health Monitoring
Norm Hunter, ESA-MT	Environmental Testing and Signal Processing
Tom Paez, Sandia National Laboratory	Random Vibrations

A summary of the final overall survey is shown in Table 8. Clearly from Table 8 the program benefited students educationally as well as motivating students that had not already decided on attending graduate school to do so. The goal of making students aware of career opportunities at Los Alamos in hopes of recruiting them upon graduation was realized when 12 of the 13 students indicated a desire to return to the Lab in subsequent summers as a graduate research assistant. The fact that all 13 students would encourage someone they know to apply to the program next year is a clear testimony as to how positively the students viewed the program. As can be seen from Table 8 the average overall rating of the summer school was a 4.92. Basically 12 of the students gave the school a

Table 8. Summary of Assessment Results of the Overall Program	
Question	**Average Rating**
As a result of the program your knowledge and experience in experimental vibrations: (5 –Increased a great deal, 3 – Increased slightly, 1 – Stayed the same)	4.62
As a result of the program your knowledge and experience in analytical methods in vibrations: (5 –Increased a great deal, 3 – Increased slightly, 1 – Stayed the same)	4.46
Prior to the program if you had not already decided to go to graduate school did this program influence you to do so? (If you are already in graduate school or are attending one in the fall please leave blank)	5 yes, 0 no, 8 blank
Would you encourage someone to apply to the program next year?	13 yes, 0 no
Would you be interested in coming back to the Los Alamos National Laboratory as a graduate research assistant next summer if a position was available?	12 yes, 1 no
Overall rating of the summer school? (5 – Excellent, 4 – Very good, 3 – Good, 2 – Fair, 1 – Poor)	**4.92**

5 (excellent) and one student rated it as a 4 (very good).

When the students were asked to rate the quality of the teamwork in their groups, two of the groups averaged a score of 5, one an average of 4.66, and the final group had an average of 2.33. It was later discovered after reviewing these numbers that the group that rated the teamwork very low had one group member that did not fully participate in the project. Unfortunately, the program coordinator and mentor did not diagnose this problem earlier in the summer. A greater effort will be made in future years to diagnose the health of the groups early in the summer. It is interesting to note that even though two of the students were extremely frustrated with their remaining team member, they still rated the summer school as excellent.

Selected "Sound Bites"
The following quotes were obtained from the final survey of the students.

- "Overall the LADSS was the best engineering experience I have had. It definitely reaffirmed my desire to pursue advanced degrees in engineering."
- "As a graduate student, the concepts/ background in structural dynamics that I learned during the summer school were of great importance and provided me with great motivation to continue graduate work in the field of NDT."
- "Thanks for a great summer."
- "Thanks guys! Awesome summer. Really opened my eyes to graduate school and all the things I can look forward to learning."
- "What a great opportunity! This was the best summer I've spent at LANL. I learned a ton."
- "I enjoyed the camaraderie of the students."
- "It's the closest thing I've done to real engineering problem solving."
- "Great project. I learned a lot."
- "Overall best experience I've had here (at LANL) yet."

Even though the overall assessment of the program was overwhelmingly positive there were a number of suggested improvements. These primarily had to do with the ordering of the lectures, the lecture times, the limited or mildly inadequate experimental or computer equipment, and the relatively rare poor lecturer.

The success of the program was due to a number of factors including the following:

1. The quality of the students
2. The projects being relatively well defined at the beginning of the summer
3. The team nature of the projects
4. The already existing infrastructure at the lab for dealing with student programs
5. The overall quality of the mentors, distinguished lecturers and the other speakers.

Performance Objectives and Milestones

The original performance objectives were as follows:

1. The 10-week program will be designed for a select group of 15 upper division, US citizen, undergraduate or first-year graduate students.
2. Attempts will be made to identify high-quality students from diverse (human and academic) backgrounds.
3. Every attempt will be made to identify students from universities that emphasize undergraduate education as well as research institutes.

4. A variety of academic disciplines will be sought including aerospace eng., civil eng., mechanical eng., electrical eng., computer science, and mathematics/ statistics.
5. Expose students to the multi-disciplinary aspects of structural dynamics through analytical/experimental research project.
6. Develop students' written and oral communications skills.
7. Make students aware of career possibilities at DOE DP laboratories.
8. Students will be required to provide written feedback regarding their experience during the summer school.
9. The guest lecturers will be required to provide written feedback regarding the projects and overall administration of the program.
10. Los Alamos National Laboratory and DOE education programs offices will be provided an annual summary of the summer school and its demographics.
11. We will maintain an "alumni database" to track the careers of the summer school participants over the next few years. The information contained in this database will be used to quantify the success of the summer school in meeting its intended goals of motivating the students to attend graduate school and pursue engineering careers at DOE DP laboratories.

The milestones identified for the program in the original proposal were as follows:

- End of November 99: Obtain DOE funds for FY00 summer school and begin to recruit students.
- End of January 00: Identify and receive commitments of guest lecture. Obtain approval for field trips. Identify student projects and required equipment/test items.
- End of February 00: Identify students for FY00 summer school.
- End of March 00: Obtain space allocations for FY00 summer school. Obtain NSF and other matching funds and in-kind support.
- End of May 00: Obtain all necessary hardware and software for FY00 summer school.
- Mid June 00: Begin FY00 summer school.

As summarized in the program description, all the program objectives and milestones originally defined for this program have been met! Because the funding provided was significantly less than requested, the school was reduced in duration to eight weeks and only offered to thirteen students. The guest lecturers only provided oral feedback on the student projects and overall administration of the summer school. This feedback was overwhelmingly positive.

Of particular significance was the in-kind support provided by a leading mathematical software supplier that wishes to remain anonymous. The software they provide at no charge was instrumental in the success of this summer school and represented over $100K of support if we had to purchase it. Also, ESA Division provided 14 new PCs for the summer school at a cost of over $90k. The Engineering Analysis group in ESA provided the administrative support that was essential to the success of the summer school. A proposal was submitted to Los Alamos National Laboratory's Deputy Laboratory Director for Science and Technology Programs to obtain additional general and administrative (G&A) reinvestment funds to support the guest lecturers. This proposal was successful.

The organizers of the International Modal Analysis Conference (IMAC) have setup special session for our students to present their papers at this year's IMAC Conference in

February. We have obtained support from the students' various schools to have all of the summer school students attend the IMAC Conference.

Highlights of This Year's Accomplishments

Clearly the major highlight of this effort was simply putting on the summer school only three weeks after the staff involved with this activity were allowed to return to work from the unplanned leave of absence caused by the Cerro Grande Fire. The program appears to have achieved its primary goals of motivating undecided students to go to graduate school, of introducing a talented group of engineering students to both analytical and experimental engineering structural dynamics, and of making them aware of career opportunities at national laboratories such as Los Alamos, Sandia and Lawrence Livermore. Of particular note, this last goal was further addressed recently when the woman that the mentors in consensus considered the best student in the summer school recently inquired about the possibility of a job at Los Alamos National Laboratory upon completion of her MS degree in June, 2001. Management in ESA Division is now actively pursuing this individual through the appropriate recruiting channels. In this regard, the recruiting aspect of the summer school is already paying dividends. This accomplishment directly addresses the issues raised in the Chiles Commission Report regarding Recommendation #7 "Establish and Implement Plans on a Priority Basis for Replenishing Essential Technical Workforce Needs in Critical Skills."

The students rated the summer school as excellent, and every student indicated that he/she would encourage someone they knew to apply to the summer school. To truly meet the recruiting goal of the program, the staff in the Engineering Sciences Division will now have to be proactive in acting as mentors so that these students can return to Los Alamos as graduate research assistants in future summers.

All the student groups produce quality papers that will be presented at the International Modal Analysis Conference. A culminating highlight of the summer school was the oral presentations that the students made to the staff in the Engineering Science and Applications Division. Managers in this division noted that the student presentations were of the quality that the staff would give for a high-level program review in the nuclear weapons directorate. Another highlight of this first edition of the Los Alamos Dynamics Summer School was that the student group working on the spinal cord protection device made sufficient progress to apply for a patent for the device they have conceived. The students' conference papers along with their viewgraphs can be viewed at www.lanl.gov/projects/dss.

Finally, the quality of this program was further attested to during a recent visit to the Technology Center at Caterpillar, Inc. (one of the 30 Dow-Jones Industrial corporations). Caterpillar requested a presentation on the Los Alamos Dynamics Summer School. Upon completion of this presentation, the Director for New Technology asked if Caterpillar could send their new employees to the summer school along with Caterpillar Equipment to be used for the research projects.

Reference

Engineering & Technology Degrees, 1999, Engineering Workforce Commission of the American Association of Engineering Societies (EWC/AAES), 1999.

Los Alamos Summer School

Program Description

The Los Alamos Summer School, a joint program of the University of New Mexico (UNM) and the Los Alamos National Laboratory, has just completed its eleventh full year. The school targets upper-level undergraduates students, who will soon be making career choices, and recruits nationally to gain the most diverse possible class. We give the students an intense exposure to basic research by concentrating on many fascinating areas of physics, both through lectures by distinguished scientists on the latest developments and through mentored term projects. These areas include such eclectic disciplines of physics as high-energy, astronomical, weapons, condensed-matter, plasma, biological, laser, atomic, molecular, and optical. We also have the broader goal of teaching certain basic physics skills not commonly emphasized in the university curriculum, introducing high-performance supercomputing, and fostering a personal interaction between research scientists and students. Knowledge of the workings of scientific research, the frontier discoveries, and the newest computer techniques will greatly aid students, no matter what their ultimate career choice. For the past eight 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 office at the Laboratory through a DOE Defense Programs grant in addition to in-kind support from the Theoretical Directorate 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 “hot topics” in the field of physics, motivated from the speaker’s own research. First the lecturer introduces basic physical concepts from the perspective of ongoing research endeavors. This mode of presentation gives the students an opportunity to participate in new discoveries. Second, each student works on a research project for the whole summer term (see Figure 12.). A mentor from the senior scientific staff of the Laboratory or UNM guides the student through this endeavor. A variety of projects are available; many 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.

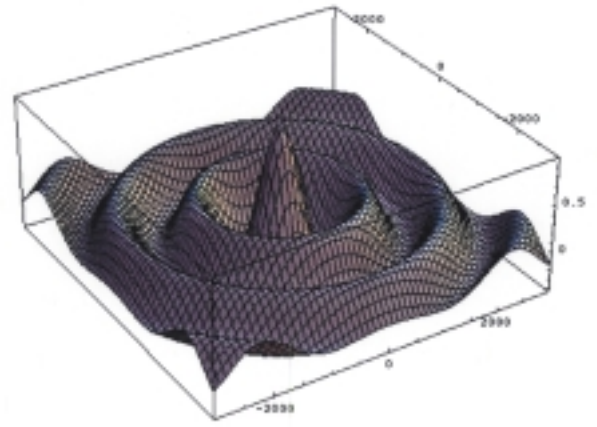


Figure 12. Nanostructure assemblage on a surface.

For 2000, we kept the ten-week term, begun last year at the behest of students and mentors, who felt the extra time led to more productive projects. Given the enthusiastic response to this year's projects, we could easily have extended the school for another two weeks. The students received 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 held the lectures in the mornings and reserved afternoons for research, attempting to strike a balance between these two activities. Classes and computer sessions were held on the campus of UNM at Los Alamos; the UNM computer center has a fast link to the Laboratory network while providing powerful local capabilities. The common class and computer rooms as well as their close proximity within student housing all encouraged a natural cohesiveness within the class. We further fostered this class spirit with tours of Laboratory facilities and of local points of interest and activities. The friendships made during the course of the school form an important, enduring feature as commented upon by almost all students, past and present.

While this basic formula has served the school admirably over its course, 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. This year we developed two special sessions: (1) Physics and Society and (2) High-performance Computing. The first session explored the role of science and scientists in the general society and culture while the second nurtured an important critical skill.

Performance Objective and Milestones

The main performance objective centers on the planning and operation of the school to encourage undergraduate students to pursue research careers in the physical sciences, important to the basic DOE/DP mission. This has become critical as biosciences and computer firms now attract the best university students. The short-term milestones of providing exciting projects and lectures to stimulate the students have been amply met. For the intermediate term, we have had students return to the Laboratory to continue research activities, had students working on advanced degrees with joint Laboratory and university mentors, and had students begin tenured-track university positions with continued strong ties with Laboratory personnel. Since the time these undergraduates may take to obtain a doctorate could span seven or eight years, we are just beginning to glimpse the long-term effects of the program.

Program Highlight Organization

Reflecting the dual nature of the sponsorship, we have co-directors with each taking particular responsibility for various tasks in operation and organization, based on resources, personnel, and location. For example, UNM has excellent facilities and staff at its several locations to handle the vital task of recruiting and to provide classroom and computer access while the Laboratory has the on-site technical staff from which to draw the mentors and lecturers. Sally Seidel served as co-director for the UNM side, and Lee Collins served for Los Alamos. Howard Bryant, a co-principal investigator on the NSF grant, provided invaluable service in many areas of the program. The school could not

function without the immeasurable contributions of Norm Magee (T-4). Daniel James (T-4) and Dana Berkeland (P-23) ably assisted in the planning and operation of the program.

Mentored Research Project

In 2000, nineteen students from universities in fourteen states participated in the combined curriculum of lectures and individual research projects. We had our largest number of mentors to date, beating last year's record, representing seven different Laboratory divisions and thirteen groups as well as UNM (see Table 9). Nineteen projects, supervised by twenty mentors, covered such diverse areas as quantum computing, Bose-Einstein condensates, neutrino oscillations, ultracold neutrons, HIV, the solar wind, and collapse of supernova. Topics and principal mentors appear in more detail in Table 9. We had three women scientists serve as mentors, which provided excellent role models for the students.

All students submitted detailed final reports, crafted along the lines of a standard scientific paper, on their research accomplishments. The papers will be bound into a Laboratory publication for general distribution. To aid in writing these reports, we held a special class on technical writing, given by Dr. Collins, who also serves as an Editor to *The Physical Review*. The main emphasis of the school centers on the research *experience*, giving the

Table 9. Mentors

Mentor/Organization	Project
Dana Berkeland (P-23):	Frequency Stabilization in a He-Ne Laser
Chris Fryer (T-6):	Core-Collapsed Supernova
Jim Cohen (T-4):	Quasiclassical Dynamics and Field Ionization
Stan Cohen (LANSCE-6) & Howard Bryant (UNM):	Spectroscopic Evidence for H^- in Stars
Dirk Morr (T-11):	Physics of High-Temperature Superconductors
Daniel James (T-4):	Detuned Quantum Mechanical Systems
David Kilcrease (T-4):	Electron Scattering from Neutral Atoms
Klaus Kirch (P-23):	Ultracold Neutrons
Chris Jarzynski (T-13):	Nonequilibrium Statistical Mechanics
Bill Louis (P-25):	MiniBoNE Neutrino Oscillation Experiment(2)
Paul Kwiat (P-23):	Ion Addressing in Quantum Computers
John Nolan (B-N2):	DNA Oligonucleotides Bonded to Beads
Roy Ribeiro (T-10):	Drug Resistance in HIV Infection
Hillary Thompson (CST-18):	Synthesis of Hydroxide Solids
Marius Stan (MST-8):	Thermodynamics of a Mg-Si Liquid Solution
Shirish Chitanvis (T-12):	Formation of Nanostructures on Surfaces
Dan Reisenfeld (NIS-1):	Studies of the Solar Wind
Lee Collins (T-4):	Nonlinear Effects in Bose-Einstein Condensates

students a taste of a hands-on technical project (see Figure 13.). 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 courses at their respective institutions. We anticipate publications in refereed research journals from some of these continuing efforts.

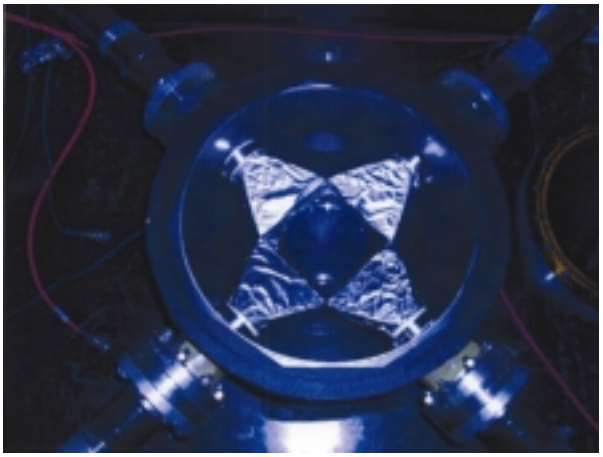


Figure 13. Neutrino oscillation experiment.

In fact, one of the students, Anne Arroyo, plans to return to the Laboratory in February to begin a masters degree in physics, jointly mentored by Dr. Dana Berkeland (P-23) and her research Professor at California State at Fullerton, Heidi Fearn. As a result of the enthusiastic request by both mentors and students, nearly half the class stayed on for one to two additional weeks in order to further pursue their research projects. The whole class would probably have remained had not university and mentor schedules intervened. Table 10 gives a rather gratifying, tangible demonstration of the success of the program.

Lectures

In addition, the students attended a full set of lectures on an extensive range of topics as outlined in greater detail in Table 10. Distinguished lecturers from outside universities and research organizations, Prof. R. Park (Maryland/APS) and Prof. H. Fearn (Cal-Fullerton), from the University of New Mexico, and from the Laboratory [6 divisions and 13 groups!] gave talks. We continued our strong participation from UNM, which highlights the important ties between the university and the Laboratory, generated by this program. We again drew upon the enthusiastic participation by the junior scientific staff at Los Alamos, mainly from postdoctoral fellows. This opportunity many times provides their only experience in preparing and giving lectures to a student group. As an example, one Feynman and two Oppenheimer Fellows served as mentors or lecturers.

We also developed two special programs during the term. The first centered on physics and society and in turn consisted of several parts. The first part featured a series of three lectures by Professor Bob Park from the University of Maryland that focused on pseudoscience and its renewed popularity within society. Professor Park also serves as the Public Affairs Officer of the American Physical Society and writes the widely distributed and highly popular commentary *What's New*. This special presentation drew upon his recent book *Voodoo Science* and gave the students a fascinating tour of the misuses and abuses claimed under the rubric of "science." He skillfully illustrated the need for continued scientific vigilance through case

Table 10. Lecturers		
Name	**Organization**	**Title**
Prof. Bob Park	Maryland/APS	Pseudoscience
Prof. Susan Atlas	UNM	Computational physics
Prof. Sally Seidel	UNM	Particle Physics
Prof. Howard Bryant	UNM	Physics of H^-
Prof. Heidi Fearn	Cal State	Quantum mechanics
Dr. Steven Younger	NWT	Nuclear weapons
Dr, Geoffrey West	T-8	Biological scaling Laws
Dr. Chris Fryer	T-6	Gamma ray bursts
Dr. Daniel Reisenfeld	NIS-1	Solar wind and corona
Dr. Eli Ben-Naim	T-CNLS	Granular matter
Dr. Mark Chadwick	T-2	Nuclear physics
Dr. Blake P. Wood	P-24	Plasma physics
Dr. David Rector	P-21	Biophysics
Dr. Rex Tayloe	P-25	Neutrinos oscillations
Dr. Cy Hoffman	P-23	Gamma-ray astronomy
Dr. Andrew Hime	P-23	Elusive Neutrinos
Dr. George Nickel	P-23	Information theory
Dr. Michael Holzscheiter	P-23	Ion traps
Dr. Salman Habib	T-8	State of cosmology
Dr. Steve Valone	MST-8	Shattering behavior
Dr. Paul Kwiat	P-25	Quantum cryptography
Dr. Antonio Redondo	T-12	Polymers

studies of actual incidents, many appearing on popular TV news segments, and the need of awareness by scientists of the large issues in society. The second part complemented this through a talk by Dr. Steven Younger, Associate Laboratory Director for Nuclear Weapons, on the nature and politics involved with national defense, especially in regards to nuclear weapons. This lecture again demonstrated the current situation of science as deeply tied to national and international events and politics. The second feature concerned science and culture. This part was initiated by a series of lectures from Dr. George Csanak (T-4) on science and eastern thought. Additional programs throughout the term built upon these links to cultural ideas; for example through a talk and class trip to a performance of the Santa Fe Opera.

The lecture series has been open to all Laboratory students, and we have routinely distributed the schedule to the undergraduate (UGS) and graduate (GRA) programs. Students in these programs attended many of the lectures.

Activities

In addition to the formal lecture and mentor programs, we have arranged for a wide variety of related activities for the students. We also had tours of various Laboratory facilities such as the Neutron Scattering Center (LANCE) and quantum computing Laboratories. We continued our traditional Night at the Santa Fe Opera (SFO) by attending *Rigoletto*. We have over the years fostered a special relation with the SFO and have been able to acquire block tickets so that the whole class can conveniently attend a single performance.

Recruitment and Demographics

Unlike most REU sites, we recruited nationwide with an emphasis on students from schools with little or no graduate research programs. The University of New Mexico handled the recruitment phase, consisting of an extensive mailing of fliers to all members of several American Physical Society Divisions (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 have worked closely with other efforts within the science education area at the Laboratory, including the Historically Black Colleges and Universities program. We have also developed a Web site http://www.phys.unm.edu/LASS that gives general information and allows direct applications. For 2000, we received over 100 applications and admitted twenty students, of whom nineteen accepted (see Figure 14).

This class was very strong scholastically, filled with many honors students. The students came from nineteen different universities from Massachusetts to California. These included liberal arts colleges with small research

Figure 14. Members of the LASS 2000 Class.

programs to large research-oriented schools. A complete list appears in Table 11. Our participation by women was down somewhat this year (21%); however, this was more due to a series of circumstances than to problems in recruitment and selection. After offers and acceptances, the class had better than 40% women membership, reflecting our usually high participation. However, we had three women students withdraw before the school began as a result of circumstances totally unrelated to the program involving scheduling problems with classes and entry examinations over the summer. Other underrepresented groups included Native American (1), Hispanic (1), Afro-Americans (2), and Asian (3) participants.

Table 11. LASS 2000 CLASS
Cal-State Fullerton (CA)
Transylvania (KY)
Grove City (PA)
Connecticut (CT)
Macalester (MN)
Mount Allison (CN)
Midwestern State (TX)
Grinnel (IA)
Washington (WA)
Harvey Mudd (CA)
Wayne State (MI)
Harvard (MA)
Tufts (MA)
Florida State (FL)
Southern Poly State (GA)
Arizona (AZ)
Oxford (UK)
Baylor (TX)
Edinburgh (UK)

Evaluation

We 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-term effects of the school were clearly very positive.

In the intermediate term, we have had students return to the Laboratory to work further in research programs. Three students from last year's class (99) returned this summer. In addition, one student from the University of Nevada at Reno from 96 is collaborating with members of T-4 on his Ph.D. project.

Budget

The FY00 budget ran at $190,000 with $70,000 from the NSF-REU grant and $120,000 from Science Education programs. In addition, considerable in-kind support (~$50,000) comes from both institutions including materials, computer time, and staff. In addition, T-Division provided a $10K special grant. The students were paid a stipend of $4200 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.

The difficulty in obtaining housing during the summer and the expense was greatly reduced by having new UNM housing available to the school. In addition to being enrolled as non-degree students at UNM, they are placed 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.

DOE/DP Mission Benefit

The school began as an internally funded project within the Los Alamos weapons program to encourage greater participation by outstanding students in research areas deemed vital to many DOE-DP missions. The basic goals of the Los Alamos Summer School closely align with recommendations of the Chiles Report, especially item 7, to "replenish the essential workforce needs" of the weapons laboratories.

Specifically, the program gives high profile and presence through its national recruitment process that targets both students and teachers at over 2000 universities and colleges, its use of distinguished lecturers from outside academic institutions, and its alumni.

The school serves as a ten-week internship program in which students become actively involved in a variety of research programs around the Laboratory. In addition, our classes have had strong participation by women, consistently at a percentage well above of that in university physics programs at the same level. We have also employed many women scientists as mentors and lecturers to serve as role models. Finally, we have furthered contacts through special lectures on science and weapons, for example, the one given by Associate Laboratory Director for Nuclear Weapons Steve Younger.

New Mexico High School Supercomputing Challenge

Program Description

The New Mexico High School Supercomputing Challenge is a two-fold educational program. Primarily, it is an academic-year-long program, in which teams of one to five high school students conduct computational science projects using high-performance computers. Secondly, during the summer months, it is a computational science and technology training program for high school teachers.

The program is both an educational experience and a competition that strives to

- Increase students' knowledge of and interest in science-related disciplines,
- Expose students and teachers to computational experiences,
- Promote careers in science and engineering,
- Provide access to high-performance computers, and
- Institute electronic networking among schools.

Student Program

Every registered participant is assigned an access account to a high-performance computer at Los Alamos National Laboratory. This computer is readily accessible via the Internet. If Internet access is not available through school or home, New Mexico Technet, as a co-sponsor, will provide dial-up telephone access accounts.

Each team is expected to define and operate on a single computational science project of its own design. Computational science is a discipline in which a scientific problem, be it one of biology, physics, geology, medicine, engineering, or any other field, is modeled by one or more mathematical equations. These equations are so computationally intensive that a computer, where the work can be accomplished in relatively little time, must solve them. Similarly, the output can be so complex that a computer must also interpret it.

Primary instruction and support given to the participants during the year

1. Three-day kickoff conference in October: Instruction in project development, teamwork, programming, mathematical modeling, Unix, and other topics.
2. School visits to requesting schools in November: Special assistance to schools requesting support with computers, networking, programming, or other issues.
3. Regional workshops in January: Small workshops held at sponsoring universities and colleges statewide. Students present the progress on their projects and attend classes in programming, computer graphics, and technical writing.
4. Project evaluation sessions in February: Semi-formal presentations, also held at sponsoring universities and colleges statewide, to a group of scientists who critique and provide feedback to teams about their projects.

5. Year-round online consulting: Technical support from Challenge consultants at Los Alamos National Laboratory by means of e-mail and telephone.

The sponsoring teachers provide year-round instruction and support. Many have been trained in the art of computational science during the summer teacher training sessions made available by the Challenge. Additionally, every effort is made to find mentors to help guide the teams through their projects. These mentors often specialize in the area of science or engineering that the student projects reflect.

Various deadlines are posted throughout the year. In general, the project abstract is due in late October, an interim report by mid-January, and the final report by early April.

The academic-year program culminates with an awards ceremony at the Laboratory (see Figure 15). Project finalists arrive a day in advance to present their project to a panel of scientists from national laboratories, industry, and academia. On awards day, prizes and awards are bestowed upon those teams whose projects demonstrate a high level of quality in one manner or another. Additionally, scholarships from universities throughout New Mexico are awarded on an individual basis to qualified Challenge participants. To finish the day off, students participate in special tours, talks, and demonstrations around the Laboratory, as well as a student poster contest.

Figure 15. 2000 Challenge Winners at the Awards Day Ceremony at Los Alamos National Laboratory.

Teacher Program

During the summer, a two-week summer teacher training session is held at an institution of higher education in New Mexico. Participating teachers are instructed in such topics as computational science, mathematical modeling, programming, Web page design, networking, and other topics. Additionally, individuals receive three units of graduate credit for their work.

The Challenge pays for the cost of instructors, facilities, books, graduate credits, housing, and stipends for food and miscellaneous expenses. Instructors come directly from Los Alamos National Laboratory and help to further enhance the Laboratory's relations with the communities of New Mexico.

Teachers who have attended the summer teacher training session become better able to support their students' endeavors in the Challenge, as well as develop into healthier computational scientists themselves. Although the days of instruction are intense, teachers always learn a lot and say that they would recommend the sessions to others.

Performance Objective and Milestones

One goal of the Challenge is 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 workforce of the future. Many milestones have already occurred this year for the Challenge relating to this goal.

Two new scholarships were added this year, for a total of nine. New Mexico State University is offering a renewable physics scholarship of $1,000 per year. New Mexico Highlands University has submitted a $1,866-per-year renewable scholarship. This brings this year's total to $36,000. See http://www.challenge.nm.org/scholarships.shtml, for a complete listing of our scholarships.

This year we introduced three new classes at the Kickoff Conference:

- Parallel programming techniques
- Message Passing Interface—MPI programming; and
- Java programming

The Challenge is continuing to provide a technology boost, giving schools access to the latest in computing hardware architectures and programming techniques.

A guided project for first-year Challenge teams was also created this year. The object of this project is to serve as a tool to educate uninitiated Challenge participants about the nature and processes of the Challenge. Furthermore, it gives the novice participant very basic-to-advanced programming skills, depending upon how far the project is taken. At http://www.challenge.nm.org/cryptography/, the guided project is available online.

Another milestone reached this year was the development of a set of online tutorials. These tutorials will help students learn technical aspects of the Challenge. The *Challenge Technical Guide* is located online at: http://www.challenge.nm.org/ctg/ and offers guidance in project development, networking, programming, Web page design, and other topics.

Since 1990, new organizations in New Mexico are continually joining with Los Alamos National Laboratory and New Mexico Technet

to sponsor the Challenge. New sponsors include NASA, Belew's Office Supplies, Miller Bonded, Inc., and Western New Mexico University. At http://www.challenge.nm.org/sponsors.shtml, you may view a complete list of our current sponsors.

Data was collected about the participants. Of the almost 70 teachers in attendance, females and males represented 51% and 49% of the population, respectively. It was the first time in over five years that female teachers outnumbered males. Nearly 325 students were divided into 67% males and 33% females. We continue to look for new ways to bolster the female student involvement in the Challenge.

Ethnic representation for students and teachers can be seen in Figure 16. We believe that the Challenge has been successful in reaching out to an incredibly diverse population.

Over 75% were new students, and 40% were new teachers of the total student and teacher populations, respectively. Additionally, over half of Challenge participants are from small towns and rural areas (Figure 17).

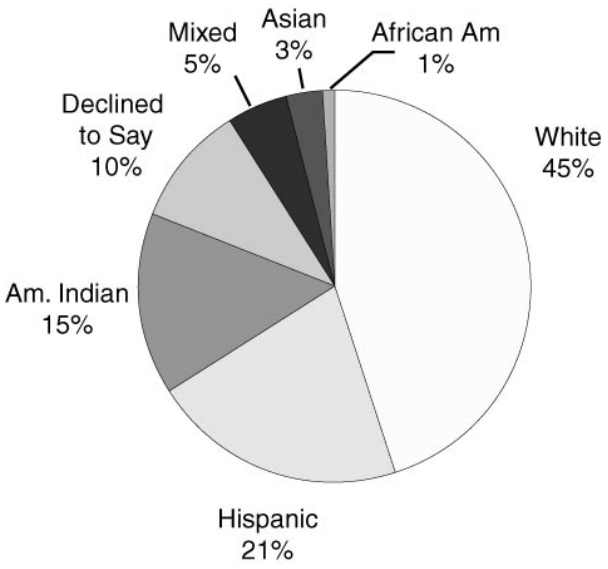


Figure 16. Ethnicity for 1999–2000.

Figure 17. '99–'00 finalists from Roswell.

It was the first time a Challenge event has taken place at Western New Mexico University. The 2000 Summer Teacher Training Session at WNMU was very successful, due largely in part to the exceptional cooperation from the faculty and staff at the university. As a result of lack of funding, however, the standard two-week teacher training session had to be condensed into one week. It was, as a result, a challenge for the participants to absorb all of the information.

The Challenge has also directly addressed Los Alamos National Laboratory's Stockpile Stewardship Critical Skills Area #3: HPC—High Performance Computing and Simulation.

The official definition of High-performance Computing and Simulation includes the following:

- Computer Operations: Challenge students learn how to remotely access and operate high-performance computers;
- Computer and Computational Science and Math: Students learn computer programming at Challenge events, and use computational science and math within their computer programs to carry out their projects;

- Code Development and Code Maintenance: The students continually update and improve their codes over a seven-month period;
- Advanced Codes and Computation: Students have learned advanced programming techniques such as MPI from Challenge events.

Most importantly, October 1999 marked the beginning of the tenth year of the Challenge. The Challenge staff has been proud to offer other services to the communities of New Mexico during the past decade. Current information about the Challenge can be viewed online at: http://www.challenge.nm.org.

Relation to Chiles Commission Report

The March 1, 1999, report of the Commission on Maintaining United States Nuclear Weapons Expertise is generally referred to as the "Chiles Commission Report." The report was written to

> Develop a plan for recruiting and retaining within the Department of Energy (DOE) nuclear weapons complex such scientific, engineering and technical personnel as the Commission determines appropriate in order to permit the Department to maintain over the long term a safe and reliable nuclear weapons stockpile without engaging in underground nuclear testing.

The Laboratory is reaching out to the communities of New Mexico. Laboratory scientists are visibly involved in the student and teacher instructional sessions, as well as the awards day talks, tours, and demonstrations. As a result, students who are involved in the Challenge view the national laboratories as great places to work, learn, and conduct science. We are without a doubt, recruiting for the Laboratory scientific talent, who are at a young age. The Challenge is also directing students towards and instructing in scientific, engineering, and technical disciplines. All of these disciplines are natural parts of a computational science project. The phrase "without engaging in underground nuclear testing" means that Laboratory scientists must use computational science techniques to model the reliability of the nuclear weapons stockpile. The Challenge is in fact training students in these same critical scientific techniques.

Recommendation Seven of the Chiles Commission Report

This recommendation suggests that

- We establish and implement plans on a priority basis for replenishing essential technical workforce needs in critical skills.
- "DOE and its nuclear weapons program contractors should, on a priority basis, develop and implement a detailed and long-term site-specific and complex-wide plan for replenishing the essential scientific, engineering and technical nuclear weapons workforce. Large numbers of workers are reaching retirement and a new generation of workers must be hired and trained in order to preserve essential skills."

The Challenge is directly aiding in replenishing the essential scientific, engineering, and technical nuclear weapons workforce by stimulating interest and training in the discipline of computational science.

As a direct example, winning teams from the last three years have used a cluster of machines named "Theta" to solve their

projects. Theta is a cluster of two SGI Origin 2000s, the same architecture as the Accelerated Strategic Computing Initiative, or ASCI, "Blue Mountain" machine (see Figure 18.). ASCI is a tri-laboratory and DOE Defense Programs collaboration that will create the leading-edge computations modeling and simulation capabilities that are essential for maintaining the safety, reliability, and performance of the US nuclear stockpile and reducing the nuclear danger. Blue Mountain is a machine that assists in this mission and eliminates the need for underground nuclear testing.

Highlights of This Year's Accomplishments

Kickoff Conference (see Figure 19)

The Challenge was able to obtain Mark Henne (a University of New Mexico graduate) from Pixar Animation to deliver the keynote speech. Additionally, he presented engaging evening discussions about his work on the movie "A Bug's Life." This was truly a joy for the students.

Another speaker that came to the conference was the winner in the first annual New

Figure 18. Overview of the ASCI Blue Mountain supercomputer.

Figure 19. (left and right). Students in Unix and programming classes at the'99 kickoff conference.

Mexico High School Supercomputing Challenge. It was motivational for the students to see how successful a former Challenge participant has been with his career.

Recognition and Awards
The Governor Gary Johnson of New Mexico signed a proclamation that designated October as Supercomputing Month, in honor of the Challenge. The plaque has been displayed during Challenge events throughout the year.

David Kratzer of Los Alamos National Laboratory was honored with a Certificate of Appreciation signed by the governor of New Mexico. The certificate honored his decade of work with the Challenge, and the effect it has had on the approximately 5,000 students who have participated in the Challenge.

Congressional Briefing
In early November, Challenge coordinators and participants invited the Press and New Mexico's Senators and Representatives to Bernalillo High School. This event was to celebrate the tenth anniversary of the Challenge and to bring attention to the funding tribulations the Challenge has been facing.

Candace Martinez, a Bernalillo High School computer science teacher and Challenge team sponsor, and her students hosted this congressional briefing for Senators Bingaman and Domenici, Representatives Wilson and Udall, and Commissioner Gloria Tristani of the Federal Communications Commission.

Teachers in attendance discussed the importance of the student and teacher training programs. The speed of parallel processing was demonstrated on a high-performance computer at the Laboratory. Students presented their projects and outlined some of the Challenge elements: what supercomputing is and why it is essential for solving certain kinds of problems, the importance of a mentor for successful projects, and ten-year Challenge statistics.

Regional Workshops
A great success this year was the "meet the scientist luncheon" at the regional workshops. Over lunch, local faculty members and scientists discussed the teams' projects with them, offered suggestions, and lent support to their ideas.

Promotion
Several times during the year, Challenge coordinators attended conferences and workshops to promote the Challenge and encourage participation by others. A portion of the Laboratory's booth at Supercomputing '99 in Portland was for a Challenge display.

Awards Day Ceremony
The Challenge competition came to a conclusion in April when about 150 participants came to Los Alamos. LANL scientists provided tours and scientific talks. Additionally, the participants were able to see the computers they had been working on while viewing the Laboratory Data Communication Center machine room.
Approximately 90 LANL personnel were involved with the activities in one way or another.

A team of three freshman girls from Sandia Preparatory School walked away with the top honors. At http://www.challenge.nm.org/Archive/99-00/AwardsDay/winners.shtml there is an official Laboratory press release with more details.

Summer Teacher Training Session
In June, a week-long Summer Teacher Training Session was held at Western New Mexico University in Silver City, New Mexico (see Figure 20). This was the very first time a Challenge activity has taken place at WNMU.

Participating were 13 teachers from around the state, receiving two units of graduate credit each from WNMU. They were instructed in Java, Unix, HTML, and other topics. It was the first time Java has been taught at a teacher training session

Other

The Challenge has had a positive impact on students, teachers, schools, and communities throughout New Mexico. As a result, the Laboratory's participation has had a positive effect on participants' perception of the Laboratory. Additionally, the Laboratory has been able to use the Challenge to promote "good neighbor" practices and has received a lot of positive press coverage due to the Challenge.

The Laboratory and the other Challenge sponsors look forward to their contributions to the future participants and the world in which they will live.

The New Mexico High School Supercomputing Challenge

Web: http://www.challenge.nm.org

E-mail: consult@challenge.nm.org

Figure 20. Teachers and staff at the Summer Teacher Training Session at Western New Mexico University.

Nuclear Science Education for the 21st Century: *Modern f-Element Chemistry*

Program Description

This project continues the unique undergraduate/graduate-level course focused exclusively on the molecular chemistry of the actinide elements. The program, which is fully accredited by the University of New Mexico (UNM), features both a lecture course and selective research fellowships, and is coordinated through the Seaborg Institute for Transactinium Science (ITS). The lecture course was presented during the summer semester at UNM-Los Alamos (UNM-LA). The lectures provide an introduction to the chemistry of the actinide elements—an area that is frequently overlooked in most undergraduate and graduate courses. The 12-week summer research fellowships entailed participation in both the lecture course and an independent research project.

Performance Objectives and Milestones

Our aim is to develop an internationally recognized educational program that will (1) act as a national resource for the teaching of actinide chemistry, (2) complement Lawrence Livermore's summer school program in nuclear chemistry, and (3) provide a vehicle for recruitment of the next generation of actinide scientists and engineers. As a result of the success from the previous year, this pilot-level program was continued and grew to include a second set of fellowships and classes in radiochemistry. We are hopeful that this growth will continue in subsequent years and will lead to establishment of a number of similar educational curricula in related disciplines, e.g., material, and interfacial and environmental aspects of actinide science. At the conclusion of the course the students acquired a greater appreciation of the diverse role of actinide chemistry in nuclear energy and national security. With this insight, together with the introduction to the extensive research facilities available at national laboratories, we hope to stimulate talented young researchers toward a career in actinide or nuclear science. All milestones listed in the proposal, including fellows search, presenting the course and research presentations and publications, were realized. In addition, a half-day short-course in *f*-element chemistry was presented at the Waste Management 2000 Conference in Tucson, AZ, where a mix of industrial and academic participants attended.

Highlights of Year's Accomplishments

We detail below our progress to date this fiscal year on three separate projects: (1) a Spring short-course in Tucson, AZ, (2) the Summer lecture course at LANL, and (3) sponsoring of research fellows in actinide science during the summer of 2000.

1. On February 28th we presented a four-hour short course entitled "Actinide Chemistry - Environmental Applications" at the Waste Management 2000 Conference in Tucson, AZ, the conference sponsors included the Waste-management Education and Research Consortium (WERC), who were responsible for inviting us to present this course. Registrants for the course included employees from

the Idaho National Engineering and Environmental Laboratory and Pacific Northwest National Laboratory, and also a professor of chemistry from Clemson University who was interested in implementing a course in actinide chemistry. The course was a highly condensed version of our "Modern *f*-element Chemistry" class, although aimed at a slightly higher level (since the Waste Management 2000 Conference was attended exclusively by scientists with a background in actinide chemistry).

2. We arranged once again to teach the "Modern *f*-element Chemistry" course at the University of New Mexico's Los Alamos campus, and the course was added to the summer schedule (as course numbers CHEM 325 (undergraduate) and CHEM 537 (graduate). The collaboration with the broadcasting personnel at the WERC site at New Mexico State University was continued, where a rebroadcast of the signal via satellite was sent to downlink sites around the state.

3. We distributed posters to approximately 125 chemistry departments nationwide announcing our intention to fund six Seaborg Institute Research Fellows during the summer of 2000. This year we also set up a Web site <http://pearl1.lanl.gov/seaborg> to allow the applicants to obtain information about the Seaborg Institute and to apply on-line. The deadline for applications was March 1st. The selected candidates comprised three junior undergraduates (from Columbia University, Wheaton College and Colorado State University), and three graduate students (from the University of Idaho, Ohio State University and the University of Texas, Austin). The fellows were at the Laboratory for 10–12 weeks. They attended the "Modern *f*-element Chemistry" course in addition to performing independent research under the guidance of LANL scientists. During their summer research, they gave oral presentations of their work to groups of staff, postdocs and fellow students (see Figure 21).

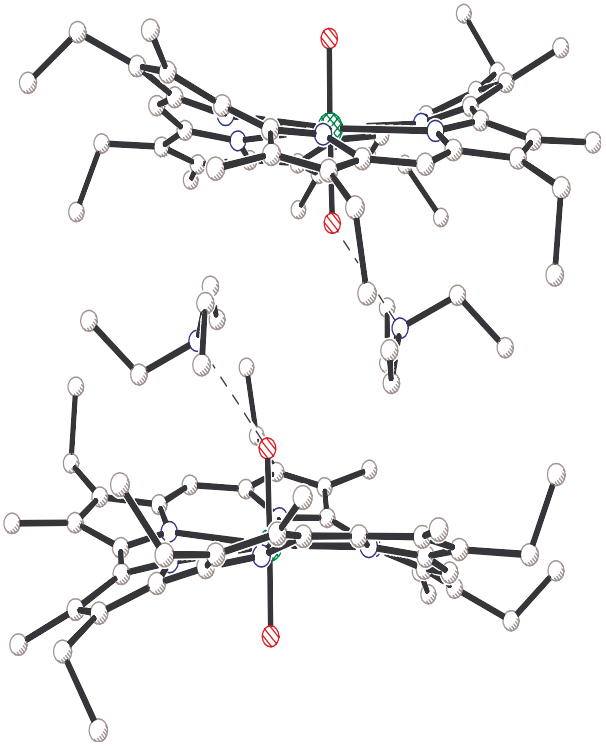


Figure 21. Luminescent terbium complexes used to detect low levels of anthrax spores.

Technician and Student Development

We also distributed an announcement of the summer course to the students, postdocs and technicians who work within the Chemical Science, Nuclear Materials and Materials Science Divisions at the Laboratory. The course announcement was also posted on both the student and postdoc pages on the LANL Web site so that it was seen by all incoming students this summer. We had an extremely positive response to the course announcement

from many LANL employees, and a significant number registered to take the course.

The six research fellows, who were at the Laboratory for 10–12 weeks, were

Mark Rubinshtein
Junior at Columbia University. Mark examined the coordination geometries of lanthanide metals within the framework of ambidentate ligands such as 2,2'-binicotinic acid.

Susan Habas
Junior at Wheaton College. Susan examined the use of environmentally-friendly barrier materials for the sequestration of toxic and radioactive materials. Of immediate concern was the migration of aqueous uranium and colloidal plutonium from the Los Alamos site.

Erick Palmer
A second year graduate student from Ohio State University (Research Advisor – Prof. Bruce Bursten). Erick studied potential synthetic pathways to the isolation of an alkylidene complex of samarium.

David Foo
A third year graduate student from the University of Idaho (Research Advisor – Prof. Pam Shapiro). David prepared a number of novel ligands that may be used to prepare olefin polymerization catalysts containing lanthanide metals.

Anne Vivian
A third year graduate student from the University of Texas, Austin (Research Advisor – Prof. Jonathan Sessler). Anne prepared the first example of a transuranic element (neptunium) coordinated by an aza-donor expanded porphyrin ligand.

The research fellows all had an extremely productive summer at the Laboratory, and there are currently several manuscripts published, in preparation, or in press:

- Sessler, J. L.; Seidel, D.; Vivian, A. E.; Lynch, V.; Scott, B. L.; Keogh, D. W.; "The Expanded Porphyrin Hexaphyrin(1.0.1.0.0.0): A Novel Ligand for the Complexation of Actinide Cations Uranyl (UO_2^{+2}) and Neptunyl (NpO_2^{+})," submitted to *Angew. Chem.*

- Clark, D. L.; Donohoe, R. J.; Gordon, J. C.; Gordon, P. L.; Keogh, D. W.; Scott, B. L.; Tait, C. D.; Watkin, J. G.; "The First Single-Crystal X-Ray Diffraction Study of a Lanthanide Tricarbonate Complex: $[Co(NH_3)_6][Sm(CO_3)_3(H_2O)].4H_2O$," *J. Chem. Soc., Dalton Trans.*, 2000, 1975.

- Bond, D. L.; Clark, D. L.; Donohoe, R. J.; Gordon, J. C.; Gordon, P. L.; Keogh, D. W.; Scott, B. L.; Tait, C. D.; Watkin, J. G.; "A New Class of Lanthanide Carbonates: Synthesis, Properties and X-Ray Structure of the One-Dimensional Chain Complex $[Co(NH_3)_6]_3[K(H_2O)_6][Nd_2(CO_3)_8]$," *Inorg. Chem.* 2000, *39*, 3934.

- Essig, M. W.; Keogh, D. W.; Scott, B. L.; Watkin, J. G.; "Synthesis and Structural Characterization of the Lanthanide Schiff-Base Complexes $\{N[CH_2CH_2N{=}CH(2\text{-}O\text{-}3,5\text{-}t\text{-}Bu_2C_6H_2)]_3\}Ln$ (Ln = Sm, Nd)," *Polyhedron*, in press.

- Keogh, D. W.; Warner, B. P.; Williams, D. B.; Morris, D. E.; Vanderberg, L. A.; Watkin, J. G.; "Low Level Detection of Anthrax Residues Using Terbium Luminescence," manuscript in preparation.

- Keogh, D. W.; Watkin, J. G.; Scott, B.L.; Gordon, J. C.; Rubinshtein, M. "Formation of Bimetallic Lanthanide Complexes Using 2,2'-Binicotinic Acid," manuscript in preparation.

The nuclear weapons mission of both Defense Programs and the Laboratory is to ensure confidence in the safety, reliability and performance of US nuclear weapons without nuclear testing. In the absence of nuclear testing, this requires a science-based approach to stockpile stewardship. Decisions must be made based on sound technical understanding and expert judgement developed through theory, experiment, and simulation. Therefore, one of the principal long-term issues facing the DP laboratories is that of maintaining the quality of our scientific staff. Of grave concern is that a large fraction of Laboratory staff could retire within the next decade (40% of LANL technical staff are aged 50 or older), and their expertise and knowledge must be transferred to a new generation. From this perspective, modern *f*-element chemistry is one of the crucial components of science and technology needed to reconstitute an underground nuclear testing or nuclear weapons production capability. It is sobering to recognize that virtually all of the LANL new hires over the past 20 years lack formal training in either this discipline or nuclear and radiochemistry. Our educational program is designed to provide overlap to transfer this corporate knowledge to current laboratory and DOE staff, and build a scientific base for future programmatic success. On page 29 of the Chiles Commission Report "Maintaining United States Nuclear Weapons Expertise," it is stated that "Post-doctoral, intern, and continuing education programs should be emphasized as especially important recruitment tools, and special emphasis should be placed on making the nuclear weapons complex an attractive place for women to work, given the increasing fraction of women in the scientific and engineering programs at American universities." Over the two-year duration of this program, 33 of our students and fellows have been women, which represents 42% of our total enrollment. We are extremely pleased with the relatively high proportion of female students, technicians and postdocs who have signed up to take the *f*-element course, and we will strive to maintain this level of interest.

A combined total of 29 students registered for the workshop and summer course. In addition to the students enrolled at UNM-LA, local Albuquerque and distance-education sites coordinated through either the UNM or WERC systems led to the registration of four students from UNM's Albuquerque campus and two students at New Mexico Tech in Socorro (see Table 12.) This course attracted a diverse audience representing a number of ethnic and minority groups.

Table 12. Institutions Represented by Students Attending "Modern *f*-Element Chemistry" Courses

University of New Mexico - Albuquerque
University of New Mexico - Los Alamos
New Mexico State University
New Mexico Institute of Mining and Technology
Ohio State University
Columbia University
Clemson University
Wheaton College
University of Idaho
Colorado State University
University of Texas, Austin

In order to continually improve the quality of the program, feedback from both UNM course surveys and custom-made course evaluations is being employed. These surveys seek input on the specific course topics, potential interest in additional classes in future years, the attitudes of the students toward actinide chemistry, and the possibility of future career plans within actinide or nuclear science. In addition, we are compiling complete listings of e–mail addresses of all students participating in the courses, in order to track the future educational or employment endeavors of the students. This will enable us to judge the potency this program has in stimulating interest among young scientists in the "Nuclear Future."

Summary

We have described the activities that have taken place during the initial year of this program. Our intention is to expand the scope of the program to the point at which students will be able to take fully accredited courses not only in *f*-element chemistry, but also in closely allied subjects such as radiochemistry, environmental actinide chemistry, and interfacial actinide science.

Robotics Workshop

Program Description

The sixth Los Alamos Robotics Workshop took place in Santa Fe on May 4–7, 2000. The advanced workshop was a three-day event; Thursday, Friday, and Saturday. Sunday afternoon was the time set aside for younger roboticists (6–12 years old) and their parents. In the afternoon we held an informal competition for both the "solar rollers" and the aesthetic "solar flapper" butterflies. This year's Workshop added a new dimension with the addition of the Santa Fe Art Institute as a co-sponsor. They provided space to conduct the workshop, dorm space for workshop mentors, a lecture hall where nightly lectures were held on robotics and kinetic art, and a speaker from the Santa Fe Institute.

The advanced three-day workshop had over 100 students from all over New Mexico and adjoining states. A series of graded-level kits were provided to the students as they progressed through the technology, starting with simple solar-engined cars and butterflies and ending with four-motor walkers with heads that detected light sources and guided the walker to follow them. Eight mentors were available to work with students on demand, providing an intense and satisfying hands-on experience for the participants. The half-day beginning workshop had eighty student attendees, each with at least one parent or guardian present. These participants built the simplest kits – the solar-engined cars and butterflies.

We had students from northern and southern New Mexico, Colorado, Texas and Kansas. An "English as the second language" class from Raton, New Mexico attended the advanced workshop, as did an advanced robotics class from Albuquerque. A group of students from the Family Resources Center in Las Vegas, New Mexico also attended the three-day workshop.

Attendance Figures

Advanced Workshop
- 111 student participants, 7 teachers
- 36 female students
- 49 Hispanic
- 13 Native American

Beginners Workshop
- 80 student participants
- 29 female students
- 14 Hispanic
- 18 Native American

Summer of Applied Geophysical Experience (SAGE)

Program Description

SAGE, the Summer of Applied Geophysical Experience, is a month-long, field-based course in geophysics for graduate students, upper-level undergraduate students, and selected professionals including postdoctoral fellows and college faculty. The goals of the program are to enhance students' education in the earth sciences, to expose them to research, and to advance their careers in Earth science and related fields. In addition, the program exposes students to career opportunities through an extensive visitors' program, whereby professionals from industry and Los Alamos interact with the students. Industry professionals work with the students in the field, lecture on case studies and technical topics, and even recruit at SAGE. SAGE is unique and different from university courses in that students learn by collecting and interpreting original geophysical data related to a variety of applied and basic problems (see next section), and by integrating data from a variety of geophysical techniques to arrive at self consistent interpretations. Final oral and written presentations of their results ensure that each student "takes possession" of his/her projects.

Students use a variety of geophysical exploration methods, including seismic refraction and reflection, ground-penetrating radar, magnetics, gravity, and several electromagnetic techniques. Students learn to combine the results of all techniques together, taking into account the different resolutions and sometimes disparate results provided by the different techniques, to derive an integrated interpretation that is compatible with the geological context. Data are processed on personal computers and workstations. Because of the students' diverse backgrounds and different educational levels, classroom lectures on all techniques are provided at the beginning of SAGE. In addition, participants spent three full days on field trips studying the geology of the Rio Grande Valley to provide a context within which to interpret their geophysical results. Teamwork is emphasized throughout the program because in both academic and industrial work environments geophysical investigation and interpretation are typically done by groups of individuals working as teams. Students work in *field teams* to collect data. After the data are dowloaded in the laboratory, students work simultaneously as part of *disciplinary* teams (e.g., seismic refraction technique) and as *multidisciplinary teams* (focused on a specific area or topic) to process and interpret the geophysical data. Each team selects a "team leader," who is responsible for presenting a summary prior to, and an integration following, oral presentations by the team members.

Some students come from universities that already have strong geophysics programs. Others are from smaller universities or colleges that do not have geophysics courses or concentrations. These latter students are selected for their strong preparation in math and physics, and a strong interest in Earth science. SAGE helps them combine their math and physics skills with Earth science to expose them, many for the first time, to geophysics.

SAGE strives to foster independent, critical thinking by requiring that each student focus

on an independent project (while still working as a member of a team) for final data processing and interpretation. For some students, SAGE is their first exposure to research. Some students continue to process SAGE data for senior theses, and many develop M.S. theses around their SAGE projects.

Many of the students' home institutions award academic credit for SAGE by allowing students to register for independent study, or by substituting SAGE for a required geology field course. Formal credit may also be received by registering with the University of California (Riverside) Extension Program, which can then be transferred to the students' home institutions.

SAGE recruits nationally by a variety of means, including (1) an annual mailing to all geoscience departments in the United States, (2) maintaining a World Wide Web site (see below), (3) peer-reviewed and programmatic publications, (4) presentations at national meetings, (5) the inevitable personal contacts by the SAGE faculty, and (6) word-of-mouth by former students. SAGE receives international visibility primarily though its publications and through professional contacts by faculty and former students. SAGE has attracted some students through coordination with other educational programs at Los Alamos.

Logistics

SAGE is presently based at the College of Santa Fe (CSF) in Santa Fe, New Mexico. All students and most faculty and visitors are housed in dormitories, and meals are provided at the cafeteria. SAGE rents classrooms in the Science Building for lecture, computer, and storage facilities. Vehicles for field work are rented from San Diego State University, the University of California at Riverside, the GSA motor pool at Los Alamos, and through commercial companies. Strong office support is provided by the University of California's branch of the Institute of Geophysics and Planetary Physics at Los Alamos.

Recent Publication

Jiracek, G. R.; Baldridge, W. S.; Biehler, S.; Braile, L. W.; Ferguson, J. F., Gilpin, B. E., and Alumbaugh, D. L., 2000, "SAGE: Learning Geophysics by Immersion, The Leading Edge," Society of Exploration Geophysicists, v. 19, pp. 986-990.

Performance Objective and Milestones

Primary objectives of SAGE are (1) to instruct graduate and upper-level undergraduate students in a variety of methods in exploration geophysics and to apply these techniques to problems of significant geological interest, (2) to involve students in a long-term program of research into the structure/tectonics of the Rio Grande rift and in other applied geological problems (e. g., hydrology and characterization of contaminated waste sites), (3) to enhance and advance their careers in earth sciences, and (4) to introduce students to research and career opportunities at Los Alamos and other national laboratories.

Three students from SAGE 2000 spent the remainder of their summer conducting research projects at the Los Alamos National Laboratory. They joined at least two former SAGE students who are currently at the Laboratory (see below). In general it is too soon to evaluate the potential benefits to students from SAGE 2000 because most or all have returned to the universities from which

they attended SAGE and are continuing with their studies. For the SAGE 1999 students, however, evaluation is easier. Of the undergraduates who attended, at least six have entered graduate schools in geophysical programs. One former undergraduate student from SAGE 1999 is currently working for an environmental geophysical company as a direct result of contacts she made at SAGE. One graduate student from SAGE 1999 is continuing to use SAGE data acquired at Material Disposal Area-B (MDA-B) (LANL) for his M.S. thesis. Nine graduate students are continuing with their thesis work.

How are these performance measures strategically related to the Laboratory's objectives?

Objective 1
"Strengthen and provide broad-based, scientifically-grounded support for programmatic mission elements." SAGE has worked with the Environmental Restoration Project and other programs to apply basic geophysical techniques and interpretations to program objectives.

Objective 2
"Foster excellence in basic research." SAGE fosters basic research in geophysics, in collaboration with several universities, the County of Santa Fe, the New Mexico Office of the State Engineer, and the U. S. Geological Survey. SAGE results are presented in technical meetings and published in peer-reviewed, international literature. SAGE enhances the national and international visibility of Laboratory programs.

Objective 3
"Foster partnerships with universities, industries, other government laboratories, and other scientific institutions to enhance our research efforts and to extend our capabilities." SAGE *is* a partnership between the Los Alamos National Laboratory, Sandia National Laboratories, and six universities. Each year students represent more than 20 colleges and universities nationwide. Funding and "in-kind" support for SAGE typically includes approximately 20 companies.

Objective 4
"Protect and strengthen the Department of Energy's national security mission." Several individuals who have participated in the SAGE program work for the DOE weapons laboratories, have participated as students or postdoctoral fellows, or have continuing working relationships with Laboratory programs. In addition, at least one SAGE faculty member has participated directly in programmatic work at Los Alamos.

Objective (5)
"Cause the laboratory to be increasingly valued as a good neighbor; candid, open, and effective community relations strengthen the Laboratory's ability to conduct its national mission." SAGE works closely with, and contributes valuable information to, adjacent communities (e.g., the City and County of Santa Fe), public agencies (NM Office of the State Engineer and the New Mexico Bureau of Mines and Mineral Resources), private agencies (e.g., Eldorado Utilities), and private citizens. These frequent and open contacts are enormously valued by the outside agencies and individuals, and cause the Laboratory to be viewed positively.

SAGE 2000 - Highlights of This Year's Accomplishments

From Boston to San Diego, and Atlanta to Seattle, a group of 27 undergraduate and graduate students representing 23 institutions from the United States, Mexico, Canada, and New Zealand (Table 13) attended SAGE 2000. After the lecture program, students worked on two separate but related projects. The first was a continuation of a multiyear project to image subsurface sedimentary units and buried faults in the Rio Grande rift near Santa Fe, New Mexico. New data from SAGE 2000 were integrated with data from the last two years, providing students with the opportunity to merge their data into a broader picture. The techniques used for this project were seismic refraction/ reflection (using a Vibroseis source), gravity, and electromagnetics methods. The Vibroseis technique used hydraulically driven vibrators mounted on a truck 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 (Figure 22) were provided to SAGE by Veritas Geophysical Services, a major contracting company to the oil-and-gas industry.

Table 13. Institutions Represented by Students Attending SAGE 2000

University of California, Santa Cruz
Purdue University
Georgia Institute of Technology
University of Utah
University of Texas at Dallas
Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE)
San Diego State University
Williams College
University of Canterbury (New Zealand)
University of Georgia
College of William and Mary
University of Southern Utah
Boston University
California Institute of Technology
University of British Columbia (Canada)
University of New Mexico
University of Texas at Arlington
University of Tennessee
University of Nevada at Reno
University of Washington
Southern Oregon State University
University of Arizona
Syracuse University

Figure 22. Vibroseis truck used in seismic refraction/reflection survey.

This major contribution by Veritas is a new arrangement for SAGE and one that we hope will last for many years. The research goal, in part, was to help constrain hydrologic models in the rapidly developing Santa Fe area. Students, many of whom have an interest in hydrological applications in geophysics, acquired experience with an important applied problem.

Secondly, a small-scale survey, using seismic refraction, ground-penetrating radar, total-field magnetics, and electrical resistivity was undertaken in Los Alamos, New Mexico, to

evaluate the site of a former Los Alamos National Laboratory waste-water treatment facility. The facility, which has been dismantled and partially buried, has been turned over to Los Alamos County for construction of a senior citizen extended care facility. The purpose of the work was to search for buried debris that might indicate that residual contamination was present at the site.

This study complements previous environmental work done by SAGE at various sites related to previous Laboratory activities. Preliminary results were provided to the Environmental Restoration project at Los Alamos, which is actively investigating this site for possible remediation. The SAGE investigation helped established the feasibility of using geophysical techniques for environmental applications, providing students with experience in a field in which many are likely to be employed. As in previous years, many of the SAGE students declared an interest in environmental geophysics.

Visitors to SAGE this year included personnel from Sensors & Software, Geometrics, Exxon-Mobil, Chevron, and Veritas. Most of the visitors gave lectures and worked with students in the field. Contact with scientists from industry is invaluable to students planning careers in geophysics and was favorably commented upon by several of the students in their evaluations.

As in previous years, support both in direct contributions and loans of personnel, equipment, and software from industrial affiliates is of key importance for the successful execution of the course.

Workshops and Other Activities

In addition to the main summer program, in January of this year SAGE held two concurrent week-long workshops for NSF/REU undergraduate students from SAGE 1999. The workshops were in (1) processing and interpretation of seismic refraction and reflection data, and (2) interpretation of electrical and gravity data. As last year, the workshops 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 combine their results for a more comprehensive analysis of the problems.

SAGE Co-Directors Honored

In a major recognition of the value and accomplishments of the SAGE program over its 18-year history, the Society of Exploration Geophysicists (SEG), which has more than 16,538 members working in 110 countries, presented a Special Commendation award to co-directors W. Scott Baldridge and George Jiracek (Table 14) at the annual meeting in Calgary. The citation was awarded “for their exceptional efforts in developing and leading the SAGE program…This invaluable education fostered by Scott and George as co-directors has greatly benefited our profession....”

Table 14. SAGE Faculty

Dr. W. Scott Baldridge, Co-Director, Los Alamos National Laboratory
Prof. Shawn Biehler, University of California, Riverside.
Prof. Lawrence W. Braile, Purdue University
Prof. Bernard E. Gilpin, Golden West College
Prof. John F. Ferguson, University of Texas, Dallas
Prof. George R. Jiracek, Co-Director, San Diego State University
Adjunct Faculty, Dr. David Alumbaugh, University of Wisconsin

Relationship to Recruitment / Replenishment of Essential Technical Workforce Needs in Critical Skills ("Chiles report")

Every year SAGE brings some of the nation's best and brightest science students to the Los Alamos National Laboratory. Here, they become acquainted with the Laboratory, participate in geophysical work (partly) on-site, become acquainted with the mission of the Laboratory and with the expertise and research opportunities that are available here, and are introduced to career opportunities at Los Alamos and other national laboratories. Many former SAGE students have worked or are currently working at Los Alamos and other national laboratories; several have been or are postdocs at the laboratories, and several are currently staff members. Most recently, following SAGE 2000, three students continued at Los Alamos as GRAs doing graduate research projects. They joined two former students who are currently at Los Alamos, one (SAGE 1992) as a Director's-funded postdoctoral fellow, the other (SAGE 1995) as a GRA completing his Ph.D. work at the Laboratory. Thus, the students are able to move through a series of opportunities in while working at the Laboratory.

Geophysics is critical to a number of important skill areas at the Laboratory, including those that are part of the core mission such as nuclear nonproliferation and stockpile stewardship. Geophysics will be of critical importance if underground nuclear testing should ever be resumed. Thus, SAGE is important for recruiting new personnel, without being an overt "recruiting" effort.

Information about SAGE

Information about SAGE, including photographs, published results, and a list of Industrial Affiliates, is available on the World Wide Web at http://geont1.lanl.gov/SAGE/sage.htm.

Students from SAGE 2000 conducted an ambitious seismic refraction/reflection survey in the Santa Fe River Canyon near Santa Fe, New Mexico, to image buried rock layers and faults. Seen above is one of the Vibroseis trucks provided by Veritas Geophysical Services of Houston, Texas (Figure 22). The truck operates by placing a hydraulically-driven plate against the ground surface, which provides the source of seismic energy. SAGE is one of the very few opportunities anywhere in the world that students have to work with a Vibroseis seismic survey and alongside a professional crew. The better understanding of the subsurface geology provided by this work will have important applications to the hydrology of the area.

In Figure 23 SAGE 2000 Teaching Assistant Allen Porter (SAGE 1995) (far right) instructs (left to right) Hanna Redmond (Purdue University), Tom Roper (University of Washington), and Sergio Peralta (CICESE, Mexico) in the use of the cesium-vapor magnetometer. Students were surveying for buried facilities and other debris at the site of a former waste-water treatment plant at Los Alamos.

Figure 23. Instructions in the use of the cesium-vapor magnetometer.

Teacher Opportunities to Promote Science (TOPS)

Description

Teacher Opportunities to Promote Science is a three-year teacher enhancement program conducted by the Education Program Office at Los Alamos National Laboratory for northern New Mexico K–12 science, math, and technology teachers. The primary program goal of TOPS is to increase teachers' physical science knowledge and teaching skills, while promoting curriculum alignment and communication through computer networking. Over the course of the program, which spans three fiscal years, TOPS teachers participate in a total of ten meetings: one two-day orientation at the Laboratory; three two-week summer institutes at the Laboratory; and three academic-year two-day regional workshops held between each pair of summers (six workshops, in all). TOPS teachers receive ongoing instruction, tuition assistance, classroom materials and equipment, stipends, grants, and interaction with Laboratory education specialists, scientists, and sites.

Participants form district or regional teams that represent all three levels of instruction—elementary (K–5), middle (6–8), and high school (9–12)—to develop spiral curricula which are inquiry- and contructivist-based and integrate math, science, and technology. Laboratory scientists and educators act as mentors on curriculum projects tied directly to ongoing Laboratory areas of scientific research. TOPS teachers learn the skills to develop and post their projects on Web sites, making them available to anyone with Internet access.

Los Alamos National Laboratory's continuing success may depend in part on how well science is taught in northern New Mexico K–12 classrooms for several reasons:

1. The schools closest to the Laboratory are educating the public most impacted by the Laboratory's presence, who therefore need to understand and appreciate the mission of the Laboratory. This requires that they learn science.
2. The Laboratory employees' children are most likely to attend schools in northern New Mexico. These well-educated parents place a high value on their children's schooling in general, and science education in particular. The Laboratory cannot attract or retain the specialized workforce it needs if the schools are not up to the standards that that workforce demands.
3. Much of the Laboratory's future workforce could be children enrolled today in K–12 northern New Mexico classrooms, who will have grown up near the Laboratory and may want to live and work in this area as adults. The skills they will need to be employed at a national defense science laboratory are science- and technology-related.
4. The Chiles Commission Report (the March 1, 1999, report of the Commission on Maintaining United States Nuclear Weapons Expertise) states that the development of scientific, engineering, and technical personnel requires education programs that are targeted toward critical

skills and that build upon unique Laboratory resources and capabilities. Developing and disseminating effective science education initiatives through a successful and established K–12 teacher enhancement program such as TOPS will ultimately create, recruit, and retain a quality and diverse workforce for the Laboratory.

While the Laboratory's continued success depends on science being taught well nationally, too few K–12 teachers of science are good science teachers. Elementary teachers are often science generalists who completed only those science classes required for their elementary education degrees and K–8 teaching licenses. With identical pre-service preparations, some become teachers at the lower grades who must teach science as one part of the elementary curriculum, and others teach science full time at junior high schools and middle schools. They may have inadequate knowledge or confidence to teach science well, and lack the skills to integrate it effectively with math and current technology. Although secondary science teachers are specialists whose college education earned them a science endorsement on their 7–12 teaching licenses, they may not be teaching in their specific fields of concentration. These teachers often need a more comprehensive understanding of science in general, their course in particular, and effective teaching methods that incorporate more math and newer technology into their instruction.

These are compelling arguments for the Laboratory and its partners to be dedicated to improving science education in northern New Mexico schools by addressing the crucial need here for quality K–12 science teachers. For this purpose, Teacher Opportunities to Promote Science was created at the Laboratory in 1991, and with funding from DOE Defense Programs at the U. S. Department of Energy, has been conducted at Los Alamos National Laboratory for the past nine years. To date, TOPS has directly served almost 300 teachers in over 30 different school districts, benefiting thousands of northern New Mexico schoolchildren.

External recognition of the value of TOPS recently came in the form of collaboration with the College of Santa Fe-Albuquerque to offer eight 400- and 500-level three-hour courses in its departments of science and education that can only be taken through participation in TOPS. In March, 1999, the New Mexico State Department of Education approved acceptance of these 24 hours as fulfillment of the requirements to add a science endorsement to secondary NM Teaching licenses. This is an option being pursued by 74% of the 1999–2001 TOPS participants.

Goals

The TOPS Program seeks to enhance the overall quality of science, mathematics, and technology education in northern New Mexico's school districts by

- Increasing teachers' knowledge of physical science, math, and technology;
- Enhancing teachers' skills in teaching science, math, and technology;
- Providing hands-on activities, materials, and training to take back to participants' schools;
- Exposing teachers to the application of science, math, and technology to research at a national laboratory;

- Enabling teachers to provide their students with the education and encouragement to pursue careers in science, math, engineering, and technology; and
- Developing a Web-based communications network, to provide a strong educational support network among program participants and in their own communities.

Implementation

Oct. 1 1999–Sept. 30, 2000 was the second of three fiscal years of intended participation for the cohort of TOPS teachers who joined the program in April 1999. Following their first summer institute in July 1999, they expected to attend three two-day regional workshops the following November, February, and April, and their second two-week summer institute in June 2000. In addition, the program coordinator planned to visit each teacher that fall at her/his school to make a preliminary classroom/school/district evaluation.

FY00 funding did not come through from DOE/DP until late January 2000. By then, the site visits and TOPS regional workshops scheduled for November and February had been cancelled. The planned three-hour College of Santa Fe TOPS education course (EDU 596—Field Experience I) was postponed, as too much contact time had thus been missed. To meet the 24-hour requirement to receive the science endorsement on NM teaching licenses, this course will need to be made up before the end of FY01.

Participants

TOPS teachers come from 17 different school districts and 11 northern New Mexico counties. Over 80% of these teachers are employed in nine school systems where the vast majority (at least 90%) of the student population is Hispanic and/or Native American. Table 15 below is a summary of the demographics of the TOPS teachers themselves.

Spring Regional Workshops

The TOPS spring regional workshops in April 2000 were the first meetings for the 1999–2001 cohort since the summer of 1999. The agenda focused on reviewing the general science content of the previous Summer Institute I, preparing for the up-coming Summer Institute II, and forming the TOPS

Table 15. 1999–2001 TOPS Cohort

Ethnicity	Number (56)	Percent (100)
African American	1	2%
Caucasian	31	55%
Hispanic	16	29%
Native American	8	14%
Gender		
female	45	80%
male	11	20%

teams of elementary, middle school, and high school level teachers. To these ends, the two-day workshop schedule included viewing/discussing a Disney video on atomic models, *The Atom-A Closer Look*; doing a hands-on graphing activity using M&M candy to generate half-life data; reflecting/discussing the many metaphors for "teacher"; and viewing the Annenberg video, *A Private Universe*. The *Atom* video and graphing activity were presented not only to reinforce the teachers' understanding of these physics concepts, but as lessons adaptable for their own classroom use with their students. *A Private Universe* was an introduction to the basis of the next (June 2000) TOPS education course. Time was also provided to create the teams and critique selected science education/curriculum Web sites.

The spring regional workshop for the 20 Four Corners area teachers took place at the Kirtland Technology Center near Farmington, NM, on April 7–8, 2000, and was attended by 19 of the 20 TOPS participants there. Twenty-eight of the 33 TOPS participants in the Los Alamos area met at the Laboratory on April 14–15.

Summer Institute II – Forty-nine TOPS participants came to the Laboratory for their second two-week summer institute on June 19–30, 2000. The curriculum had three main components:

Science Workshops

Do You Know Your 3Rs: Radiation, Radioactivity, & Radon?
This two-day workshop was a sequence of hands-on activities developed and delivered through the Denver Earth Science Project, a K–12 curriculum teacher development effort coordinated by the Colorado School of Mines. The TOPS teachers were trained in the use of teacher-developed lessons and kit-materials that introduce students in grades 7–10 to major science concepts related to radiation, radioactivity, and radon (see Figure 24). A Laboratory scientist also participated in the presentations to relate the lessons to Laboratory history and ongoing research.

Figure 24. radiation, Radioactivity, and Radon (3Rs) Workshop

American Nuclear Society Geiger Counter Workshop
Two Laboratory scientists who are members of the American Nuclear Society (ANS) provided each TOPS teacher with his/her own Geiger counter and hands-on activities to use in their classrooms. This 90-minute workshop was funded in part by ANS through a grant from the Department of Energy, Office of Nuclear Science and Technology.

ReefNews
ReefNews is a Laboratory-sanctioned nonprofit education and research organization dedicated to teaching students of all ages about the oceans and their shores. The president of ReefNews is a Laboratory staff member, and he provided the TOPS teachers with a two-hour presentation that included information about their Web site and biweekly e-mail newsletter, and gave each TOPS teacher a CD-ROM that included a slide-show tour of the Grand Turk Island and Caribbean Sea.

Education Course

Educational Methods to Promote Constructivist Learning
Based in part on the Annenberg *Private Universe Teacher Workshops*, this course explored the reasons why teaching science is so difficult and offered practical advise to help TOPS participants teach more effectively. Each of nine two-and-a-half-hour sessions focused on one constructivist teaching strategy and one science content area, using specific examples to show how students' preconceived ideas can create critical barriers to learning.

Technology Course

Developing and Using Web-Based Curricula for Classroom Research
This course provided participants in TOPS basic instruction and practice in developing Web-based curricula and integrating the use of computer technology in the science classroom. The course focused on the inclusion of computer technology as a research and communication tool for classroom instruction.

Twenty percent of the class time was devoted to "formal" instruction in the use of Web-writing software and basic HTML (see Figure 25). The other eighty percent of the teachers' time in the computer room was theirs to spend in the development of a personal Web site and beginning the teams' Web-based physical science curricula.

Thirty-seven of the 49 teachers took the option of registering for credit at the College of Santa Fe, earning six additional hours (six were also earned by them last summer, making a total of 12 hours to-date) towards the 24 required to earn a science endorsement through TOPS participation.

Figure 25. TOPS class in developing and using Web-based curricula.)

In addition to stipends and applicable tuition and hotel costs, the TOPS participants who came to Summer Institute II each received the following materials or grants: graphing calculator (that they used at Summer Institute I, and will use again at Summer Institute III); illustrated Periodic Table chart; HTML textbook; Web page software, resource kit and activities binder for radioactivity lessons; oceanography compact disk; Geiger counter; and a $500 grant to his/her district to assist with implementing TOPS curriculum into the classroom during the 2000–2001 school year.

Evaluation

Numerous formative and summative evaluations are always conducted throughout the course of the TOPS program. Specifics of each component of every regional workshop and summer institute are immediately evaluated by the participants, providing the TOPS Program Coordinator with feedback, both for planning the current cohort's next TOPS meeting, and to make improvements to that particular component for future cohorts.

Informal evaluations of the TOPS program are also provided frequently through such means as teacher journals, written assignments produced for college credit, and reports on various grants.

In FY00 the 1999–2001 TOPS teachers evaluated the Spring Regional Workshop and Summer Institute II (see Table 16). The summary of those evaluations show that they were very pleased with TOPS this year. The participants were asked to indicate their evaluation of a given component by circling a number between 0 and 5, where 5 = excellent and 0 = worthless. In this way, choices of 5, 4, and 3 can be interpreted as varying degrees of "positive." Their overall evaluation of the TOPS Spring Regional Workshop was 100% favorable, with 59% choosing the maximum value of 5. Table 16 below summarizes their overall evaluations of the main components.

Summer Institute II

Pretests on general science and math knowledge were administered to these teachers in April 1999 when they joined the program, and will be readministered at its conclusion in June 2001 for comparison. In June 2001 they will also be asked to evaluate their overall three-year TOPS experience and reflect on the impact it has had on their professional and personal development. A strong indication of their feelings will be revealed when they are asked to assign the program an overall grade, and whether or not they would recommend TOPS to a teaching colleague.

Table 16. Teachers' Evaluation of Spring Regional Workshop

Component	% positive (5, 4, or 3 rating)	% 5 (highest satisfaction)
Radiation, Radioactivity, and Radon Workshop	100	73
Web-writing Course (SCI 401)	82	39
Constructivist Learning Course (EDU 594)	100	76
Geiger Counter Workshop	100	42
Oceanography Presentation	97	58

Undergraduate Research Semester (URS)

Program Description

The Undergraduate Research Semester (URS) Program at Los Alamos National Laboratory continued the standard of excellence established in 1989 by the Science and Engineering Research Semester (SERS) Program as part of the undergraduate education effort at the three Department of Energy Office of Defense Programs laboratories. The purpose of the research semester was 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 over 450 undergraduate students in the URS and SERS programs. In FY00 we hosted completed the final semester with 13 students.

Students and scientists work together on a wide variety of research problems. Science mentors from across the Laboratory 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 Office of Defense Programs 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 backgrounds and perspectives for future career decisions. The URS Program encourages participation by women (39% this year) and underrepresented minorities (32% this year) in science and engineering fields.

Performance Objective and Milestones

The principal goal of the URS Program is to use the Department of Energy Office of Defense Program'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 Defense Programs related areas of research;
- Strengthen and focus their fields of study and career plans; and
- Increase the diversity of students that participate in DOE Defense Programs research.

Highlights of This Year's Accomplishments

The Fall 1999 URS Program was completed with 13 students participating in the closing poster session at the Bradbury Science Museum. This was the final session of the URS Program. The 13 students who completed the program were represented by 3 females, 10 males, 1 Asian, 9 Caucasians, 1 Hispanic, and 2 unspecified. The 13 students provided support to fundamental research in five divisions.

Overall, the URS program was seeing a substantial reduction in incoming student applications because of the loss of the national recruiting infrastructure. The three labs jointly e-mailed promotional materials to over 4000 contacts at 2300 universities nationwide to continue the process of stimulating the flow of quality students. When the program lost its funding, the URS three-lab home page was converted to a general recruiting site for all three labs.

Section 2

Diversity Working Group

Diversity Work Group
Increasing the Quality and Diversity of the Employment Pool

A new strategy for FY00 with guidance and direction from DOE/DP, the Science and Technology Base Program Office at Los Alamos National Laboratory has initiated a new strategy for increasing the quality and diversity of the employment pool. The new strategy is grounded in the core competencies and especially the stockpile stewardship mission of the Laboratory.

Background

During FY99 staff in the University Programs Team were responsible for recruiting women and minorities into the following programs: (a) Historically Black Colleges and Universities (HBCU), (b) Underrepresented Minorities and Females (URMF), (c) Two-year College Initiative (TYCI), and (d) Mentored Collaborative Research (MCRP). These programs were successful and opened the door to many students who otherwise would not have been exposed to the national laboratory, research environment. However, these programs were limited by funding and thus did not impact the larger laboratory-wide undergraduate, graduate and DOE/DP science education programs implemented by line organizations in the Laboratory. As a result of further budget cuts in Congress and a desire to have a greater impact in recruiting and retaining students of color and females into all education programs at the Laboratory, a new strategy was initiated for FY00.

FY00 Strategy

The new strategy for increasing the quality and diversity of participation in Laboratory education programs is in its initial phase. Work started with the establishment of a new work group in the Education Program Office called the "Diversity Work Group." The Diversity Work Group comprise staff who were previously responsible for education programs for underrepresented students, as well as new staff members. The charge to the Diversity Work Group is to design and implement activities that recruit students of color, women, and persons with disabilities into all education programs at the Laboratory.

Basic elements of the strategy are to

1. Meet recommendations in the March 1, 1999, report of the Commission on Maintaining United States Nuclear Weapons Expertise, generally referred to as the "Chiles Commission Report," Recommendation #7;
2. Increase the quality of diversified candidates for the employment pool at the Laboratory;
3. Enhance the capabilities of underrepresented students and faculty to pursue math and science careers;
4. Recruit at majority and minority institutions of higher education;
5. Impact the Laboratory employment pipeline to target students for future employment; and
6. Increase awareness and knowledge about diversity in Laboratory education programs.

In a conversation with Steven P. Younger, Associate Laboratory Director for Nuclear Weapons, the Diversity Work Group has been told that when quality students are identified, funding will be allocated.

The new group is currently developing a work plan for FY00 to include specific activities, persons responsible, milestones and completion dates, and indicators of success with metrics. The metrics component of the work plan will include an accurate system to collect data about recruiting and implementation. For example:

- Number of students and faculty contacted;
- Number of students that follow up to request additional information;
- Number of underrepresented students that become part of an education program;
- Summary of recruiting efforts; and
- Other useful data points.

This report will reflect the Science and Technology Base (STB) Programs that were funded by the Department of Energy/Defense Programs (DOE/DP) and data from the Teacher Opportunities to Promote Science (TOPS) Program.

The Education Program Office supports the Science and Technology Base Programs of Los Alamos National Laboratory (LANL) by fostering technical excellence through collaborative research with colleges and universities, and by carrying out post-secondary science education activities and programs. Special emphasis was placed on supporting defense programs' technology base, creating a qualified technical pool of diverse candidates for full-time employment, and developing programs that enhance the technical staff, capabilities, and infrastructure of our partner institutions.

Future Program Initiative

As part of implementing the new strategy, the Diversity Work Group explored multiple options to enlist support from the technical divisions to fund student research internships. To impact challenges in the *Chiles Commission Report*, the work required staff members to think strategically, explore new options and consider all available data. For example, Los Alamos National Laboratory's (LANL's) aging scientific workforce will have a devastating impact on the current and future exchange of technical information to up-and-coming scientists, engineers, and technicians. In addition, the US Bureau of Census states that by 2010, people of color will account for 33% of the nation's population.

In three months, members of the Diversity Work Group have participated in four national conferences and career fairs and have collected over 160 student resumes. This does not include the many e-mails, letters, and telephone calls from students inquiring about possible internships. Because of funding and time constraints, the Diversity Work Group has only been able to place eight students for summer 2000. For all eight students, Laboratory technical organizations and other sources budgeted for the student salaries and travel expenses.

Members of the Diversity Work Group will continue working with business/industry and two-year post-secondary institutions in New Mexico. They have formed a working group (Intel, Allied Signal, Sandia, and Los Alamos) called the "Technology Advisory Coalition" (TAC). The objectives are to

- Communicate business/industry needs and employment demands;
- Identify industry-based competencies for associate degree curriculum in technology areas; and
- Map out and integrate initiatives and players and provide input to colleges regarding articulations with high schools and universities.

Student Comments

The following are stories from students who have participated in the Mentored Collaborative Research Program (MCRP) and the Historically Black Colleges and Universities (HBCU) Program.

Angelique Neuman
"On May 20th, 1996 I was selected for the GRA Program under the Mentored Collaborative Research Program (MCRP). The position was for three months working on erbium oxide research. Near the end of the summer, I asked my supervisor and University Programs (UP) if it would be possible to continue on the project. I was learning a lot and really enjoyed working at Los Alamos. UP was able to come up with 50% of the funding and my supervisor provided the rest. I was given a one-year extension. During that year I established lots of contacts. I also applied for a job in my group. I was interviewed, but the job was awarded to a person with more experience. I applied for other jobs at the Laboratory and was selected for a job with a different division where I am currently employed.

"Two years later I was promoted to team leader. I don't know how things would have gone if I hadn't been given the chance to work at the Laboratory through the UP program. Most hiring officials at the Laboratory are more likely to take on a student that has funding and, provided things work out, continue bringing them back on group funding, rather than hiring them on the spot. It would be a shame if this opportunity is taken away.

"Thanks for the opportunity to provide input on the UP Program for which I was selected to participate."

Tommy Rockward, M.S.
"This letter comes in regard to student program funding at Los Alamos National Laboratory. Just recently, the Laboratory had several student programs 'zeroed' in terms of funding. For me, the programs have definitely given me an opportunity to advance my scientific background. At Los Alamos, I was able to relate theoretical studies to practical applications. The mentorship provided at the Laboratory enhanced my studies as well as gave me confidence to approach the most difficult problems with ease. I personally think that if we consider the science of tomorrow as vital to our nation, then programs such as HBCU should be equally important."

Michelle Lee, M.S.
"My name is Michelle Lee, I work with the Health Physics Operations Group in the Environmental Safety and Health Division (ESH-1) at Los Alamos as a research staff assistant. In addition, I am a second year Ph.D. student in the Health Education Program at the University of New Mexico; my studies are funded by ESH-1.

"During summers of 1991 and 1992, I interned at Los Alamos as an undergraduate research assistant (UGS) through the HBCU Program. I graduated from Grambling State University (HBCU) with a Bachelor of Science in Physics, May 1993. After receiving my BS, I returned to Los Alamos as a Graduate Research Assistant (GRA) under the HBCU Program for 15 months before matriculating to graduate school. During this time, I conducted research, presented the results at an international conference, and published the data in a scientific journal as first author. Also, I was awarded a DOE applied Health Physics Fellowship at Colorado State University. After completing my graduate course work, I returned to Los Alamos the summer of 1996. In May of 1997,

my Masters in Radiological Health Sciences was granted.

"The HBCU Program at Los Alamos National Laboratory revealed new opportunities and created an avenue that connected me to a community that otherwise would have been inaccessible. Thus far, my achievements can be attributed to the HBCU Program at Los Alamos, as it established a foundation for my educational and career goals."

Al Hutchinson, M.S.
"I am a technical staff member at Los Alamos National Laboratory currently working with the Business Information Systems Group (CIC-13), as an applications programmer. My opportunity to work and learn from this program was funded by the HBCU Program.

"For a program to excel and achieve success, it must bring top quality students to Los Alamos. That has always been the case despite the fact that the internship package (compensation, housing, etc.) doesn't measure up to those available in the commercial sector. Also, the Laboratory has benefited from the student presence and participation. The majority of the research that goes on in Los Alamos would not get done if it were not for students. Maybe, for a program to achieve success, it means that students return and hire on after graduation. HBCU students have consistently requested to return for additional internships and have even tried to hire on but have been sidestepped with budgetary constraints. Unlike the commercial world, two or three years as an intern has no bearing on being employed. I was fortunate enough to find a group leader who was hired at Los Alamos after matriculating through the Undergraduate Student and Graduate Research Assistant Programs and understood their benefit.

"Most of the non-minority students I met found out about Los Alamos National Laboratory from professors at their Colleges/ Universities that had direct ties to research teams here at the Laboratory. Since most professors at HBCU schools do not share this direct connection, the loss of the HBCU Program will alienate the Laboratory from hundreds of deserving students of color.

"My hope is that someone with a vision of diversity will revisit the decision to eliminate the HBCU Program and consider reinstatement in the near future."

Diversity in the Teacher Opportunities to Promote Science (TOPS) Program

Our Teacher Opportunities to Promote Science is a three-year teacher enhancement program conducted by Los Alamos National Laboratory (LANL) for northern New Mexico elementary-, middle-, and high-school science, math, and technology teachers. The primary program goal is to increase teachers' physical science knowledge and teaching skills, while promoting curriculum alignment and communication through computer networking, using the extraordinary resources of a national defense laboratory. Participants demonstrate a desire to improve their understanding and teaching skills in science, math, and technology and to integrate those areas into all parts of their curriculum and across grade-levels; and agree to stay with their school districts during the duration of the program (two consecutive school years), serving as role models and mentors for their colleagues. TOPS teachers receive ongoing instruction, tuition assistance, classroom materials and equipment, stipends, grants, and interaction with Los Alamos scientists and sites. In addition, TOPS teachers may earn up to 24

hours of academic credit from the College of Santa Fe for an Endorsement in Science on their teaching licenses.

Priority is given to applicants from northern New Mexico schools with a high percentage of minority students and/or limited access to businesses, universities, or research institutions with available technical expertise and support.

TOPS Teacher Participants for 1999-2001

Cohort = 56

Ethnicity Number Percent
Caucasian = 31, 55%
Hispanic = 16, 29%
Native American = 8, 14%
African American = 1, 2%

Gender
Female = 45, 80%
Male = 11, 20%

County Number of Participants

1. Los Alamos 5
2. Rio Arriba 8
3. Santa Fe 4

Tri-County Total = 17 (1–3 above)

4. San Miguel 2
5. Sandoval 5
6. Taos 4
7. Mora 3

Tri-County Total = 31 (1-7 above) 8.

8. San Juan 18
9. Colfax 3
10. McKinley 3
11. Valencia 1

Total of All Counties = 56 (1–11 above)

Anderson School of Management at UCLA's African-American Leadership Institute

In keeping with the continued development of a program toward providing students with leadership skills, a member of the Diversity Work Group sought participation in the African-American Leadership Institute at UCLA. Scientists seek research careers at Los Alamos because of the science that is created here. However, their focus is primarily scientific pursuits and does not allow them to focus on nor develop their human side and leadership skills.

Thus, participation in the African-American Leadership Institute allowed the program administrator to share leadership information with young researchers early in their academic and career development. Information obtained from this Institute has and will assist the program administrator with the ability to further instill the ideals of leadership in the program and will also incorporate the information in presentations given at various conferences and campus visits on behalf of the Laboratory.

Future College/University Collaborations
Collaborations with colleges and universities across the nation will ensure the success of bringing in a qualified pool of applicants for summer and/or academic year research internships. Collaborative efforts are sought out from campus personnel who recognize the benefit of their students' and faculty's participation in unique and cutting-edge research pursuits only available at LANL.

Current collaborations are underway with Morehouse College, the Nation's only historically Black, private liberal arts college for men. Following a visit to LANL by the

President of Morehouse College, Walter Massey, Ph.D., follow-up was ensured by his division administrator for the Division of Mathematics, Natural and Physical Sciences, Duane Johnson, Ph.D.

Following the success of the first collaborative initiative with Morehouse College (GA), other models of implementation are planned. Five Historically Black Colleges and Universities have been identified for like collaborative initiatives. They are expected to be Florida A&M University, Hampton University (VA), Howard University (D.C.) Spelman College (GA), and Tuskegee University (AL).

Thus, six HBCUs and their students and faculty will benefit from unique partnerships fostered through scientific divisions at LANL. This creates the exchange of scientific expertise to further eliminate the "brain drain" that is of tremendous concern in LANL's scientific and technical community today.

Interest Group Collaboration

The National Action Council for Minorities in Engineering, Inc. (NACME) has agreed to partner with LANL to further increase the pool of qualified and capable summer research interns. NACME has fostered a successful partnership with NASA in which NASA covers $4,000 stipends for "NASA Scholars," through NACME, to obtain summer internships at NASA-specific sites. However, NACME will open up the avenue of those summer sites to include LANL whereby their "NASA Scholars" will have the opportunity to conduct research on NASA-funded projects; thus, fulfilling their summer internship obligation for scholars dollars. The success of this collaboration may also serve as a model for future initiatives.

The NACME Forum, in addition to student development, seeks to ensure the development of administrators geared toward the success of students of color in engineering. Diversity is an over-riding theme in each forum to include an all day diversity workshop for administrators.

Leadership Presentations

Members of the Diversity Work Group completed the following presentations:

- National Association of Minority Engineering Program Admin. (NAMEPA), Inc.
  March 3–6, 2000, Chicago, IL
  "Overview of the African-American Leadership Institute at UCLA"

- National Society of Black Engineers (NSBE), Inc.; March 21–26, 2000, Charlotte, N.C.; "Creating a Competitive Edge"

Recruitment Activities/Career Fairs

A member of the Diversity Work Group actively recruited at the following career fairs and professional meetings:

- Grambling, Louisiana, October 23, 1999, Grambling State University, Chemistry Department (Michelle Lee, MS, recruited on behalf of the HBCU Program)
- Hampton/Norfolk, Virginia, October 25–30, 1999, Hampton University, School of Engineering and Technology,
  Norfolk State University, Department of Chemistry
- Albuquerque, N.M., February 5, 2000, University of New Mexico, National Society of Black Engineers (NSBE), Inc. Regional Chapter Career Fair , (Michelle

Lee, MS, and Al Hutchinson, MS, recruited on behalf of the HBCU Program.)

- Columbia, Missouri, February 7 and 8, 2000, University of Missouri-Columbia Spring Career Fair, Charlotte, North Carolina, March 24 & 25, 2000, NSBE Career Fair

- Los Alamos National Laboratory Black History Month Acknowledgement, February 3, 2000, Presentation to Dr. Walter Massey, President, Morehouse College, Overview of Los Alamos Post-Secondary Programs

- National Association of Minority Engineering Program Admin. (NAMEPA), Inc., March 3-6, 2000, Chicago, IL

- National Society of Black Engineers (NSBE), Inc., March 21–26, 2000, Charlotte, NC

Published Paper/Article

Pamela Bivens, a member of the Diversity Work Group, published the following: *Achieving Workforce Diversity Through Strategic Program Initiatives: A Model Program to Increase Diversity,* National Association of Minority Engineering Program Administrators (NAMEPA), Inc. Conference (1/99), 2/2000.

Creating A Competitive Edge, Black Issues in Higher Education, The Last Word, 11/11/99.

Summary

Through collaborative initiatives with campus personnel and interested organizations, Los Alamos National Laboratory has a tremendous and invaluable opportunity to recruit, develop, and retain students, faculty leaders of color, women, and persons with disabilities. This will ultimately create a diverse pool of qualified employee candidates for technical, scientific, and management consideration.

The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM)

Program Description

The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM), is a tax-exempt, nonprofit corporation headquartered at the University of Notre Dame in Notre Dame, Indiana. Chartered in 1976, GEM is jointly sponsored by a consortium of university and employer members. It is governed by a board of directors composed of GEM representatives from university and employer members. The board is responsible for policy and serves as the legal representative for the GEM Consortium.

The primary mission of GEM is to enhance the value of the nation's human capital in engineering and science by increasing the participation of underrepresented minorities, to include American Indians, African Americans, Mexican Americans, Puerto Ricans, and other Hispanics, at the master's and doctoral levels.

The activities of the GEM Consortium are principally developed and administered by the GEM Office. The GEM Consortium is a center of excellence engaging in activities that span beyond recruitment into retention, leading to graduation from master's and doctoral programs in engineering and science.

The GEM Consortium, comprehensive nationwide programs have been established to identify, recruit, and enroll minority science and engineering students into graduate programs leading to advanced degrees. GEM offers M.S. Engineering, Ph.D. engineering, and Ph.D. science fellowships. In addition to offering fellowships at the M.S. and Ph.D. levels, GEM produces publications and videos for graduate, undergraduate, and pre-college students. The GEM Consortium also provides courses to prepare undergraduates to succeed in graduate curricula and guidance to graduate students on how to achieve success in doctoral research programs (GEM 2000 Annual Report, Inside Cover).

GEM Fellowships are awarded to US citizens of American Indian, African American, Mexican American, Puerto Rican, and other Hispanic ethnicities. Grade point requirements are 2.8 and above for master's fellowships and 3.0 and above for Ph.D. fellowships.

Application Process

Applications are accepted from September 1 through December 1. The application is available on the GEM Web site: http://www.nd.edu/~gem

GEM Fellowship Programs

M.S. Engineering Fellowship
The objective of the master's program is to increase the pool of minority M.S. engineering graduates. Each GEM fellow is provided with summer internship opportunities and an academic fellowship of tuition, fees and stipend, that is portable to any GEM member university. GEM's M.S. Fellows are supported for three semesters or four quarters.

Ph.D. Engineering Fellowship
The objective of the Ph.D. engineering program is to offer post-master's fellowships to underrepresented minority students. Fellowships may be used at any GEM member university to include tuition, fees, and an academic-year stipend. Fellows may be required to accept a research or teaching assistantship.

Ph.D. Science Fellowship
The objective of the Ph.D. science program is to increase the number of minority students pursuing doctoral degrees in the natural, physical and life sciences (chemistry, physics, mathematics, and computer science, as well as earth, biological, and pharmaceutical sciences.) Fellowships are portable to any participating GEM member university and include tuition, fees and an academic year stipend. Fellows may be required to accept a research or teaching assistantship (GEM 2000 Annual Report, p. 4).

Los Alamos National Laboratory's Support of GEM

The Los Alamos National Laboratory (LANL), as a recognized GEM corporate member, has sponsored a significant number of exceptional GEM fellows for summer research positions. These future scientists and researchers hail from various GEM member universities. Some of them have attended or are currently attending the University of Maryland-College Park, New Mexico State University, University of New Mexico-Albuquerque, and Texas A&M University.

Master's level GEM fellows are required to spend two consecutive summers at LANL to fulfill requirements for their Fellowship. Academic majors of LANL's fellows span disciplines including chemical engineering, civil engineering, electrical engineering, and material science-physics. Two pre-select GEM fellows are currently enrolled at Texas A&M University studying electrical and civil engineering.

The GEM Consortium has provided LANL with qualified and competent young summer researchers who have added great value to the future of its scientific pursuits. According to the President of GEM, Jack Krol, President of DuPont, as a GEM Member Corporation, "LANL has made it possible for many underrepresented minority students to earn graduate degrees in engineering and science and to become significant contributors to our society" (GEM 2000 Annual Report, p. 2).

Section 3

Postdoctoral Program

The Postdoctoral Program

The Postdoctoral Program provides a means of advancing knowledge in the areas of basic and applied research and strengthening our national scientific and technical capabilities. Appointees are provided the opportunity to perform research in a scientifically rich R&D environment. The Laboratory experience presents appointees the opportunity to derive significant professional accomplishment and advancement of their career goals by publishing and presenting the results of their work and participating in scientific and technical conferences while contributing to the overall research efforts of the Laboratory. Appointees (see Figs. 30–35) provide valuable stimulus to the research efforts of Laboratory staff and make available current university research endeavors as well as become the communication link between the Laboratory, industry, and universities. The program continues to serve as a primary resource for selection of regular Laboratory technical staff. Candidates are nominated and sponsored by a member of the Laboratory's technical staff. Selection is based on a Laboratory-wide competition and is determined by the candidate's academic qualifications and research excellence.

Postdoctoral Fellows

Postdoctoral Fellows are provided the opportunity to pursue *independent* research of their own choice. Doctoral degree recipients within the past three years, who are recognized in their fields, are eligible to compete for these limited-term appointments. The Laboratory's Postdoctoral Committee reviews sponsored candidates at the postdoctoral quarterly meetings. Selections are based on the strengths of the candidates' research proposals and their academic and research excellence. The Director of the Laboratory will make the final selections. There is an average of 50 regular postdoctoral fellows at the Laboratory at any given time.

In addition to the regular Postdoctoral Fellow category, there are three other prestigious types of appointments:

The J. Robert Oppenheimer (JRO) Postdoctoral Fellowship
Named after the Laboratory's first director, this fellowship provides the opportunity for recipients to pursue independent research of their own choice. This opportunity is not restricted to US citizens.

The Richard P. Feynman (RPF) Postdoctoral Fellowship in Theory and Computing
Named after the famed theoretical physicist and winner of the 1965 Nobel Prize in Physics, this fellowship provides the opportunity for recipients to pursue independent research of their own choice in the areas of theory and computing with emphasis on modeling and simulation.

The Frederick Reines (FR) Postdoctoral Fellowship in Experimental Sciences
Named after the former Los Alamos National Laboratory researcher who won the 1995 Nobel Prize in Physics, this fellowship provides the opportunity for recipients to pursue independent research of their own choice in experimental sciences. The awards will go to outstanding experimentalists regardless of their field of study.

The Feynman and Reines Fellowship appointments will require US citizenship and

the ability to obtain a DOE "Q" clearance. The Associate Laboratory Director for Nuclear Weapons funds these fellowship categories.

Candidates for these prestigious fellowships must display extraordinary ability in scientific research and show clear and definite promise of becoming outstanding leaders in the research they pursue. The Postdoctoral Committee reviews all sponsored candidates competing for these prestigious fellowship appointments at the December quarterly meeting. The Director of the Laboratory makes the final selections. A maximum of two fellowships in each category is offered annually.

Postdoctoral Research Associates (RAs) are provided the opportunity to pursue research directly involved with Laboratory programmatic efforts. Postdoctoral Research Associates are required to contribute to Laboratory programs and do not generally perform independent research. Doctoral degree recipients within the past three years are eligible to compete for these limited-term appointments. Sponsored candidates are reviewed and selected by the postdoctoral committee throughout the year. There is an average of 250 Postdoctoral Research Associates at the Laboratory at any given time.

The Intelligence Community Postdoctoral Appointment affords exciting and challenging research opportunities to candidates interested in areas that have the basis for future technological developments important to the intelligence community. This year was the first year this appointment category was offered. The Laboratory coordinates with the intelligence community and the Department of Energy regarding these appointments. Each year, the intelligence community will propose research topics of interest. The Laboratory can propose additional research topics to be considered by the intelligence community and the Department of Energy. Recipients of these postdoctoral appointments will have the opportunity to work as Laboratory Postdocs for a period of up to three years. In addition to conducting research with their identified LANL sponsors, recipients of these appointments will interact with a resource person within the intelligence community. In addition, the recipients and LANL sponsors will travel to Washington up to two times a year to meet with other recipients of this appointment as well as visit the funding agency to gain a better understanding of its technical needs. Salary and eligibility requirements for these appointments are the same as for regular Laboratory postdoctoral appointments. Appointments will require the ability to obtain a DOE "Q" clearance. US citizenship is required. Current Laboratory postdocs who have been at the Laboratory for less than two years are eligible to apply for this opportunity. One selection was made in FY00. Up to two appointments will be funded per year.

Length of Appointments

Postdoctoral candidates are appointed to an initial two-year term, with an option of a third year if funding is available. JRO/RPF/FR Fellowship appointments are for three years.

Summary of Program Year

FY00 was an extremely challenging year. The number of candidates sponsored for postdoctoral appointments in FY00 was down by 28% from the previous year. The acceptance rate for positions offered remained very high, averaging 87% year:

The following are a few of the issues impacting the program this past year

- Issues regarding sensitive country foreign nationals,
- Restriction on travel
- Cuts in Laboratory Directed Research and Development (LDRD) funding, and
- Hiring moratorium impacting the number of postdocs converting to Laboratory staff positions.

Activity/Initiative Summaries in FY00

- A Tri-Lab (Sandia, Livermore and Los Alamos) Postdoctoral Program meeting was held in Albuquerque, January 2000. This forum provided the opportunity for the participants from the three labs to work together and communicate pertinent information regarding how their programs are run.
- Awarded the 10th the Postdoctoral Publication Prize in Theoretical Physics (see Fig. 26). Gerardo Ortiz, T-11, was selected as the winner for his paper titled, "Exchange-Correlation Hole in Polarized Insulators: Implications for the Microscopic Functional Theory of Dielectrics," which was published in *Physical Review of Letters*.
- Established a Lab-wide postdoctoral luncheon seminar series.
- Worked with Laboratory technical staff and management, postdocs, and industry to begin to develop an outplacement initiative for postdocs.

Figure 26. Gerardo Ortiz, winner of the 10th Postdoctoral Publications Prize in Theoretical Physics.

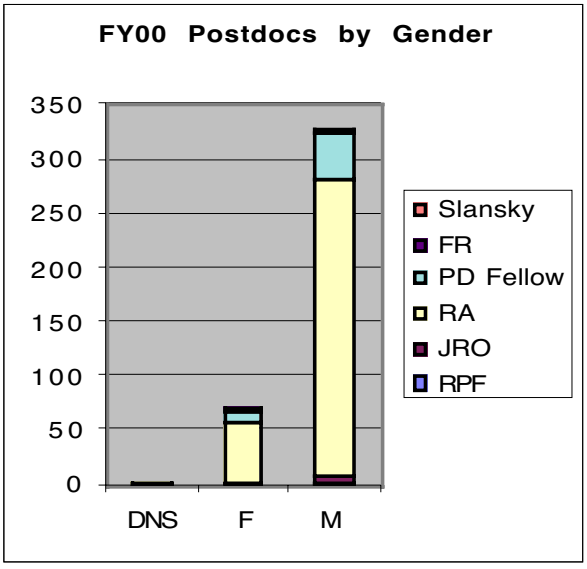


Figure 27. FY00 postdocs by gender.

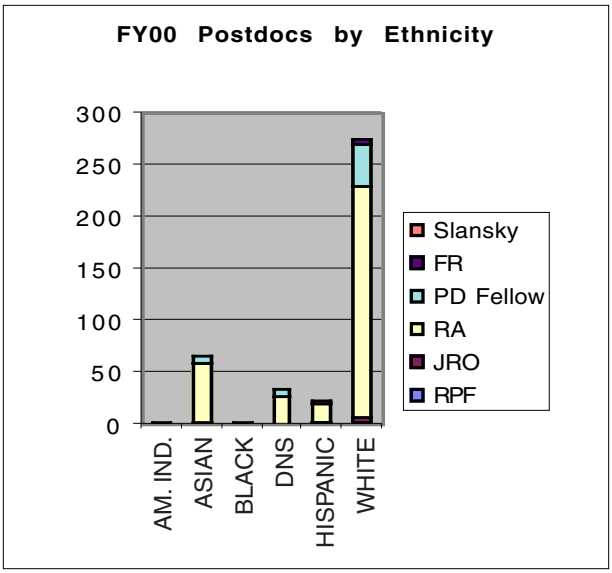


Figure 28. FY00 postdocs by ethnicity.

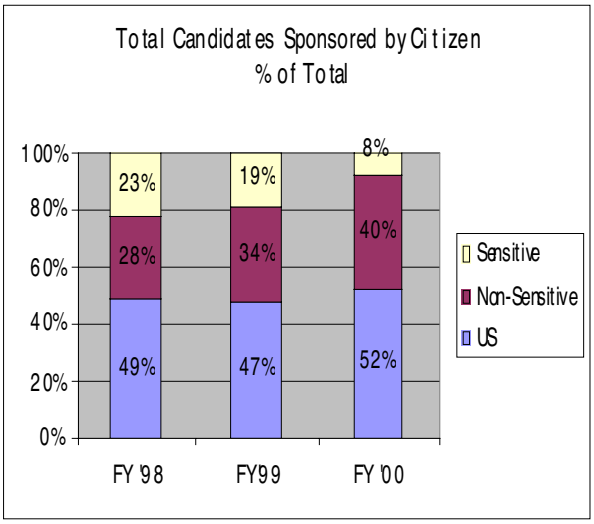


Figure 30. Total candidates sponsored by citizenship, % of total.

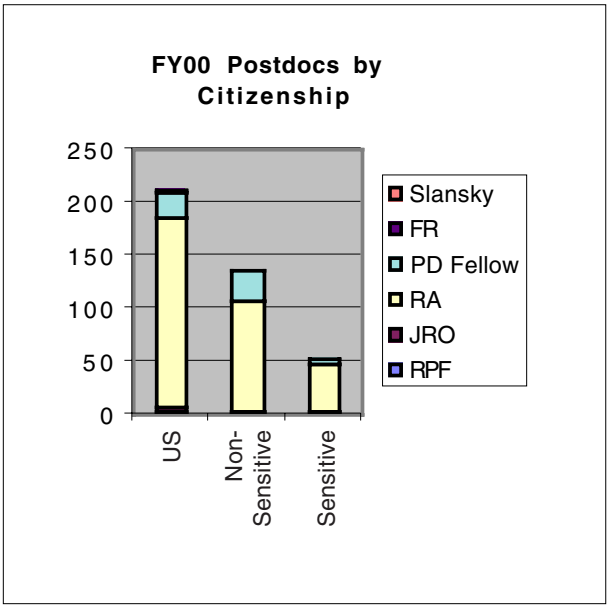
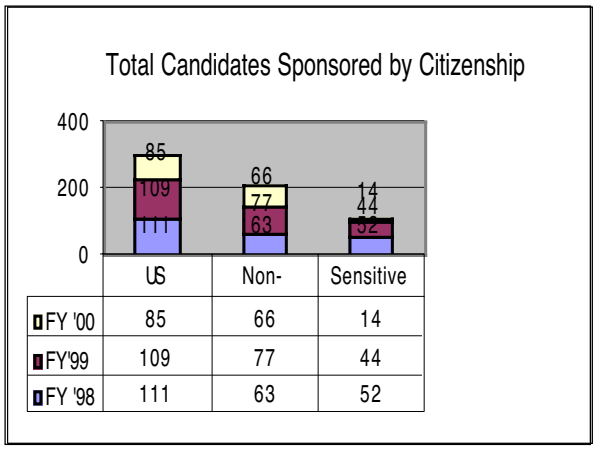


Figure 29. FY00 postdocs by chitizenship.



	US	Non-	Sensitive
FY '00	85	66	14
FY'99	109	77	44
FY '98	111	63	52

Figure 31. Total candidates sponsored by citizenship.

Section 4

Mathematics and Science Education Programs

Supported by DOE Office of Advanced Automotive Technologies, NASA, Private Industry, Universities, Volunteers and Other Parties

Fuel Cell Video Documentary

In May 1999, the Fuel Cell Education Project at Laboratory was tasked by the Office of Advanced Automotive Technologies at the Office of Transportation Technologies to develop and produce a video documentary on fuel cells.

Project Description

The goal of the documentary will be to inform a general audience about the benefits of fuel cell technology and show the exciting and diverse opportunities the technology holds for the future.

The scope of the documentary will be international. Viewers will learn about the work being done in the U.S., Europe and Japan. Demonstration projects such as the Chicago transit buses, Munich airport buses and refueling station, the Desert Research Institute sustainable energy system, the Iceland project to develop a hydrogen energy economy, and the London taxi will be included. Research centers in Japan, Germany, and Canada as well as the US will be included in the documentary. Transportation, utility and portable power applications for fuel cells will be included.

The documentary is being produced at the Laboratory. Cambridge Documentary Films (CDF) serves as the executive producer on the project. CDF has been making films about social issues for more than 20 years. Their numerous achievements include an Academy Award; their films have been presented at film festivals around the world. Through their nonprofit distribution company, their films have reached thousands of students and educators, community leaders and concerned citizens.

The video documentary will make the viewing public aware of the numerous applications of fuel cell technology as well as the benefits of the technology. It is fair to say the automobile changed the industrial and social fabric of the United States and most countries around the globe. Henry Ford epitomized “Yankee ingenuity,” and the Model T helped create the open road, new horizons, abundant and inexpensive gasoline...and tailpipe exhaust. People are driving more cars in 1999 than ever before — more than 200 million vehicles are on the road in the US alone. But the car has contributed to our air and water pollution and forced us to rely on imported oil from the Middle East, helping to create a significant trade imbalance. Today many people think fuel cell technology will play a pivotal role in a new technological renaissance — just as the internal combustion engine vehicle revolutionized life at the beginning of the twentieth century. Such innovation would have a global environmental and economic impact.

The primary focus of the documentary will be fuel cells for transportation. Viewers will be shown that fuel cells are not just laboratory curiosities. While there is much work that needs to be done to optimize the fuel cell system (remember, the gasoline internal combustion engine is nearly 120 years old and still being improved), hydrogen fuel cell vehicles are on the road — *now*. The film will show commuters living in Chicago who ride on fuel-cell propelled buses as well as a fuel-cell propelled motor scooter about to make its debut in Taiwan.

In addition, the documentary will show that every major automobile manufacturer in the world is developing fuel cell vehicles. The introduction of fuel cells into the transportation sector will increase fuel efficiency, decrease foreign oil dependency, and become an important strategy/technology to mitigate climate change. As fuel cell vehicles begin to operate on fuels from natural gas or gasoline, greenhouse gas emissions will be reduced by 50%. In the future, the combination of high efficiency fuel cells and fuels from renewable energy sources would nearly eliminate greenhouse gas emissions. The early transition to lower carbon-based fuels will begin to create cleaner air and a stronger national energy security.

Viewers will also learn about additional applications for fuel cells including utility applications such as office buildings and homes as well as portable power requirements that could include laptop computers and cellular phones.

Performance Objectives and Milestones

During FY00, additional fundraising efforts have been successful to meet the budget of the project. While DOE contributed over one half of the overall budget, it was expected that money from corporations would be required. Motorola, General Motors, the 3M Foundation, Ford Motor Company, Plug Power, Ballard Power Systems, and W.L. Gore have contributed to the production.

It was anticipated that filming all of the interviews along with editing would be completed by the end of FY00. However, while we were successful in completing nearly all of the production on the documentary, post production efforts (editing, special effects, and graphic design) have been significantly delayed because of the need for the video production unit at the Laboratory to document the aftermath of the Cerro Grande fire.

Highlights of This Year's Accomplishments

Ninety-five percent of all interviews and filming have been completed on the documentary. The following people have been interviewed

Mr. H. Watanabe, Member of Board, Toyota

Mr. N. Tanaka, NEDO/WE-NET Project Minister of the Environment

Dr. Mohamed El-Ashry, President, Global Environment Facility

Dr. Alan Lloyd, President, California Air Resources Board

Prof. Joan Ogden, Princeton University

Paul MacCready, President, Aerovironment

John Wallace, Ford Motor Company

Harry Pearce, Vice Chairman, Board, General Motors

Frank Kruesi
Chicago Transit Authority
Director
Mechanic
Bus Driver
Public Relations

Chris Galvin, CEO, Motorola
Desert Research Institute

Glenn Rambach, Student

Bill Poldony, Retired, International Fuel Cells

William Miller, CEO, International Fuel Cells

Georg Burkhardt and students (Germans teacher and students)

W.K.D. Borthwick, European Commission, head of Fuel Cell Annex

Jon Bjorn Skulason, Iceland New Energy Project

Marcus Nurdin, World Fuel Cell Council

Gordon MacKerron, University of Sussex

Venki Raman, Hydrogen Dept. Air Products

Don Huberts, CEO, Shell Hydrogen

Fedrinand Panik, VP, Fuel Cell Projects, Daimler/Chrysler

Graham Batchelor, President, Alternative Fuels, Texaco

Editing is underway and should be competed by the end of November. Immediately thereafter, efforts will begin to identify appropriate outlets for distribution that will include cable, television and film festivals as well as schools and the Internet.

Over the past year, archival film footage, photos, drawings, supporting video footage have been accumulated to provide visual materials for the final film. It is expected that the documentary will be completed before the end of 2000.

Fuel Cell Tutorial Project Description

In October 1999, a 36-page, four-color publication, *Green Power – Fuel Cells* was published. This activity began in May 1998, when the Fuel Cell Education Project at the Laboratory received funding from the Office of Advanced Automotive Technologies (OAAT) at the Office of Transportation Technology at the US Department of Energy, to develop of a tutorial for high school and college students on fuel cells. Because OAAT receives numerous requests from students for information on fuel cells; it was determined this tutorial should be designed for the "overachieving" and independently inquisitive student. The tutorial is being mailed directly to the student at home, so it is important that the brochure be self-contained including references and resources for easy follow-up. OAAT asked that additional information concerning global climate change and sustainability be included. The 3M Foundation also supported this work through a financial contribution.

Achievements

1. Develop a "standalone" publication containing detailed and up-to-date information on current developments in fuel cell research and technology.

2. Supplement the tutorial with information on global climate change and sustainability.

3. Stimulate independent inquiry by providing appropriate follow-up resources.

4. Create an engaging and visually attractive brochure.

Highlights

1. 2000 copies of the tutorial were printed, and as of March 2000 they had all been distributed. As second printing, with minor corrections and revisions was completed in April 2000.

2. High school and college students from around the country have requested copies of the publication.

3. Hundreds of copies have been requested by industry. All major automobile manufacturers are distributing the publication to their staffs involved in the newly formed fuel cell research and development areas. Four hundred copies were sent to ShellHydrogen in Amsterdam.

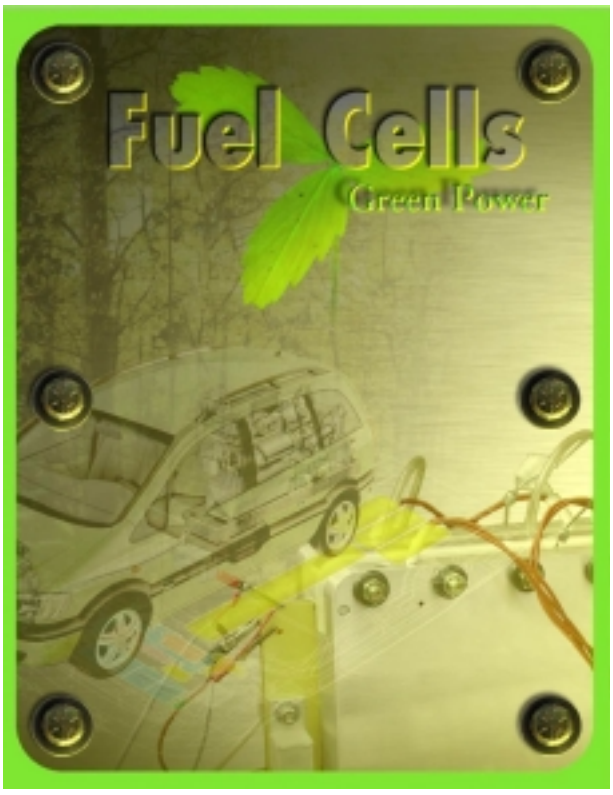
4. Colleges and universities from around the world are requesting copies.

5. The design received an award of Merit in Technical Publications from the Society for Technical Communication.

6. The Department of Energy's Office of Advanced Automotive Technologies (OAAT) presented an award in recognition of the outstanding achievement in the creation of *Fuel Cells – Green Power* to Project Leader Marcia Zalbowitz, who accepted the award on behalf of Sharon Thomas, co-author and Jim Cruz, designer. The award was made at a program review in Richland, Washington on June 7, 2000.

Tutorial Based Web Site Project Description and Accomplishments

Fuel Cells - Green Power is also available on the internet at http://education.lanl.gov/resources/fuelcells in PDF format for easy and convenient downloading. The site receives approximately 7,500 hits per month. Hyperlinks to references and resources are included in the text. E-mail comes from around the world from students as well as businesses. Our responses provide information, references, and referrals. Technical experts occasionally assist in assuring complete and accurate answers.



Investing in Science in Our Nation (InVISION)

Program Description

The Investing in Science in Our Nation program is designed to offer research and training opportunities at the Laboratory that complement academic programs and introduce promising students to the unique intellectual and scientific resources present at the Laboratory. The program enhances the education of qualified undergraduate and graduate students majoring in science, mathematics, engineering, technology, or related disciplines that support the mission of the Laboratory, while focusing on the critical skills areas. Internships provide participants with an intensive introduction to mission support areas through applied research and application projects under the guidance of experienced mentors. Specific program implementation, which includes focused recruitment of students who are recognized academic achievers, will increase the number of students with the skills and content knowledge necessary to be employed at Los Alamos National Laboratory.

InVision Program

InVision is part of the Laboratory's strategic action to meet workforce demands and to increase diversity.

The program

- Meets selected expectations in the Chiles Commission Report;
- Is based on research and goals endorsed by the Northern New Mexico Council for Excellence in Education;
- Utilizes "lessons learned" and evaluation data from Laboratory university programs; and
- Continues the Laboratory's educational commitments to northern New Mexico that began with special provisions in the University of California Contract.

InVISION seeks to attract students who have the potential to help meet the Laboratory's human capital needs necessary to carry out the Laboratory mission. Vigorous recruitment activities focus on, but are not limited to, the following academic achievers:

1. USA Today All Academic Teams
2. US Physics Team
3. International Olympiad Teams (Chemistry, Math, Physics)
4. Tandy Technology Scholars
5. Intel Science Talent Search winners/ finalist
6. Intel Science & Engineering Fair winners
7. Hertz Fellows
8. National Merit Scholars
9. LANL Foundation Scholarship winners

Performance Objective and Milestones

The primary goal of the program is to increase the number of students qualified for Laboratory employment, focusing on the critical skills areas. This goal requires partnering with colleges, universities, and technical divisions throughout the Laboratory. FY00 was the first year the program was implemented at the Laboratory and, by most accounts, it was a successful year. Some glitches arose in the aftermath of the Cerro Grande fire, but most were overcome without much negative impact on the program.

Highlights of this Year's Accomplishments

This year's recruiting effort focused on those students who have received some of the honors and awards shown in the list above. Our efforts were rewarded by the successful recruitment of five new "super achievers" into the InVISION program. Four of the students were the subject of articles in the Laboratory's Newsbulletin. All of the students had a positive and rewarding internship and hope to return to the Laboratory next year.

Number of Participants: 11

Ethnicity Breakdown
- Anglo Females – 5
- Anglo Males – 2
- American Indian Males – 1
- Hispanic Males – 3

Average GPA of Participants: 3.64/4.0

Schools Represented/Number of Participants Attending

- Massachusetts Inst of Tech – 3
- Stanford University – 2
- Boston University – 1
- California Inst of Tech - 1
- Eastern New Mexico University - 1
- New Mexico State University – 1
- New Mexico Tech – 1
- University of Illinois – 1

Thumbnail sketches of some of the participants follow:

Farzad Alemi.
Farzad (Figure 32) is an undergraduate in biological sciences at Stanford University, 3.9/4.0 GPA. This was his second summer at the Laboratory performing DNA repair and mutagenesis research in the Bioscience Division, Wright Langham Resource. This summer he worked on a project to develop a Spatial Genomics instrument. His honors and awards include being a member of the USA Today All-American Academic First Team; Tandy Technology Scholar; Toyota Community Scholar; and Los Alamos Science and Technology Base/Education Program Office Outstanding Student Award FY99.

Golnaz Alemi
Golnaz (Figure 32) is an undergraduate in biology at Stanford University, 3.8/4.0 GPA. Her Laboratory assignment was to study aging in yeast. Her research was performed in the Bioscience Division, Wright Langham Resource. Her honors and awards include being a member of the USA Today All-American Academic Third Team; National Merit Commended Scholar; Target All Around Scholarship; Tylenol Scholarship; Robert C. Byrd Scholarship; and the US Marines Outstanding Academic Achievement Award.

Figure 32. Farzad and Golnaz Alemi

Alexander Ho
Alexander is an undergraduate in Biochemistry at the University of Illinois, 5.0/5.0 GPA. His Laboratory assignment involved the synthesizing and characterization of compounds. His research was performed in the Bioscience Division. Alexander's honors and awards include winning the Gold Medal at the 31st International Chemistry Olympiad, 1999; FMC Award of Excellence Scholarship; and the GPPA Award for Excellence in Academic Achievement Scholarship.

Gregory Natoni
A native New Mexican from the Four Corners area, Greg (Figure 33) will receive his BS in mechanical engineering in December 2000 from New Mexico State University, 3.4/4.0 GPA. He participated in the Laboratory's URMF program for two years before returning this year as a participant in the InVISION program. His research this summer was as part of the design team for a circulating liquid metal test facility at the Los Alamos Neutron Science Center. Greg was recruited to the Laboratory through the Alliance for Minority Participation Program at New Mexico State University. His honors and awards include the Golden Key National Honor Society. He is an extremely active member of the American Indian Science and Engineering Society.

Katherine Scott
Katherine just completed her freshman year at the California Institute of Technology where she is majoring in physics. She performed research this summer on the Magnetized Target Fusion project in the Laboratory's Physics Division. Her numerous honors and awards include being a member of the 1999 United States Physics Team; National Merit Finalist; Rockwell International Corporation Trust Merit Scholarship; CalTech Merit Scholar; and 1999 National Science Olympiad, first place.

Natalia Toro
Natalia (Figure 34) just completed her freshman year at the Massachusetts Institute of Technology. Her research this summer was to investigate the role of nuclear deformation on parity violation in neutron transmission experiments. Her assignment was in the

Figure 33. Gregory Natoni.

Figure 34. Natalia Toro.

Theoretical Division. Her numerous honors and awards include being a member of the USA Today All-Academic First Team; first place winner, Intel Science Talent Search; Lucent Global Science and Technology Scholar; member of the 1998 and 1999 United States Physics Team; silver medallist, 1999 International Physics Olympiad; and National Merit Scholar.

Program Opportunities

Specific InVISION education activities will include the following:

- Participating in research internships based on a detailed work plan, careful monitoring by program staff, and assistance from mentors;
- Attending multidisciplinary science lectures, cultural awareness activities, and field trips;
- Presenting individual and group research for Los Alamos to technical divisions staff and student peers;
- Developing and publishing research findings;
- Traveling to professional conferences; and
- Attending guest lectures to further enhance the student and faculty research knowledge base.

Los Alamos National Laboratory
Education Equipment Gift Program

The Los Alamos National Laboratory Education Equipment Gift Program (LEEG) was launched in April, 2000, in order to facilitate science and technology research and education at schools and non-profit organizations. The program offers a streamlined process allowing the Laboratory to donate laboratory equipment for the conduct of technical and scientific education and research. The LEEG program will enable the Laboratory to partner with and assist deserving institutions of higher educational and other organizations in an efficient manner, thereby strengthening the quality of national research and education in science, math and engineering.

Type of Equipment Available

All lab equipment is managed to enable the Laboratory to perform its mission as efficiently as possible. When it is no longer needed, it is declared excess to the Laboratory's needs and will be made available to the LEEG program.

Some examples of excess equipment that will be available:

- Laboratory equipment
- Photographic and optical equipment
- Electronic equipment
- Measuring tools
- Special industrial and metal-working machinery
- Any equipment deemed appropriate for use in improving scientific education or research activities

Restricted Equipment

Only safe equipment certified to be free of contamination or radiation will be released. General office supplies and material, weapons-related equipment, equipment listed in the U. S. Munitions List, and equipment related to nuclear proliferation will not be eligible for transfer.

Eligible Institutions

- Educational institutions that are accredited by their State Accreditation Board;
- Non-profit organizations that are engaged in collaborative projects with schools or that have education as their primary focus and provide IRS 501-c(3) certification;
- Applications were sent to over one hundred institutions nationally with a total of over forty pieces of equipment gifted.

Gift Summary

- Metal Lathe, NM State University
- CAD Plotter, Northern NM Community College

Figure 35. Gamma ray detectors given to Caltech.

- Gas Chromatograph System, Lewis University
- Blueprint Copier, Northern New Mexico Community College
- Welders, Northern New Mexico Community College El Rito
- Dye Laser System, North Carolina State University
- Geiger Counter, University of New Mexico/Los Alamos
- Cosmic Ray Detectors, California Technical Institute
- Electron Microscope, Northern NM Community College
- Tensile Test Machines, NM Institute of Mining & Technology
- Excimer Laser System, Baylor U/Texas State Tech College
- Ceramic Tape Caster, NM Institute of Mining & Technology
- Computer Systems, Santa Fe Boys & Girls Club
- Spectrometer, University of New Mexico

The Laboratory Education Equipment Gift program will continue its efforts to strengthen collaboration and stimulate more partnering with the university community. It is anticipated that the gift program will also help create improved opportunities for graduates to qualify for work at Los Alamos.

Los Alamos Space Science Outreach Program (LASSO)

Program Description

The Los Alamos Space Science Outreach Program (LASSO) for FY00 is a collaborative effort between the NIS-1 group and the Education Program Office at Los Alamos National Laboratory. New Mexico contains a significant population of Hispanic and Native American people, traditionally underrepresented in scientific and technical vocations. LASSO contributes directly to LANL efforts to reach out effectively to this population through a comprehensive teacher development program.

Based on current NASA projects exploring the composition of the solar system, the LASSO project realistically affects the educational community of rural New Mexico and the nation as a whole by enhancing science content knowledge. The program provides current science curricula and decreases isolation factors for teachers in rural areas through the World Wide Web and electronic communication models.

The LASSO project engages professional learners in sustained classroom activities directly tied to the NASA-LANL space science programs, thus supporting improved science, math, and technology content knowledge as well as lifelong learning process skills. The LASSO science education effort adheres to an effective instructional model based on education research and cognitive theory. Through this program students and teachers engage in activities that encourage critical thinking, a constructivist approach to learning, research, reflection, cycles of inquiry, and iterative assessments over the life of a project.

The educational component of this project involves master teachers representing secondary and elementary school levels in the development of multidisciplinary/multilevel classroom lessons and activities that focus on NASA projects through a collaborative, distance-learning process. Master teachers enhance their use of computer technology through the development of skills in Web page creation, concept mapping and Internet research. The teachers interact with LANL mentors throughout the program. An additional component for this year's program includes the production of a traveling, museum-based display project. This is a long-term project; the planning and research phase is the current task.

During the program, teachers critically investigate the LASSO projects through the examination of basic and advanced science concepts behind the project goals. LANL mentors from NIS-1 collaborate with the master teachers providing science content, motivation, and support. The master teachers learn how scientific data is collected, analyzed and interpreted. They learn effective instructional methods that are incorporated into effective Web-appropriate lessons and activities published on the LASSO educational Web site.

The teachers continue collaborative efforts through telecommunications during the research and development phase and during the implementation phase. They participate in a culminating activity where they finalize and deliver their Web-formatted lessons and activities for the LASSO Web site. They demonstrate their final products at the end of

the summer session, and the developed Web-based lessons are added to the LASSO Web site.

Goals

The LASSO program leverages Los Alamos National Laboratory's scientific capabilities and resources by integrating current research in the area of space physics. The LASSO project supports the NASA education mission by aligning with the following:

- To increase public understanding of the issues relating to the future of space exploration;
- To develop the connections between scientific concepts and everyday life;
- To increase understanding of the science process;
- To provide opportunities to develop and apply critical thinking and problem-solving skills on complex problems of scientific significance; and
- To promote cooperative learning through successful teamwork.

Project Objectives

The LASSO project is designed to enhance the overall quality, scope, and realism of science, mathematics and technology education in New Mexico schools by

- Increasing teachers' and students' knowledge of the science, math and technology involved in space physics;
- Enhancing teachers' skills in teaching the content of earth and space sciences and new exciting technologies;
- Providing hands-on activities and materials to utilize in the schools;
- Exposing teachers and students to the application of earth and space science to current and future research projects at national laboratories; and
- Providing a mechanism for teachers to encourage students to pursue careers in Earth and space science.

Implementation Strategy

A select team of six master teachers, representing secondary and elementary school levels in New Mexico was chosen to participate in workshops held at Los Alamos National Laboratory. The master teachers worked together with Laboratory scientists to develop appropriate curricula for their educational communities. Scientists participated in the workshops by identifying and discussing basic concepts of space and planetary sciences while introducing new technologies behind current and future explorations. The teachers developed and implemented appropriate activities in their classrooms. The teacher-developed, scientist-directed, student-based units were inquiry-driven and modeled sound pedagogical practices. These practices included the constructivist learning theory, cooperative and collaborative learning relationships, and the integration of math, science and technology content. The teacher-prepared material was published on the LASSO Web site thus impacting a wider community.

The represented schools supported the program by providing administrative resources and participation, substitute teachers, and paid leave to the master teachers to attend the LASSO workshops.

Program Quality was Assured in the Following Ways:

Workshops
The LASSO program was designed to match Laboratory expertise with the needs of schools in New Mexico to provide a unique educational opportunity tied to the NASA

mission. Los Alamos National Laboratory program staff met with teachers in a series of workshops to develop and promote an effective curricular approach. The workshops demonstrated provisions of instruction for teachers in process and content and the application of resources that required the teachers to sharpen their critical thinking and problem-solving skills on current real space science projects.

Teachers were required to demonstrate their learning and understanding through various tasks that combined content information, research, critical thinking, problem-solving, and telecommunications skills.

Products

Each teacher produced dissemination products based on his/her work on the project areas (Cassini, IMAGE, and the magnetosphere). The teachers examined specific projects as conducted by the NIS-1 Group, and worked to develop educational products. These educational products included grade-level-specific lessons and activities. Products were produced for the elementary and high school levels. Examples from the new lessons and activities include the Great Magnet, What Happens on the Sun, Feel the Force, Space Weather: Probability, Space Weather Forecast, Space Weather Impacts Earthlings, Blastoff: Ideas and Problems in Space Science, and the Magnetosphere Project. Previous lessons and activities are also included on the LASSO Web site and can be accessed at http://set.lanl.gov/programs/lasso/standards.html.

Demographics

Table 17 represents the breakdown of the participants by gender, ethnicity, location, population served, and academic level taught.

Table 17. LASSO Demographics			
Gender Breakdown:	**Total**	6	100%
Total Male Participants		3	50%
Total Female Participants		3	50%
Ethnicity Breakdown:			
Total Caucasian		6	100%
Total minority		0	0%
Location Breakdown	**Population Served**	**Level**	
Bloomfield	Native American, Hispanic and Anglo	Elem.	
Albuquerque	Native American, Hispanic and Anglo	High	
Floyd	Hispanic and Anglo	High	
Los Alamos	Native American, Anglo, Asian, and Hispanic	Elem.	
Shelburne, Vermont	Anglo	Elem	

Evaluation

Evaluation was composed of a combination of formative and summative strategies. A variety of evaluation tools were used to measure how well the program met its objectives. These tools included process feedback forms and teacher surveys. Follow-up activities are being conducted throughout the academic year where teachers will implement a variety of LASSO lessons. Teachers are expected to evaluate their implementation through evaluation of student papers, student presentations, and student-prepared products. The teachers will submit final reports during the spring of FY01.

Review of the teacher surveys showed that the project was successful in meeting its overall goals. The teachers enjoyed interacting with each other during the LASSO workshops while conducting their research and completing their LASSO lessons and activities. Teachers generally agreed that they learned a lot about the topic.

Evaluation of the program using a variety of tools and methods revealed that the teachers demonstrated positive increases in the following areas:

- Understanding of space physics,
- Content understanding in the monitoring of space phenomena,
- Understanding of telecommunications,
- Use of technology for research purposes,
- Ability to use the computer to communicate and share information with others,
- Ability to research a complex issue in-depth,
- Use of concept mapping,
- Understanding of content by using a problem-based approach to learning science, and
- Small-group work

Program Highlights

The first workshop was held on June 16, 2000, at Los Alamos National Laboratory for six master teachers to begin developing classroom lessons and activities that support the LASSO curriculum efforts in the area of space physics. Teachers were introduced to the varying NIS-1 projects included in the LASSO effort. Project scientists discussed some of the basics included within their research. Teachers also began to learn about current research in effective pedagogical approaches.

The summer institute was held July 10 through July 21, 2000, at Los Alamos National Laboratory. Six master teachers representing four NM school districts, one Vermont school district, and five individual schools participated in the summer institute. The teachers engaged in the development of curriculum as well as establishing a communication network that would be utilized in the program to share and disseminate curriculum ideas, thus reducing their isolation from the rest of the educational community. Los Alamos National Laboratory scientists participated as content specialist mentors and offered a varied cross section of opinions and experiences within the space physics arena. Seminars included lectures and demonstrations on particle physics, charged particles, and electromagnetic fields. Further studies acted as a background for advanced sessions on the solar wind and Earth's magnetosphere.

The final workshop was held at LANL on August 7–10, 2000. There were five schools, six teachers participating, with two high schools and three elementary schools represented. The projected overall student enrollment supervised by the six teachers was approximately 520.

The participants used the Los Alamos National Laboratory Critical Thinking Curriculum Model (CTCM) developed for the Critical Issues Forum program. The CTCM is a multidisciplinary approach to learning encompassing computer technology, current real-world issues, and proven learning and teaching practices. This model incorporates four identified areas that form its core components: effective educational practices, technology integration, alternative assessment practices, and developing community involvement. The model features open-ended and collaborative activities and is designed as a project-based research experience for students and teachers to develop a conceptually correct understanding of the topic being studied.

LASSO also had effects on teaching and learning within the participating schools. For example, at Naaba Ani Elementary School in northwestern New Mexico, the teacher demonstrated a shift to using many of the techniques from Critical Thinking Curriculum Model (CTCM) that forms the basis of the LASSO curriculum development. Follow-up reports from last year's teachers were submitted in the late spring. They reported that student projects were displayed in the school for several weeks receiving compliments from other teachers, administrators, and parents. Parental involvement included building a one-half scale model of the Lunar Prospector, complete with data collection instruments, which was put on display on the school grounds. Another example was at a Los Alamos elementary school where students were involved in creating myths explaining the Aurora Borealis and comparing their own and ancient myths to the science of the phenomenon. Middle school students were involved in designing exhibits and rides demonstrating gravity, satellites, and solar wind. High school students were interpreting complex data from instruments measuring solar wind. Student projects demonstrated a definite transition from before teacher involvement to after involvement.

In the area of technology use in the classroom, teachers became very comfortable using technology, and it was expected that their students use the technology as part of their classes.

Table 18. LASSO Milestones

March 2000	Recruiting FY00 Cohort	Active recruiting ongoing
June 2000	Introductory Workshop	Conducted June 16, 2000
July 2000	Summer Institute	Conducted July 10–21, 2000
August 2000	Culminating Workshop	Conducted August 7–10, 2000
Aug 2000–April 2001	Program Implementation and Report Follow-up	Current implementation stage

Milestones

Anecdotal Comments from Teachers

"I wanted to thank you for the LASSO learning opportunity this summer. Thank you for hanging in there with me. My self-confidence and comfort zone were on a roller coaster ride several times. But now that the lessons are done and I have a unit ready to go, I'm thrilled and so pleased with the summer experience. Combining science topics and technology is just what I needed.
I'm determined to keep up the Web page skills and hopefully expand them. (I wish we could clone you. I would love to take science classes from you as well as technology classes.)
Thank you again for making LASSO such a wonderful professional development opportunity for teachers. It was great for me. I needed and appreciated all your one to one help with the technology!

"The students REALLY liked this unit. They were very involved, enthusiastic, and quite informed (already) on the different aspects of space science. I really enjoyed listening to each team give their presentation and demonstration because they were "into" their subject area and wanted the rest of the class to learn about it too. I would make three adjustments for next year: have more research materials available in the room for students to use, have more of a variety of "stuff" for kids to use to build things (possibly generating ideas from them and then have them bring in stuff from home) and also have scientists come over from the lab to share their expertise with the students. I never imagined how enthusiastic the students would be. They really enjoyed working on this unit. I think this opportunity also lead many students to choose a space science research area for their long-term project in my class this year too."

"While working for LASSO during the summer of 1999, I chose to focus on some of the instruments created at LANL, as well as the satellites they fly on. I made my decision based on the fifth grade science curriculum which incorporates the topics: Forces and Motion and Simple Machines. I leaned more towards Simple Machines."

"Simple machines was our last science unit of the year. The students already had a good base knowledge of forces and motion as well as, how systems work. As we began our study of simple machines, we also began to look at The Lunar Prospector. We followed many of the lesson plans on the LASSO site. We also talked about the implications of finding water on the moon and what this could mean to society. We used a great deal of LANL and NASA Web links for information."

The Massachusetts Institute of Technology (MIT) Engineering Internship Program (EIP)

Based on the belief that real-world experience is an important aspect of a sound education, the MIT Engineering Internship Program (EIP) combines the traditional on-campus academics with off-campus work experiences at the Laboratory. By giving students an opportunity to participate in work experiences early in their careers, we enable them to make more informed choices from among the various on-campus educational offerings, as well as obtain a better understanding of career opportunities available after graduation. Emphasis is placed on ensuring that students in the program are placed in rewarding real-world work assignments that extend the learning experience into areas that are not available at MIT. There is extensive faculty participation and advising in both the on- and off-campus components of the program.

This program provides the opportunity for the participating students to be awarded a B.S./M.S. degrees simultaneously upon successful completion of all degree requirements and completion of all three work phases at the Laboratory. Program participants complete a combined B.S./M.S. thesis on a topic related to their work assignments. The thesis topic is normally determined before completion of the second work assignment, and students complete their thesis primarily during the third and final work phase of the program at the Laboratory. All thesis work is completed under the combined supervision of Laboratory staff members and an MIT faculty member.

In FY00, there were 12 students who participated in the program representing 9 Laboratory organizations. Of the 12 participants, 1 entered the graduate work phase of the program and completed his/her masters thesis project while in residence at the Laboratory. An additional 2 other participants are pursuing graduate school outside the normal parameters of the program.

Table 19. Participant Demographics

Ethnicity	Male	Female	Total
African American	1		1
Anglo	4	2	6
Asian/Pacific Islander	4	1	5
Total	9	3	12

The National Physical Science Consortium (NPSC)

Program Description

The National Physical Science Consortium offers a unique and exciting doctoral graduate fellowship program in the physical sciences and related engineering fields, which directs special emphasis toward the recruitment of underrepresented minority and female physical science students in order to offset the historic imbalance faced by these underrepresented groups within the research community. The consortium is self-supporting, funded by annual membership fees received from employer members. Current membership includes 109 Ph.D.-granting colleges and universities; 39 sponsoring employers, including Los Alamos National Laboratory; and alliances with the Navajo Nation and the Hispanic Association of Colleges and Universities (HACU). The Laboratory became an employer member in 1989.

The National Physical Science Consortium is a full-time study Ph.D. track program with a maximum of six years that provides scholarly and career paths for US citizens. A GPA of 3.0/4.0 is required for participation in the program. The fellowship requires a student be enrolled in the following fields of study: astronomy, chemistry, computer science, geology, materials science, mathematical sciences, physics, and subdisciplines. Included are specific engineering fields: chemical, computer, electrical, environmental, and mechanical. The fellowship is normally continual as long as the fellow is making satisfactory academic progress and attending full time, maintains employment eligibility for his/her sponsoring employer, and maintains satisfactory on-the-job performance at the sponsoring employer's work site.

The consortium granted its first fellowship awards in 1989 with seven fellows. The program is in its eleventh year and has had 62 Ph.D. graduates from a total of 258 fellows in the program. The internal breakdown is 51% minority and 49% non-minority, of which 74% of all fellows are female.

In summary, the National Physical Science Consortium is a unique partnership of industry, national laboratories, and higher education joined together to create a continuous source of US citizen research scientists offering employers and universities the opportunity to add diversity and balance in the workplace. In turn, the program provides opportunities to young, bright future scientists to achieve their academic goals and research aspirations.

Performance Objective and Milestones

By partnering with the National Physical Science Consortium, the Laboratory hopes to increase the existing pool of Ph.D.s in the Physical Sciences with special emphasis on diversity, while supporting the Laboratory's mission. To help achieve this important mission, student research assignments through the National Physical Science Consortium focus on the Laboratory's critical skills areas.

Highlights of this Year's Accomplishments

Through leveraging of resources, including cost-sharing with the sponsoring technical divisions, the Laboratory was able to support four students through the National Physical Science Consortium during FY00. These students were awarded their fellowships in FY99 and met the requirements for continuing in the program during FY00. As a result of budget cuts at the Laboratory, no new fellowships were awarded in FY00.

Program Specifics

Number of Participants: 4

Ethnicity Breakdown:
Anglo Female – 1
Hispanic Females – 2
Hispanic Males – 1

Average GPA of Participants: 3.5/4.0

Schools Represented
Cornell University
Indiana University
University of New Mexico
University of Washington

Participants

Alicia Ayala
Alicia is a Ph.D. candidate in mechanical engineering at the University of New Mexico. She attended undergraduate school at the University of Texas-El Paso and participated in the Laboratory's undergraduate program before her acceptance into the NPSC program. Her research for the past three years has been in the Material Science and Technology Division. This past summer her research involved the processing and characterization of HTS materials.

Chris Beltran
Chris is a Ph.D. candidate in physics at Indiana University. He attended undergraduate school at New Mexico State University. His research project this past summer involved ground-based measurements of optical and electrical signals from lightning discharges. These measurements supply diagnostics to data gathered by the FORTE satellite. The research was performed in the Nonproliferation and International Security Division.

Shannon McDaniel
Shannon is a Ph.D. candidate in geophysics at the University of Washington. Her fellowship is jointly funded by Los Alamos National Laboratory and Lawrence Livermore National Laboratory. Her primary research this past summer involved learning neutron diffraction measurement techniques. The research was performed at the Los Alamos Neutron Science Center.

Antonella Romano
Antonella is a Ph.D. candidate in physics at Cornell University. Her research this summer involved investigating the use of $Lu_2(SiO_4)$:Ce for gamma-ray spectroscopy in nuclear safeguard applications. The Nonproliferation and International Security Division sponsored her research.

All four students had positive research experiences this past summer and will continue in the program in FY01 if they meet the program eligibility requirements.

Northern New Mexico Math and Science Academy

Program Description

The Northern New Mexico Math and Science Academy (MSA) was designed and developed by the Northern New Mexico Council for Excellence in Education (NNMCEE). NNMCEE was created by the University of California and the Laboratory to support and collaborate with presidents of two-year colleges, school district superintendents, the University of New Mexico, Highlands University, business leaders, and community representatives.

Student test scores and teacher competency surveys reveal a tremendous need for improving student achievement and teacher preparation in northern New Mexico. The MSA is, therefore, designed to (1) utilize master teachers and research-based best practices to significantly improve math, science, and technology education; (2) initiate systemic change in northern New Mexico schools and colleges; and (3) serve as a national model for improving mathematics, science, and technology education in rural communities. The development of the academy is viewed by northern New Mexicans as a positive and necessary "good neighbor" initiative with the Laboratory.

The MSA follows the following recommendations of the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology in order to effect systemic change:

- In order to improve professionally, teachers must be more reflective in their practice. Tools such as portfolios and journal writing are means through which reflection can be encouraged and needs defined.
- Performance-based assessments must be implemented to measure the outcomes of professional development.
- Professional development programs need to be long-term and provide ongoing follow-up. Funding needs to be committed to professional development of teachers to have a sustained positive impact.

The MSA also utilizes principles in teaching reform from "Shaping the Future," a report from the Advisory Committee to the National Science Foundation's directorate for Education and Human Resources. The principles are as follows:

- Set learning goals. These goals must include clear expectations, the attainment of which are measurable.
- Foster interdisciplinary education by integrating learning with other disciplines and previous courses.
- Provide a curriculum that engages and motivates the students. Learning should be inquiry-based. Build upon the curiosity and interest that the student brings to class.
- Create an environment in the class that both challenges and supports the students.
- Support learning communities for students that include peer learning and group study opportunities. Devise and use pedagogy that develops skills for life: communication, teamwork, critical thinking, and lifelong learning habits.
- Use instructional technology effectively.
- Develop partnerships and collaborations with colleagues in education and in the business world to improve preparation for life.

The MSA plans to stimulate lifelong learning and to enhance mathematics and science curricula in an interdisciplinary environment at three middle schools, (Chama Middle School, Mora Middle School, and Espanola Middle School) in northern New Mexico. Through the engagement of master teachers, a "lab school design," and an apprenticeship professional development model, the MSA will strengthen its students' basic skills in mathematics, science, language arts, and social studies and develop the middle school teachers' professional skills by increasing content knowledge, teaching skills, Web site development and use, and career counseling. The MSA will also provide a site for pre-service teachers in core curricular areas to participate in a model program for their student teaching experience.

Program Objectives and Milestones

The Math and Science Academy seeks to enhance the overall quality of science, mathematics and technology education in Northern New Mexico. Some of the objectives are as follows:

- Increase student performance in the areas of mathematics, science, and English as measured on the New Mexico Achievement Association (NMAA) exam in the Spring 2001.
- Decrease the number of students dropping out of school.
- Improve student attitudes toward science, math, and technology as measured on before and after surveys.
- Increase teacher content knowledge, knowledge of Internet-based applications, and instructional methods as measured on before and after surveys.
- Increase in student interest in science/ math/technology related careers as reported on before and after surveys.
- Provide positive student teaching experiences for participating student teachers as reported on a post-participation survey.
- Support a flourishing economy by supplying a trained workforce.

Some milestones to indicate progress toward the objectives:

- Participating teachers are trained in the summer before the school year.
- Teachers and student teachers observe model demonstration lessons by master teachers.
- Teachers and student teachers provided regular and specific feedback from master teachers on their work with students.
- Content aligned to NM state standards is delivered in nontraditional ways in an interdisciplinary learning format.
- Teachers and students learn or relearn concepts in which they are weak.
- Teachers learn to use technology as a productivity tool; they learn how to help students to become fluent with software applications useful in math, science, and other curricular areas.
- Students use technology, fieldwork, career exploration, and extensive laboratory experiences to practice what is being taught. The emphasis is on "be able to do" rather than just know.

Highlights of This Year's Accomplishments

Teacher Program

During the summer, 12 middle school core teachers from three northern area schools participated in an intensive two-week training and work session. Participating teachers completed a *Teacher Practice Inventory*

before the start of the training. Guest presenters from other school districts, NM Department of Education, Los Alamos National Laboratory, and NNMCEE shared their thoughts and expertise in the area of school reform and teaching strategies. Topics covered included the following:

- "Defining Student Success and School Reform,"
- "Getting a Clearer Picture of Assessment,"
- "Middle School Concept,"
- "Literacy and Remediation,"
- "Project-based Learning and Rich Assignments,"
- "Job-Embedded Professional Development," and
- "Standardized Testing—Implications."

The group developed an integrated thematic unit that delivers the New Mexico standards and benchmarks across the core areas of mathematics, science, language arts, and social studies. The group decided, after careful dialogue, to choose "Who am I?" as the theme for the integrated unit. They incorporated the practical application of mathematics across the curriculum, wherever relevant, as they mapped out the unit. The teachers developed lessons, assessments, and rubrics that clearly show the students and teachers the level of acquisition of the standards. The teams planned remediation strategies to address the level of acquisition of the standards. They also worked closely in discipline area teams to exchange ideas on delivery of content, strategies for collaborative learning, and planning the integrated thematic unit for the first semester.

They participated in various activities that enabled them to experience first-hand the concepts which were presented by the guest speakers and the master teachers. It was a challenge for the teachers to function in performance-based learning and assessment activities which, in most instances, are different than what these teachers were using in their own classrooms.

Figure 36. Participants in the 2000 Northern New Mexico Math and Science Academy.

South Carolina Universities Research and Education Foundation (SCUREF)

Program Description

Incorporated in 1998, the South Carolina Universities Research and Education Foundation is a consortium composed of the four major research institutions in South Carolina: Clemson University, the Medical University of South Carolina, South Carolina State University, and the University of South Carolina. The primary goal of the South Carolina Universities Research and Education Foundation is to enhance educational programs and research opportunities of the participating universities through collaboration. The consortium utilizes these universities to manage its research and education programs. One of these programs is the Department of Energy Nuclear Engineering and Health Physics Fellowship/Scholarship (NE/HP) graduate program. The program is managed through the Medical University of South Carolina Office of Special Programs (MUSC/OSP). Los Alamos National Laboratory is one of nine participating centers for the Nuclear Energy and Health Physics program. FY00 was only the second year the Laboratory has participated in the program.

Performance Objective and Milestones

Through its participation in the Nuclear Energy and Health Physics Fellowship/ Scholarship graduate program, the Laboratory supports its mission while focusing on the development of a future workforce in the critical skills areas. FY00 was only the second year the Laboratory has participated in the program under the SCUREF administration (Before being administered by SCUREF the program was administered by Oak Ridge Associated Universities, and the Laboratory was a participating center).

Highlights of this Year's Accomplishments

Two NE/HP fellows were recruited to the Laboratory this year through the Nuclear Energy and Health Physics Fellowship/ Scholarship program. Both had positive research experiences and plan to return to the Laboratory next summer as graduate research assistants.

Program Specifics

Number of Participants: 2

Ethnicity Breakdown
- Anglo Males – 2

Average GPA of Participants: 3.85/4.0

Schools Represented
- Massachusetts Institute of Technology
- University of New Mexico

Participants

Brian Miller
Brian is a Ph.D. candidate in nuclear engineering at the University of New Mexico, 3.7/4.0 GPA. His research was performed in the Applied Physics Division under the tutelage of Dr. Raymond Alcouffe. His primary assignment was to develop a first collision source method that included determining the eigenvalue of a fissioning system. Brian is a veteran of the US Navy. He

served previous internships at Argonne National Laboratory and Brookhaven National Laboratory.

Benjamin Wilson
Benjamin is a Ph.D. candidate in nuclear engineering at the Massachusetts Institute of Technology, 5.0/5.0 GPA. His research was performed in the Applied Physics Division under the tutelage of Dr. John Hendricks. His primary assignment was to provide assessment of new capabilities of MCNP4C n-particle transport code. Benjamin's honors and awards include the National Academy of Nuclear Training Scholarship, the American Nuclear Society Scholarship, and the Oak Ridge Institute of Science and Education Scholarship.

Summer Undergraduate Research Fellowships (SURF)

Program Description

The Summer Undergraduate Research Fellowships program is an integral part of the academic experience at the California Institute of Technology (Caltech). Founded 20 years ago, SURF has played a key role in maintaining Caltech's position as a leader in research and education. Since its inception, the program has expanded to include students from other institutions worldwide. The 2000 SURF class had 349 participants.

This unique program offers undergraduate students the opportunity to do research projects in collaboration with Caltech faculty, Jet Propulsion Laboratory staff, and technical staff at other off-campus research facilities, including Los Alamos National Laboratory. Through ten-week summer internships students experience the process of research as a creative intellectual activity and gain a more realistic view of the opportunities and demands of a professional research career. The internship includes opportunities for students to participate in stimulating exchanges of information and ideas through speaking and writing conferences and contests.

Performance Objective and Milestones

FY00 was the inaugural year of the Laboratory's participation in the SURF program. Through its partnership with Caltech, the Laboratory hopes to promote the development of young scientists and engineers to become the next generation of scientists, mathematicians, technicians and engineers, while focusing on the Laboratory's mission and critical skills areas.

Six technical groups at the Laboratory submitted proposals to the Summer Undergraduate Research Program for summer 2000. All proposals were specifically targeted for Caltech students only. The proposals resulted in two exceptional students being recruited to the Laboratory. It is anticipated these numbers will increase in the future as the Caltech students become more familiar with Los Alamos National Laboratory and our mission.

Highlights of this Year's Accomplishments

The highlight of the Summer Undergraduate Research Fellowship program at the Laboratory during FY00 was its inclusion into the Science and Education Base/Education Program Office family of internship programs and the recruitment of the first two student participants into the program. Both students had a positive research experience this summer and hope to return to the Laboratory in the future. One student, Martin Tchernookov, experienced some frustrations/ roadblocks in his assignment due to his Bulgarian citizenship and the recent policies at the Laboratory concerning non-US citizens. He was given assurance that should he choose to return to the Laboratory in the future that his citizenship would be given full consideration when planning his research assignment.

Program Specifics

Number of Participants: 2

Ethnicity Breakdown:
Anglo Males – 2

Average GPA of Participants:
One student holds freshman status and does not have a cumulative GPA but is graded on a P/F system. He holds a "P." The other student holds a 3.9/4.3 cumulative GPA.

Participants

Vikram Mittal
Vikram, class of 2003, is pursuing a BS in either aeronautical engineering or applied physics from Caltech. His summer assignment was to participate in the testing and evaluation of a new neutron detector concept. The research was performed in the Nonproliferation and International Security Division. His numerous awards and honors include National Merit Commended Scholar, Advanced Placement National Scholar, Texas Association of Secondary Schools Scholar, and Robert Byrd Scholar.

Martin Tchernookov
Martin, class of 2002, is pursuing a BS in physics from Caltech. He holds a cumulative GPA of 3.9/4.3. His summer assignment was to identify statistical problems with applied research potential and perform the research necessary to solve these problems. The research was performed in the Technology and Safety Assessment Division. His honors and awards include Honorable Mention, 28th International Physics Olympiad, 1997. He received a national diploma from the Bulgarian Department of Education upon graduation from the National High School of Science and Mathematics with a 6.0/6.0 GPA.

The Oak Ridge Institute of Science and Education (ORISE)

Program Description

The Oak Ridge Institute of Science and Education is operated by Oak Ridge Associated Universities (ORAU) for the Department Of Energy (DOE). Oak Ridge Associated Universities is a consortium of 87 doctoral-granting colleges and universities, including a significant representation of minority-serving institutions. ORAU serves the government, academia, and the private sector in important areas of science and technology. It is a private, not-for-profit operation.

ORISE has administered research participation and fellowship programs for over 50 years, and they currently administer over 100 programs. Programs target faculty, postgraduates, graduates, and undergraduates in the fields of science, mathematics, and engineering. These programs not only offer participants the opportunity to work in state-of-the-art research facilities, but they also encourage collaboration among researchers in academia and the national laboratories. Special recruitment efforts, including partnerships with organizations that promote minority participation in the sciences, resulted in more than half of the individuals placed in 1999 being from demographic groups underrepresented in science, engineering, and mathematics.

A variety of educational opportunities are available through ORISE, all of which offer summer practicums at US DOE sites. Participants receive guest appointments at the host facility and are not considered to be contractors or employees of the host facility, Oak Ridge Institute of Science and Education, Oak Ridge Associated Universities, or the Department of Energy.

Through its partnership with ORAU/ORISE, which began in FY83, the Laboratory strengthens its ties with the academic community while at the same time focusing on developing a highly trained, diverse workforce.

Performance Objective and Milestones

Utilizing their state-of-the-art research facilities the Laboratory, in partnership with the Oak Ridge Institute of Science and Education, recruits and places students and faculty in summer research projects that support the Laboratory's mission and critical skills areas. Research areas focus on theory, modeling, and high-performance computing and nuclear weapons science and technology.

Highlights of this Year's Accomplishments

Participation in the Laboratory's ORISE program during FY00 was at it lowest level in recent years. This could be attributed to several factors, including the following:

- The Cerro Grande fire: Several undergraduate students were recruited, placed and ready to report to the Laboratory when the fire occurred. As a result of parental concerns, they chose to forego their internships at the Laboratory.

- The cut in funding for the Laboratory's Historically Black Colleges and Universities Program (HBCU): When the HBCU program was active at the Laboratory, it enhanced the ORISE recruitment because it helped attract students from the five Historically Black Colleges and Universities (HBCU) programs administered by ORISE. The existence of the internal HBCU program assured those recruited through ORISE that there would be other African American students at the Laboratory. In FY99 the Laboratory successfully recruited six students and one faculty member through ORISE HBCU programs. In FY00 we did not have any ORISE HBCU participants.

The ORISE program had one participant this year: Dr. Andrew Martinez, Professor of Life Sciences, University of Texas-San Antonio. He performed collaborative research with Drs. Mark MacInnes and Robert Cary of the Biosciences Division.

Section 5

Participant Data

Number of Undergraduate Student Participants

Program Title	Afr-Am Male	Afr-Am Female	Cauc Male	Cauc Female	Hispanic Male	Hispanic Female	Nat-Am Male	Nat-Am Female	Asian Male	Asian Female	Other Male	Other Female	TOTAL
BEAM Robotics	0	0	3	1	0	0	0	0	0	0	0	0	**4**
Critical Issues Forum	0	0	0	1	1	3	0	0	0	0	0	0	**5**
LA Physics Summer School	1	1	12	0	0	0	1	0	1	2	0	0	**18**
Summer of Applied Geophysical Experience	0	0	8	8	0	1	0	0	1	0	0	0	**18**
Modern f-Element Chemistry	0	0	1	3	1	0	0	0	1	0	0	0	**6**
Developing Information Systems Careers	0	0	3	0	3	2	1	0	1	0	1	0	**11**
Undergraduate Research Semester	0	0	8	2	0	1	0	0	1	0	1	0	**13**
Nuclear & Radiochemistry	0	0	2	2	1	1	0	0	0	0	0	0	**6**
InVISION	0	0	1	5	3	0	1	0	1	0	0	0	**11**
Summer Undergraduate Research Fellowship	0	0	2	0	0	0	0	0	0	0	0	0	**2**
LA Dynamics Summer School	0	0	5	1	1	0	0	0	0	0	0	0	**7**
SUBTOTAL	**1**	**1**	**45**	**23**	**10**	**8**	**3**	**0**	**6**	**2**	**2**	**0**	**101**

Number of Graduate Student Participants

Program Title	Afr-Am Male	Afr-Am Female	Cauc Male	Cauc Female	Hispanic Male	Hispanic Female	Nat-Am Male	Nat-Am Female	Asian Male	Asian Female	Other Male	Other Female	TOTAL
Critical Issues Forum	0	1	2	1	2	4	0	0	0	0	0	0	10
LA Physics Summer School	0	0	0	0	0	1	0	0	0	0	0	0	1
Summer of Applied Geophysical Experience	0	0	2	2	0	0	0	0	0	0	4	1	9
Modern f-Element Chemistry	0	0	15	4	0	0	0	0	1	0	0	0	20
Developing Information Systems Careers	0	0	1	1	0	0	0	0	0	0	0	0	2
Nuclear & Radiochemistry	0	0	2	5	1	0	0	0	0	1	0	0	9
SC Universities Research & Education Foundation	0	0	2	0	0	0	0	0	0	0	0	0	2
Nat'l Physical Science Consoritorium	0	0	0	1	1	1	0	0	0	0	0	0	3
LA Dynamics Summer School	0	0	4	1	1	0	0	0	0	0	0	0	6
SUBTOTAL	**0**	**1**	**28**	**15**	**5**	**6**	**0**	**0**	**1**	**1**	**4**	**1**	**62**
Total Students	**3**	**2**	**303**	**147**	**200**	**165**	**59**	**53**	**18**	**6**	**49**	**165**	**1170**

Number of Faculty Participants

Program Title	Afr-Am Male	Afr-Am Female	Cauc Male	Cauc Female	Hispanic Male	Hispanic Female	Nat-Am Male	Nat-Am Female	Asian Male	Asian Female	Other Male	Other Female	TOTAL
BEAM Robotics	0	0	0	4	0	1	0	0	0	0	1	2	**8**
Critical Issues Forum	0	0	10	4	2	1	0	0	0	0	0	0	**17**
Go Figure! Math Contest	0	0	3	3	4	5	1	0	0	0	0	0	**16**
LA Space Science Outreach	0	0	3	3	0	0	0	0	0	0	0	0	**6**
Math & Science Academy	0	0	0	1	3	5	0	0	0	0	0	0	**9**
Modern f-Element Chemistry	0	0	2	1	0	0	0	0	0	0	0	0	**3**
Navajo K-12 Workshop	0	0	0	0	0	0	13	17	0	0	0	0	**30**
NM Super Computing Challenge	1	0	30	26	4	5	1	4	0	1	4	2	**78**
Nuclear & Radiochemistry	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Oak Ridge Inst of Science and Education	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Summer of Applied Geophysical Experience	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Teacher Opportunities to Promote Science	0	1	8	18	1	14	1	6	0	0	0	0	**49**
Teacher Conference in Conjunction with Expanding Your Horizons	1	0	0	8	5	8	0	1	0	0	0	0	**23**
TOTAL Teachers	**2**	**1**	**57**	**68**	**20**	**39**	**16**	**28**	**0**	**1**	**6**	**4**	**242**
TOTAL Overall Participants	**5**	**3**	**360**	**215**	**220**	**204**	**75**	**81**	**18**	**7**	**55**	**169**	**1412**

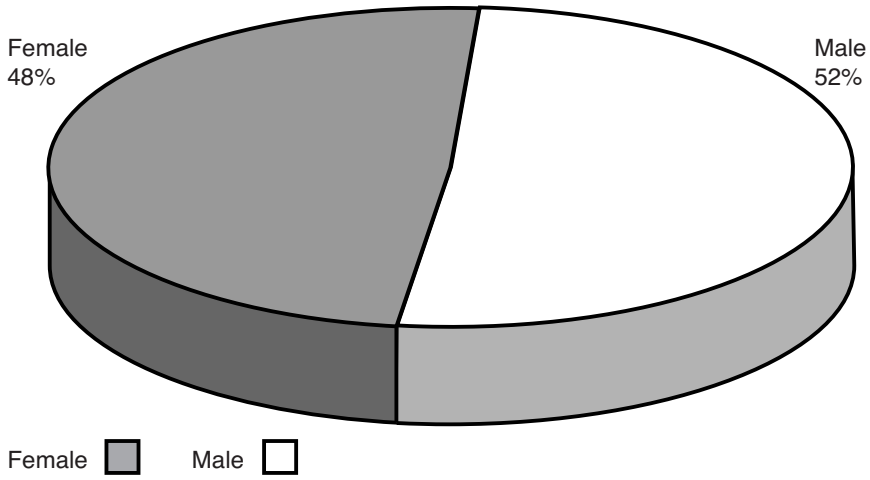


Figure 1. Gender-Science Education Programs.

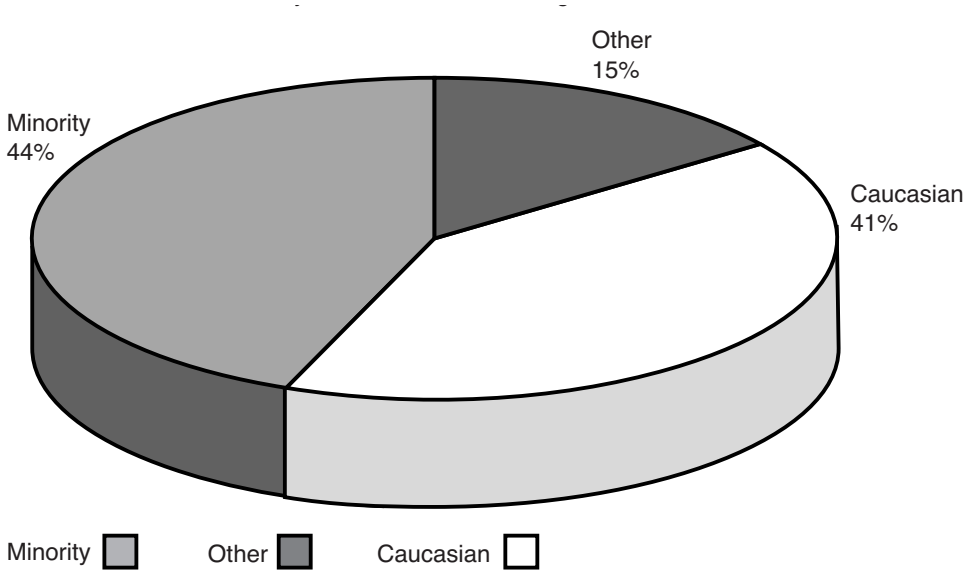


Figure 2. University-Science Education Programs.

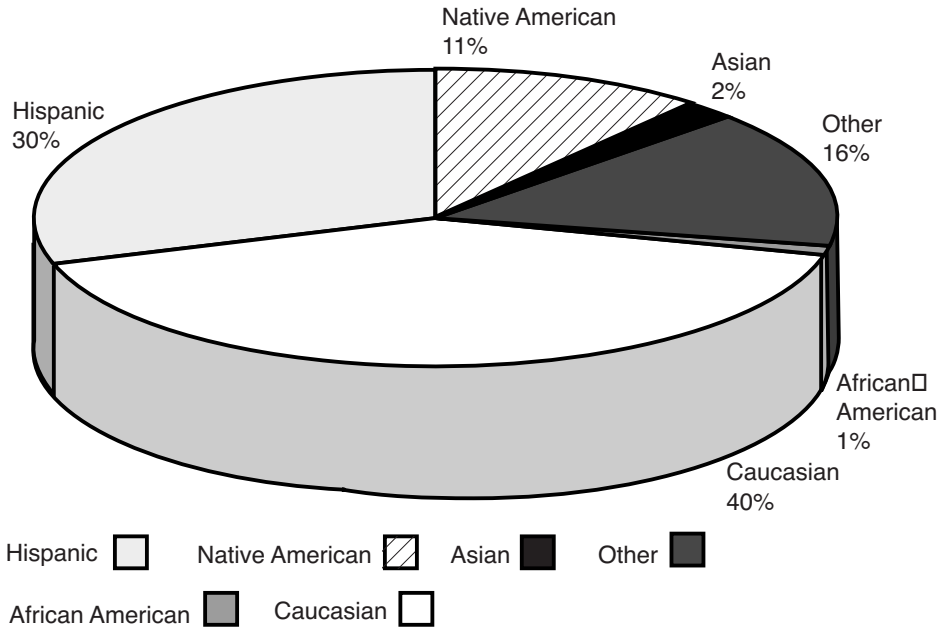


Figure 3. Diversity-Science Education Programs.