Appendix F

SUMMARY REPORTS OF THE EIGHT UFE WORKSHOP VISITS

This appendix presents summary reports of the eight workshops visited in 1998. A description of how workshops were chosen for visits is presented in Chapter III. Each summary presents a description of the goal(s) of the workshop, the activities conducted, its leaders and participants, and its impact. Each is followed by an example of the actual workshop schedule.

(1) THE ART AND SCIENCE OF MATHEMATICAL MODELING: A WORKSHOP FOR COLLEGE MATHEMATICS TEACHERS

Principal Investigator:	Robert McKelvey
Organization:	University of Montana, Missoula
Workshop dates:	July 29-August 7, 1998
Workshop location:	University of Montana, Missoula

Sources of Data

An SRI researcher visited the workshop on August 3-4, 1998. Before the visit, the project's proposal was examined. The researcher was accompanied by an outside content expert on August 3. During the visit, all activities were observed, and interviews were conducted with the project PI, 3 workshop instructors, and 10 participants. The PI provided written and oral updates in the spring of 2000.

Project Goal

The project's overarching goal was to increase the use of open-ended problem-solving activities focusing on real-world issues among faculty teaching undergraduate mathematics. To accomplish this, the project sought to:

- Introduce model building to a group of college mathematics teachers.
- Help them gain the skill and confidence necessary to introduce modeling activities into their own undergraduate teaching.
- Encourage participants to incorporate modeling as a permanent component of their own ongoing scholarly activities.

Project Description

This 2-week summer workshop focused on mathematical modeling of environmental and natural resource conflicts. The theme was the result of the PI's conviction that applied mathematical modeling can help undergraduate students discover

the central role that mathematics plays in modern science, and thereby demonstrate to them the value of further mathematical studies.

Activities

The workshop included a combination of lectures, computer lab experiences, field trips, and time to work on individual projects. The PI, staff, and guest lecturers presented sessions on a variety of mathematical models (e.g., optimal control problems, game theory, and dynamic models). In most sessions, the models were well integrated with environmental phenomena. For example, the session on decision theory used examples regarding endangered species, such as the northern spotted owl. To give participants firsthand knowledge of some of the ecological phenomena covered in the sessions, there were two field trips. Each afternoon, participants did hands-on activities in a computer lab, where they were taught software that could be used to estimate the various models (e.g., Mathlab). The computer lab was also open in the evenings.

Long breaks between sessions, social activities such as a picnic, and the housing of all participants in a single dorm were scheduled so that participants could interact informally. Participants took good advantage of these opportunities, discussing the various models, their previous experiences teaching modeling, and how they would apply what they had learned at the workshop in their own courses. Toward the end of the workshop, a full session was devoted to discussions of modeling's place in the curriculum, challenges to teaching it, and strategies for overcoming those challenges.

During the following year, participants were expected to teach a modeling course, or at least several units of modeling in a course, for undergraduate students. An Internet discussion forum was provided. In the spring of 1999, participants submitted abstracts of the courses they had taught or other postworkshop activities. The abstracts were compiled and distributed at a 3-1/2-day meeting in the summer of 1999.

Leadership

Robert McKelvey, currently a professor emeritus, came to the University of Montana, Missoula, more than 25 years ago to revamp the math department. McKelvey strongly believes that most mathematics should be applied and interdisciplinary. He has specialized in environmental and natural resource modeling for more than 20 years, with current research focusing on game theoretic models of international environmental

disputes. McKelvey is a recent past president of the Resource Modeling Association and edits the research journal *Natural Resource Modeling.*

Workshop instructors included eight faculty, six of them from the Mathematics Department of the University of Montana at Missoula. Each specialized in a particular area of modeling (e.g., game theory, discrete-state models). One was an expert in mathematics education. Five content experts spoke as guest lecturers.

Participants

The 28 participants consisted of 19 males and 9 females. Two were from underrepresented minority groups (one Hispanic and one African American). Participants came from all over the country, mostly from small 4-year or comprehensive institutions. Most taught modeling or related courses. Two were attending with the primary goal of developing programs of study for mathematics majors.

Preference was given to faculty in their first 5 years of teaching. Some more experienced faculty were accepted—particularly those whose work would have an impact on a broader scale than their own courses (for example, the two who were designing programs of study). Participants received a *per diem* payment for the 2 weeks of the workshop and were housed in a dorm at the university.

Project Impact

During interviews and/or at observed workshop sessions, all participants indicated that they intended to use in their courses what they had learned in the workshop. Of the two expected to design mathematics majors, one had recently been hired for this purpose—her college was converting from a 2-year institution to a 4-year institution, and she was to design the upper-division sequence. The other was the chair of a mathematics department that did not have the number of majors they believed they should. The chair was revamping the major in hopes of attracting more students.

Of 13 participants who responded to a survey by the project director in the spring of 2000, all indicated that since the workshop they had taught a modeling course, taught modeling in their other mathematics courses, or were engaged with students doing modeling as individual study.

Ten participants reported having spoken to their colleagues about using modeling to teach mathematics. Several wrote that their colleagues were not very receptive; however, six respondents indicated that what they had done in their own courses and their discussions with colleagues had brought about more widespread changes. For example, one stated that he would be working on ways to fit modeling into a new environmental science major; another said that her department had made a formal decision to emphasize modeling and applications throughout the curriculum; and a third indicated that his department was no longer going to remove the modeling course from the curriculum. Participants also reported developing new collaborations and new research interests.

EXHIBIT F-1
TYPICAL WEEKLY SCHEDULE: MODEL BUILDING WORKSHOP

Monday		
8:00 - 9:30 a.m.	Lecture: Modeling environmental and natural resource conflicts 1	Bob McKelvey, PI
10:15 - 11:45 a.m.	Lecture: Modeling the modes of cooperation—Concepts from collective choice theory and game theory 1	Phil Straffin
1:15 - 2:45 p.m.	Lecture: Optimization modeling 1	Jenny McNulty
3:30 - 5:30 p.m.	Computer lab	Dick Lane
Tuesday		
8:00 - 9:30 a.m.	Lecture: Deterministic models in ecology and conservation biology: the dynamics of discrete and continuous nonlinear systems 1	Bill Derrick
10:15 - 11:45 a.m.	Lecture: Modeling the modes of cooperation—Concepts from collective choice theory and game theory 2	Phil Straffin
1:15 - 2:45 p.m.	Discussion: Problems of introducing mathematical modeling into undergraduate courses	Jim Hirstein
3:30 - 5:30 p.m.	Computer lab	Jenny McNulty
Wednesday		
8:00 - Noon	Field trip to Remount Station	Park Ranger
1:00 - 2:15 p.m.	Guest lecture: Ecology of exotic plants	Dean Pearson
2:45 - 4:00 p.m.	Lecture: Modeling environmental and natural resource conflicts 2	Bob McKelvey
5:30 – 9:30 p.m.	Picnic dinner—Bass Creek	
Thursday		
8:00 - 9:30 a.m.	Lecture: Deterministic models in ecology and conservation biology: the dynamics of discrete and continuous nonlinear systems 2	Bill Derrick
10:15 - 11:45 a.m.	Lecture: Modeling the modes of cooperation—Concepts from collective choice theory and game theory 3	Phil Straffin
1:15 - 2:15 p.m.	Guest lecture: Water conservation—scientists as citizens	Vicki Watson
2:25 - 3:15 p.m.	Guest lecture: Predicting forest fires through modeling	Kevin McKelvey
3:30 - 5:30 p.m.	Computer lab	Jim Hirstein
Friday		
8:00 - 9:30 a.m.	Guest lecture: Optimal control problems	Alvaro Bolano

10:15 - 11:45 a.m.	Facilitated discussion: Integrating modeling into participants' classrooms	Jim Hirstein
1:15 - 2:15 p.m.	Guest lecture: Statistical aspects of simulation	David Patterson
3:45 - 5:30 p.m.	Computer lab	Bill Derrick

Computer lab open evenings, 7:30 - 9:30 p.m., Monday, Tuesday, Thursday, and Friday. Monitoring support available.

(2) TEACHING TEACHERS TO TEACH ENGINEERING (T^4E)

Principal Investigator:	Lt. Col. Stephen Ressler
Organization:	United States Military Academy (USMA), West Point, NY
Workshop dates:	July 26-31, 1998
Workshop location:	USMA, West Point

Sources of Data

An SRI researcher visited the T^4E workshop on July 30-31, 1998. On July 30, the researcher was accompanied by an outside content expert. Before the visit, the project's proposal was examined. During the visit, all workshop activities were observed, and interviews were conducted with the project's PI and senior staff, as well as with 14 participants. In the spring of 2000, the PI provided oral and written updates, and a Web site related to the project was examined.

Project Goal

The project's central goal was to raise the standard of teaching excellence in undergraduate engineering programs nationwide by:

- Increasing the number of engineering faculty who have studied and practiced sound, proven teaching methods.
- Creating a nationwide network of engineering educators and administrators who are committed to promoting better teaching and improved teacher training.

Project Description

The 5½-day workshop emphasized effective lecture techniques and interaction with students. It included seminars and demonstration classes for the whole group, as well as extensive hands-on experience and mentoring.

Activities

Seminars focused on particular topics such as organization and presentation of classes, establishing objectives, student learning styles, instructional technology, student-teacher relations, promotion and tenure, and success in academe. An entire

seminar session, led by two ex-participants who had returned as staff, was dedicated to a discussion of how participants might incorporate what they had learned in the workshop, barriers that might arise, and how those barriers might be overcome. Demonstration classes were taken from real engineering courses, with a staff member taking the role of the professor and the participants taking the role of undergraduate students.

The heavy focus on practice classes was intended to help participants build confidence, poise, and self-assessment skills. Practice lectures and mentoring took place in small groups consisting of four participants, plus at least one senior mentor (a senior faculty member at USMA) and at least one junior mentor (a new USMA faculty member who had just completed USMA's version of the T^4E workshop for its own faculty). Four of the small groups also included a senior observer. Working in small groups allowed each participant to present three practice classes and to receive in-depth feedback from group members immediately following each one. Thus, each attendee had the opportunity to act as presenter or observer/critic for 12 practice classes.

All practice lectures and comments were videotaped, and tapes were made available for participants to view during the week. An empty classroom was made available to each participant for the entire week so that he or she could practice teaching techniques and skills.

Follow-up for participants was principally through a Web site and e-mail. Senior observers were provided long-term technical assistance to establish teacher training programs at their institutions.

Leadership

The project's PI in 1998 was Lt. Col. Stephen Ressler, Deputy Head of the Department of Civil and Mechanical Engineering. Co-PIs were Col. Tom Lenox, Dr. Chris Conley, Dr. Mark Costello, and Lt. Col. Jon Klegka, all on the faculty of the Department of Civil and Mechanical Engineering. Both Lenox and Conley were PIs of T^4E projects under previous UFE grants. Ressler and Lenox were the workshop's primary seminar instructors. Both have won awards for their teaching and have written or presented more than 40 papers on various aspects of undergraduate engineering education. Seven senior faculty from USMA and nonmilitary institutions served as

mentors in the small-group sessions, and nine junior USMA faculty served as assistant mentors.

Participants

Twenty-seven undergraduate faculty from U.S. colleges and universities attended the workshop, 23 as regular participants and 4 as senior observers. Participants included eight women and two Americans from underrepresented minority groups (there was also one participant from Latin America and one from Africa). Participants and observers came from all areas of the country and all levels of experience and tenure. Most came from research/doctoral institutions (16); somewhat fewer came from comprehensive institutions (8). Three came from baccalaureate or 2-year institutions.

To recruit participants, the project sent an information packet to engineering deans and department heads in the United States; presentations also were given at the American Society for Engineering Education (ASEE) conference, and ads were placed in an ASEE publication. Women and minority faculty were targeted by placing an ad in the Society of Women Engineers magazine and by posting a notice at the conference of the National Society of Black Engineers. Nevertheless, the largest single source of recruitment was word of mouth from participants at previous years' workshops.

Each applicant was required to provide a resume, an administrative letter of support, and a statement regarding reasons for attending the workshop, teaching philosophy, and how the applicant intended to work to improve teaching in his or her home institution after the workshop.

Participants were housed in a hotel at USMA; however, unlike many UFE projects, T^4E did not fund participants' lodging. The project did provide meals, as well as materials and supplies.

Project Impact

The T^4E project appears to have achieved its goal of improving participants' teaching. Fifteen of the 17 participants who responded to a survey the year following the workshop reported that their teaching had improved because of the workshop, and 13 reported that their student evaluations had improved (2 others had very high student

evaluations before attending the workshop). Two participants reported that they had been nominated for institutional teaching awards.

T^4E has been used as a model for workshops in other USMA departments. In addition, six participants from other institutions reported using T^4E workshop materials to teach seminars or mini-workshops for faculty at their institutions, and five reported increasing their involvement with institutional centers for teaching excellence, peer review programs, and informal activities with department colleagues.

On a wider scale, in the years following the workshop, the PIs published a paper regarding the T^4E model in the *Journal of Engineering Education* (February 2000) and made several presentations at ASEE meetings. In 1999, a committee of experts commissioned by the American Society of Civil Engineers (ASCE) recommended that the Society adopt the T^4E workshop model for workshops to be conducted as part of its new faculty development initiative in Excellence in Civil Engineering Education. ASCE is sponsoring two such workshops in the summer of 2000, one at USMA and one at the University of Arkansas. ASCE plans to continue to expand the initiative using the T^4E model. (For more information, see http://www.asce.org/exceed/.)

EXHIBIT F-2
SCHEDULE FOR T^4E WORKSHOP

Sunday, 26 July 98		
1500-1630	Introduction to T^4E	LTC Steve Ressler
1730-1900	Seminar I - Learning to Teach	LTC Steve Ressler
Monday, 27 July 98		
0800-0900	Demo Class I - Introduction to Vibration Engineering	COL Tom Lenox
0900-1130	Seminar II - Principles of Effective Teaching. Seminar III - Teaching Assessment. Seminar IV - An Introduction to Learning Styles	LTC Steve Ressler
1300-1500	Seminar V - Lesson Objectives. Seminar VI - Planning a Classroom Presentation	LTC Steve Ressler
1500-1645	Lab I - Lesson Objectives and Board Notes. (Each participant will: (1) develop lesson objectives for his or her first prepared class, (2) write the objectives on the chalkboard, (3) develop one or more "boards" for his/her first prepared class.)	Team Mentors
1645-1700	Mentor's Wrap-up and Guidance for Tomorrow	Team Mentors
Tuesday, 28 July 98		
0800-1130	Seminar VII - Communication Skills: Writing & Speaking. Seminar VIII - Communication Skills: Questioning. Seminar IX - Teaching with Technology	COL Tom Lenox

1300-1325	Lab II - Practice Class - Participant A	Team Mentors - Participants A & B present the first 25 mins. of their first prepared class; each class is followed by a 20 min. assessment.
1325-1345	Lab II - Teaching Assessment - Participant A	
1345-1410	Lab II - Practice Class - Participant B	
1410-1430	Lab II - Teaching Assessment - Participant B	
1500-1525	Lab II - Practice Class - Participant C	Team Mentors - Participants C & D present the first 25 mins. of their first prepared class; each class is followed by a 20 min. assessment.
1525-1545	Lab II - Teaching Assessment - Participant C	
1545-1610	Lab II - Practice Class - Participant D	
1610-1630	Lab II - Teaching Assessment - Participant D	
1630-1645	Mentor's Wrap-up and Guidance for Tomorrow	Team Mentors

Wednesday, 29 July 98

0800-0900	Demo Class II - Eccentric Bolted Connections	LTC Steve Ressler
0900-0930	Discussion of Demo Class	COL Tom Lenox
0950-1040	Lab III - Practice Class - Participant B	Participants B & C present their prepared class; each is followed by an assessment and discussion.
1040-1110	Lab III - Teaching Assessment - Participant B	
1110-1200	Lab III - Practice Class - Participant C	
1200-1230	Lab III - Teaching Assessment - Participant C	
1330-1420	Lab III - Practice Class - Participant D	Participant D presents first prepared class.
1420-1450	Lab III - Teaching Assessment - Participant D	
1500-1550	Lab III - Practice Class - Participant A	Participant A presents entire first prepared class.
1550-1620	Lab III - Teaching Assessment - Participant A	
1620-1630	Mentor's Wrap-up and Guidance for Tomorrow	Team Mentors

Thursday, 30 July 98

0800-0825	Lab IV - Practice Class - Participant C	Participants C & D present the first 25 mins. of their second prepared class; each class is followed by a 30 min. assessment and discussion.
0825-0855	Lab IV - Teaching Assessment - Participant C	
0855-0920	Lab IV - Practice Class - Participant D	
0920-0950	Lab IV - Teaching Assessment - Participant D	
1010-1035	Lab IV - Practice Class - Participant A	Participants A & B present the first 25 mins. of their second prepared class; each class is followed by a 30 min. assessment and discussion.
1035-1105	Lab IV - Teaching Assessment - Participant A	
1105-1130	Lab IV - Practice Class - Participant B	
1130-1200	Lab IV - Teaching Assessment - Participant B	
1200-1330	Luncheon Seminar: Overview of USMA and the USMA Academic Program	BG F. Lamkin
1330-1430	Demo Class III - TBD	Dr. Jerry Samples
1430-1445	Discussion of Demo Class	LTC Steve Ressler
1500-1630	Seminar X - application of the T^4E Model	Drs. Schmucker, Isaacs

Friday, 31 July 98

0800-1000	Seminar XI - Developing Interpersonal Rapport with Students	LTC Ressler
1000-1100	Course Assessment and Discussion	LTC Ressler
1100-1130	Discussion of Follow-up Activities	LTC Ressler

Evenings (after hours): Class preparation and rehearsal (optional). Arrange with senior mentor for after hours access to classrooms.

(3) UNDERGRADUATE FACULTY WORKSHOP IN COMPUTER NETWORKS

Principal Investigator:	Herman Hughes, Ph.D.
Organization:	Michigan State University
Workshop dates:	July 27-August 7, 1998
Workshop location:	Michigan State University

Sources of Data

An SRI researcher and an outside content expert visited the Undergraduate Faculty Workshop in Computer Networks on August 3-4, 1998. Before the visit, the project's proposal was examined. During the visit, all activities were observed, and interviews were conducted with the project PI, the Co-PI, 4 project staff, and 15 participants. In the spring of 2000, the PI provided SRI researchers an oral update. In addition, a telephone interview was conducted with one participant, and written communications were received from three others.

Project Goal

In the 1990s, most computers in organizations were or shortly would be networked. Most major universities were offering state-of-the-art undergraduate courses in computer networking; however, such courses were not available at many small colleges, including Historically Black Colleges and Universities (HBCUs), because of a lack of computer science faculty with training in this area, as well as a shortage of networking equipment.

This project's primary goal was to provide a mechanism for faculty in small colleges and universities to add up-do-date computer network education and training to their undergraduate programs. Specific objectives were to:

- Provide participants with basic network fundamentals.
- Introduce them to emerging technologies, such as wireless communication and high-speed networking.
- Allow them to work on experiments that make use of high-speed network facilities.
- Enable them to interact with network experts.
- Encourage them to develop and use instructional materials in the areas of computer networks.
- Promote sustained interaction among the participants after the project.

Project Description

The 2-week-long workshop was divided about equally between (1) presentations and discussions of network concepts and theory and (2) laboratory assignments involving various implementations of protocols and network designs. The first week focused on basic concepts and theory of networks; the second week covered primarily high-speed networking.

Activities

Presentations were given by expert guest lecturers, as well as by the PI and workshop staff. For example, Dr. Hughes spoke on the prospects of various competing technologies, the evolution of ISDN and its role in the sharing of medical technology, data link layers; framing, and methods of error detection and correction in passing data through computer networks. A guest lecturer from AT&T Laboratories spoke regarding real-time applications of the Internet, focusing primarily on technologies such as Packet Phones and Multicast Backbone (*Mbone).*

On most days, theoretical presentations were followed by an hour-long discussion of practical issues, such as sources of grants for equipment or how participants might proceed on campuses with no formal computer or network maintenance programs. The discussions were led by faculty from small campuses and allowed a free-flowing exchange regarding participants' anticipated barriers to implementing what they were learning, as well as suggested solutions.

Each afternoon, participants worked in the campus computer lab on assignments related to the day's presentations or on exercises for their own courses. Some participants worked individually, and others worked in groups. Dr. Hughes also held informal meetings regarding pointers on proposals to NSF for equipment.

Toward the end of the workshop, participants presented their exercises to the entire group. However, this was not the end of their work. They continued to work on their laboratory exercises and communicate with one another and with the PI as they developed presentations for a panel session at the 1999 meeting of the Association for Computing Machinery's Special Interest Group on Computer Science Education (SIGCSE). The SIGCSE meetings served not only as a vehicle for disseminating

participants' projects, but also as an opportunity for participants to discuss their courses and experiences with colleagues from other institutions.

In 2000, the project offered a $1,000 grant to each participant for equipment or materials associated with a networking course, on the condition that his or her institution provide matching funds. This funding greatly facilitated participants' work.

Leadership

Dr. Herman Hughes has been professor of computer science at Michigan State University since 1984. As of 1998, he was director of the university's High-Speed Network and Performance Research Laboratory. Prior to the 1998 grant, Dr. Hughes had received three UFE grants for workshops on computer networks and three other NSF grants for equipment and research regarding computer networks. Throughout his career, Dr. Hughes, an African American himself, has shown a particular concern for training minorities in the area of computer networking.

Other workshop presenters from Michigan State included Dr. Erik Goodman, director of computer services for the College of Engineering; Dr. Thomas Atkinson, coordinator for Michigan State's campuswide network system; and Dr. Lewis Greenberg, director of MSU's campuswide network services. Guest presenters included Dr. Raj Jain of Ohio State University, who was a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and of the Association for Computing Machinery (ACM), and Dr. Nicholas Maxemchuk of AT&T Bell Labs, also an IEEE fellow.

Participants

Although Dr. Hughes had hoped to have 20 participants, relatively few applications were received, compared with previous offerings, resulting in 15 participants. Dr. Hughes made a special effort to include women, minorities, and faculty from HBCUs. Of the participants, 4 were females and 11 males; 5 were whites, 3 African Americans, and 7 Asian Americans or Asians. Five were from baccalaureate institutions, seven were from comprehensive institutions, and three were from research/doctoral institutions. Six came from HBCUs.

Participants were recruited through mailings to chairs and faculty in computer science and electrical engineering departments at HBCUs and institutions with large

Hispanic enrollments nationally, and to small colleges in Michigan. Brochures also were distributed at selected meetings and made available on the PI's Web page. Department chairs were asked to nominate a full-time faculty member for participation. Applicants were selected on the basis their letters of recommendation, the strength of their background, and their stated reasons for wanting to attend the workshop.

Participants received a stipend to cover their living expenses during the workshop and funds to travel to the ACM meetings for the follow-up activity.

Project Impact

In the spring of 2000, the PI expressed certainty that every participant had taught a networking class during the 2 years following the workshop. He reported that the five participants who had taught networking for the first time had indicated to him that the workshop had provided invaluable preparation. He also stated that eight more participants had reported making substantial changes to the networking courses they had previously taught.

Of the four participants from whom the SRI evaluator received communications in the spring of 2000, three reported having changed their teaching methods because of the workshop, incorporating more laboratory time with hands-on exercises. One of the three had made only small changes in content but was planning to make substantial changes in fall 2000. All three felt that their students' understanding of concepts had increased because of the changes they had made. The fourth reported having made only small changes in content.

At the workshop, several participants reported believing that they would not be able to apply everything they had learned at the workshop in their their own institutions because of lack of technology; however, as of the spring of 2000, most had overcome these barriers, according to communications to SRI from the PI and participants. To update their campuses' technology, many had obtained grants from outside their institutions, such as NSF grants for Instrumentation and Laboratory Improvement, and all but one had obtained the $1,000 grant from the project and corresponding matching funds from their institutions. One participant reported having taken advantage of a technology manufacturer's special offer to institutions of higher education; he credited his awareness of such special offers to the workshop.

Participants at Dr. Hughes' 1997 workshop (the year before SRI's site visit) had put together a volume of more than 40 computer networking exercises, published as *Network and Data Communications Laboratory Manual* (Prentice Hall) in 1999. (For more information, see http://www.prenticehall.com/allbooks/esm_0130117021.html.) Thus, there was less pressure for participants at the 1998 workshop to publish their exercises in a volume. However, as stated earlier, the latter did develop polished exercises, presented them at a conference, and placed them on a Web site.

Exhibit F-3
SCHEDULE FOR COMPUTER NETWORKING WORKSHOP

Week #1 (Monday - Friday)

8:30 - 11-30 a.m.	Discussion of concepts, and theoretical aspects of networks.
1:00 - 2:00 p.m.	Open discussions and sharing experiences, guest presenters.
2:30 - 5:00 p.m.	Laboratory assignments: Comparing FTP over fast Ethernet vs. ATM, Transmitting data over an unreliable channel via *sockets*, Studying Packet Switching and Congestion Control, using COMNET.

Week #2 (Monday - Friday)

8:30 - 11-30 a.m.	Discussion of concepts, and theoretical aspects of networks, including high-speed networks and wireless communications.
1:00 - 2:00 p.m.	Open discussions and sharing experiences, guest presenters.
2:30 - 5:00 p.m.	Laboratory assignments: using the high speed networking research laboratory to measure ATM cell loss rate and end-to-end delay for subsequent statistical analysis. Generate the transmitter, the receiver, and the jammer node to study wireless communications, using OPNET.

(4) IAS/PARK CITY MATHEMATICS INSTITUTE (UNDERGRADUATE FACULTY PROGRAM OF THE INSTITUTE FOR ADVANCED STUDY)

Principal Investigator:	Robert D. MacPherson
Organization:	Institute for Advanced Study (IAS), Princeton, NJ
Workshop dates:	July 12-August 1, 1998
Workshop location:	Conference facility in Park City, Utah

Sources of Data

An SRI researcher visited the IAS/Park City Mathematics Institute (PCMI) on July 29 and 30, 1998. The project's proposal was examined before the visit. On July 29, the researcher was accompanied by an outside content expert. Workshop activities were observed, and interviews were conducted with the project's PI, staff, and 13 workshop

participants. Two years after the site visit, two project evaluation reports and two project Web sites were examined.

Project Goals

The main goal of PCMI, of which the Undergraduate Faculty Program (UFE) was a part, was to promote interaction between the education and research communities in mathematics. The goals of the Undergraduate Faculty Program also focused on learning content and teaching methods and on dissemination. Specifically, the UFP's goals were to:

- Give higher education mathematics faculty the opportunity to develop their mathematical knowledge and their teaching skills in an environment where both research and educational goals are being pursued.
- Provide faculty an opportunity to interact with other members of the mathematics community.
- Disseminate newly acquired knowledge to the mathematics community at large.

Project Description

The Undergraduate Faculty Program was one of six separate but overlapping programs at the 1998 PCMI (other programs were the Mathematics Education Research Program, the High School Teacher Program, the Research Program, the Undergraduate Program, and the Graduate Summer School).

Activities

The focus of the 1998 UFP was linear algebra, and all UFP presentations, discussions, and hands-on sessions were related to that topic. Typically, the workshop included two hour-long UFP sessions per day, one of which covered curriculum and pedagogy or allowed participants to experiment with technology. Examples of topics at this type of session included geometry vs. algebra in the classroom, classroom incident cases, and comparing linear algebra textbooks. The other scheduled session was used for three interest groups to meet separately and work on a particular topic. Toward the end of the workshop, each interest group gave a report in a whole-group session.

The rest of the day, participants were able to work on projects for their own courses, do additional work with their small groups, attend sessions sponsored by other PCMI programs, or attend cross-program sessions targeted at all PCMI participants. At most times, sessions of various programs were held concurrently. Thus, participants

were able to tailor their activities to their individual needs. For example, those who wanted to improve their content knowledge could attend sessions of the Mathematics Education Research Program or the Graduate Summer School, while those who wanted to increase their understanding of undergraduate students could attend sessions sponsored by the Undergraduate Program. The 11 cross-program sessions focused on content or on policy issues, such as the National Council of Teachers of Mathematics (NCTM) standards and the Third International Mathematics and Science Study (TIMSS).

Participants' attendance at sessions outside of their own program was an important component of the workshop, given PCMI's goal of facilitating interaction among a broad range of people in the mathematics community. Numerous social activities also were scheduled for this purpose.

Because PCMI ran so many concurrent sessions, summaries of each day's sessions were posted on-line so that participants could get an overview of those they had not attended. Reports from each small working group were also placed on a Web site. Descriptions of sessions and reports, including the UFP working groups' reports, are available at http://pcmi.knox.edu and http://www2.admin.ias.edu/ma/98report.htm.

Leadership

The PI was Robert MacPherson, a faculty member of the Institute for Advanced Study. Dr. MacPherson oversaw the development and management of the UFP, along with a number of members of the PCMI Oversight/Steering Committee. Working closely with Dr. MacPherson was Daniel Goroff of Harvard University, who was responsible for the content and operations of the workshop. He also was a presenter/discussion leader in UFP workshop sessions. Other presenters/discussion leaders included Guershon Harel of Purdue University, Wilfried Schmid of Harvard University, John Polking of Rice University, Roger Howe of Yale University, William Barker of Bowdoin College, and Joan Ferrini-Mundy of the National Research Council.

Participants

Fifteen undergraduate faculty attended. Despite the project's attempts to recruit females and faculty from underrepresented minority groups (see next paragraph), there were only three female participants, one African American, and no Hispanics. One participant came from a 2-year college, and the remaining 14 came about evenly from

baccalaureate institutions (4), comprehensive institutions (5), and research/doctoral institutions (5).

The program was advertised principally though a detailed brochure distributed to professional associations (e.g., The Mathematical Association of America, the American Association for the Advancement of Science), PCMI alumni, and Historically Black Colleges and Universities. Organizers also made personal contacts with colleagues. Advertisements were placed in selected journals targeting women and minorities, such as *Black Issues in Higher Education*, *The Winds of Change*, the MAA Focus, the AWM newsletter, SIAM newsletter, and the MER newsletter.

The majority of the participants interviewed indicated that they had learned of UFP from advertisements received via regular mail or on the Internet. Others heard about the workshop from someone at their institution (e.g., their department chair) or were specifically invited to attend after participating in mathematics workshops the previous summer.

Participants were provided lodging, two meals a day, and educational materials.

Project Impact

Most participants planned, on returning to their home institutions, to revise existing courses or create new ones in linear algebra, integrating concepts learned at the PCMI or the use of computer software packages. Some had ideas for conferences and/or journal papers that would focus on educational and pedagogical issues in mathematics. Two came away from their PCMI experience with a desire to encourage the support of undergraduate research in mathematics at their home institutions. Others expressed a desire to become more involved in mathematics teacher preparation. One felt that the PCMI experience would help in completing a linear algebra textbook project.

According to the 11 respondents' answers to a survey conducted by the project's evaluator in the spring and summer of 1999, all had improved their knowledge of undergraduate teaching "some" or "a great deal" at the workshop. In addition, 10 had improved their knowledge of mathematics in general, and 9 had improved their knowledge of mathematics research "some" or "a great deal." Although only four had increased their frequency of interactions with undergraduate students, eight reported that the value they received from such interactions had improved. Two had increased their

interactions with mathematics education researchers at least "some," and six indicated that the value they received from such interactions had improved "some."

More than half had increased their work for mathematics reform; two had increased their participation on mathematics curriculum or reform committees "a great deal," and eight had increased their participation "some." Similarly, most reported having engaged in dissemination efforts. Ten of the 11 respondents had made presentations related to the UFP program; 4 of them to 1-10 people, 3 of them to 11-25 people, and 3 to more than 25 people. Another dissemination effort came from a collaboration begun at the workshop; two participants coauthored a journal article titled "Teaching Linear Algebra: Issues and Resources" (Jane M. Day and Dan Kalman; publication in the *College Mathematics Journal* pending as of June 2000).

Exhibit F-4
TYPICAL DAILY SCHEDULE FOR PARK CITY MATHEMATICS INSTITUTE

(Shows Concurrent Sessions)

US = Undergraduate Student Program
T = High School Teacher Program
ER = Mathematics Education Research Program
G = Graduate Summer School
MR = (Mathematics) Research Program
MS = Microsoft
UF = Undergraduate Faculty Program

July 28, 1998

8:30 - 9:30 a.m.	ER - Seminar. G - Lecture. T - Building Mathematics in the Classroom. **UF - Pedagogy Group: Reports from concept sub-groups.** US - Class; Continuous Symmetry.
9:40 - 10:40 a.m.	ER - Seminar. G - Problem sessions. MR - Seminar. T - Advanced Mathematics. US - Class; Introduction to Lie Groups.
11:00 - Noon	G - Lecture. T - Teaching Mathematics with Technology. **UF - Technology Group: Reports on sample problems.** US - Working Problem Session.
1:30 - 2:30 p.m.	G - Lecture. T - Cincinnati Site Presentation. **UF - Working Problem Groups.**
2:45 - 3:45 p.m.	**Cross Program Activity: How to Read Your PCMI T-Shirt.**

4:15 - 5:15 p.m.	MR - Seminar: Equivariant D-modules on a semisimple Lie algebra and a homomorphism of Harish-Chandra. **T/UF - Seminar: Linear algebra in the high school curriculum.**
5:30 p.m.	MS Activity: Netmeeting with Jennifer Chayes and Christian Borgs of Microsoft. G - Seminar: Affine Hecke algebras.
7:00 p.m.	**UF - Panel Discussion: Getting your textbook published.**

(5) MOLECULAR GENETIC AN ALYSIS APPLIED TO EVOLUTION, ECOLOGY, AND SYSTEMATIC BIOLOGY: AN EXTENDED LABORATORY COURSE

Principal Investigator:	Frank T. Bayliss
Organization:	San Francisco State University, San Francisco, CA
Workshop dates:	August 1-14, 1998
Workshop location:	San Francisco State University

Sources of Data

An SRI reseacher visited the Molecular Genetic Analysis workshop on August 1 and 13, 1998. On August 13, the researcher was accompanied by an outside content expert. All workshop activities were observed, and interviews were conducted with the project PI, the Co-PI, four project staff, and participants. Before the site visit, the project's proposal was examined. Oral and written updates were received from the PI in June 2000.

Project Goals

The primary goals of the project were that undergraduate faculty who specialize in evolutionary biology, ecology, and systematic biology:

- Increase their knowledge of molecular biology and techniques.
- Incorporate molecular biology and its techniques into their laboratories and research.

Project Description

The project's principal component was an intensive 14-day course in molecular genetics and evolutionary biology designed to broaden participants' content knowledge and their skills in laboratory techniques through lectures, demonstrations, and experiments.

Activities

The workshop opened with a 1-day symposium consisting of presentations and poster sessions by 15 faculty who had participated in earlier similar workshops. The

remainder of the workshop was divided between staff presentations and hands-on laboratory work. Seminars were held on five evenings. A broad range of topics was covered, including DNA replication and polymerase chain reaction, DNA sequencing/restriction analysis, and genetic distance and maximum likelihood. Practical topics also were covered, and laboratory techniques were demonstrated.

Approximately half the workshop's time was devoted to laboratory sessions during which participants worked in five-person groups to learn techniques and to develop teaching modules incorporating the techniques. Although each group specialized in the application of molecular techniques to a given content area (vertebrates, invertebrates, or plant systems), participants were free to develop modules within that area individually or collaboratively. The PI rotated regularly through the labs, monitoring the work of all groups. In addition, two staff members were available to each group for logistical and organizational assistance.

During the last 2 days of the workshop, all projects were presented to the whole group by their developers. Presentations included content background, as well as a description of the experimental techniques and results. The atmosphere for the presentations was informal, allowing for questions, answers, and discussion.

The project also included preworkshop preparation and postworkshop assistance. To prepare for the workshop, participants were required to read various materials, complete homework assignments, and begin preparation of a laboratory exercise. After the workshop, San Francisco State University (SFSU) faculty and an instructional support technician provided technical assistance to participants, primarily via e-mail. In addition, participants were asked to submit summaries of their projects and materials for inclusion on the project Web site. A 4-day follow-up session that was planned for the summer following the workshop was cancelled because a majority of the participants had time conflicts.

Leadership

The PI, a full professor at SFSU, has a long history of conducting similar workshops. In addition to coordinating the Molecular Genetic Analysis workshop at SFSU, for several years, Dr. Bayliss had taught numerous short courses in the Chautauqua program, and had organized and taught in a number of science education

projects funded by NSF and NIH grants. Throughout, Dr. Bayliss has focused on introducing modern techniques into the biology laboratory and promoting collaboration among biologists of varying backgrounds. At SFSU he has built a team of like-minded faculty members, as well as a group of staff and graduate assistants who worked with him to conduct the 2-week course.

Participants

Twenty persons participated in the workshop, but only 13 were undergraduate faculty from U.S. institutions. (Seven participants either were undergraduate faculty from foreign institutions or were not undergraduate faculty; two were preservice teachers from the PI's institution.) U.S. undergraduate faculty participants included 3 females and 10 males. None were from underrepresented minority groups. One was from a 2-year college, three from baccalaureate institutions, four from comprehensive universities, and five from research/doctoral institutions.

Participants were recruited through announcements in publications of professional associations, such as the American Association for the Advancement of Science (AAAS) and the American Society for Microbiologists, and through targeted electronic bulletin boards and newsgroups on the Internet. Brochures also were sent to biology departments in colleges and universities across the country and to faculty who had participated in past workshops. Applicants were asked to submit a statement describing their research, proposing a project for the workshop, and committing to attend the follow-up session. Participants' laboratory materials and supplies were paid for through the UFE grant, as were lodging and meals for participants from outside the local area.

Project Impact

All participants who were interviewed expected the workshop to change and enrich their teaching. The types of courses varied, ranging from ecology to health topics. The numbers of students each participant anticipated would be affected ranged from several dozen to several hundred each year. Several participants indicated that they would seek funding to develop new courses, make substantial revisions to existing courses, and/or develop projects for undergraduates incorporating molecular genetic analysis. Several indicated that they would be spearheading broad curricular change at their home

institutions. They felt that the experience and knowledge they had gained would increase their credibility as advocates of curriculum change.

The project did not conduct a systematic follow-up study of the impact of the workshop on participants. However, as of the summer of 2000, the PI had heard from four undergraduate faculty who had participated in the workshop and one who had participated in the symposium. Two faculty participants had submitted grant proposals to improve instruction at their home institutions. The other two had attended further professional development activities on molecular biology the year following the workshop. The symposium participant had published his research findings in a refereed journal and acknowledged the UFE workshop in the publication.

Exhibit F-5.
MOLECULAR GENETIC AN ALYSIS WORKSHOP– FIRST WEEK

Saturday, August 1, 1998: meeting at Seven Hills Conference Center for talks and posters presented by the 1996 and 1997 UFE participants. 1998 UFE participants are strongly encouraged to attend.

Monday, August 3, 1998		
8:30 a.m.	Orientation and introductions	Faculty and students
	Central Dogma of Molecular Biology, Nucleic Acid Structure and Function	Bayliss
9:30 a.m.	DNA Replication/Polymerase Chain Reaction (PCR)	Bayliss
10:30 a.m.	Laboratory facility: (a) Orientation to Facilities, (b) Extract DNA from "cheek" cells of participants and set-up PCR for VNTR analysis, (c) Load agarose mini-gel with pre-digested DNA's	Bayliss
1:30 p.m.	Laboratory: Thematic Research Groups meet and plan projects	
	Group I: Plants	Patterson, Bayliss, Spicer
	Group II: Invertebrates	Spicer
	Group III: Fish/Misc. Invertebrates	Routman
	Group IV: Vertebrates	Girman
7:00 p.m.	Keynote lecture	
Tuesday, August 4, 1998		
8:30 a.m.	DNA Sequencing/Restriction Analysis	Bayliss
9:30 a.m.	Complex Genome and the Search for Variation	Routman
10:30 a.m.	Laboratory facility: (a) Load agarose gels to visualize DIS80 VNTR PCR products, (b) Start preparation of samples for thematic research projects	Bayliss
1:00 p.m.	Laboratory: (Commence thematic group projects)	
	Group I: Plants	Patterson, Bayliss, Spicer
	Group II: Invertebrates	Spicer
	Group III: Fish/Misc. Invertebrates	Routman
	Group IV: Vertebrates	Girman
7:00 p.m.	Seminar speaker	
Wednesday, August 5, 1998		
8:30 a.m.	Detection of Sequence Variation w/ DGGE and SSCP	Girman
9:30 a.m.	Basic and Computer Assisted Primer Design	Staff
10:30 a.m.	Laboratory facility: (a) Work on research projects	

7:00 p.m.	Seminar	Derek Girman

Thursday, August 6, 1998

8:30 a.m.	Analysis of Molecular Data: Diversity and Divergence	Routman
9:30 a.m.	Phylogeny Estimation and Population Genetics	Spicer
2:00 p.m.	Group research projects (Groups I - IV)	

Friday, August 7, 1998

8:30 a.m.	Parsimony	Spicer
9:30 a.m.	Genetic Distance and Maximum Likelihood	Spicer
1:00 p.m.	Group research projects (Groups I - IV)	
7:00 p.m.	Open	

Saturday, August 9, 1998

9:00 - Noon	Demonstrations of Lab Equipment	Staff
	Computer Software Molecular Analysis	De Geoffrey
1:00 p.m.	Open laboratory	

Sunday, August 10, 1998: 9:00 a.m. - Open laboratory

(6) USING MATHCAD IN TEACHING PHYSICAL CHEMISTRY

Principal Investigator:	Sidney H. Young
Organization:	University of South Alabama, Mobile, AL
Workshop dates:	July 19-23, 1998
Workshop location:	University of South Alabama

Sources of Data

An SRI researcher visited this workshop on July 20-21, 1998, and was accompanied on the first day by an outside content expert. The project's proposal was reviewed in advance. All workshop activities were observed, and interviews were conducted with the project's PI, the 2 co-PIs, and 12 participants.

Project Goals

The project's goals were to help undergraduate chemistry faculty to:

- Gain fluency in using Mathcad.
- Develop and present mathematical methods useful in physical chemistry lecture and laboratory courses.

Project Description

This project included two workshops held at the University of South Alabama, one in the summer of 1997 and another in 1998. The workshops were organized to offer physical chemistry faculty the means of incorporating numerical methods into the undergraduate curriculum using Mathcad, a software package that displays equations as

they are written in text and reference books, and allows them to be solved by using functions from a pull-down menu bar. The ease of its use allows chemistry instructors and students to focus on the chemistry of experiments, rather than on solving mathematical problems or on generating complex computer programs.

Activities

During the visited (1998) workshop, participants learned the basics of using Mathcad and worked on individual projects involving the use of Mathcad for their own courses. The first day was dedicated to a presentation of how to use Mathcad, followed by hands-on exercises. Participants also were asked to identify a teaching project they wished to develop later in the workshop.

The following 2½ days included presentations of mathematics content related to physical chemistry (e.g., statistical methods and calculus methods). As the presenter discussed the content, he modeled how to manipulate data and equations with Mathcad, and fielded participants' questions. For each content area, there was a lengthy discussion of its relationship to chemistry, and there were hands-on Mathcad activities. Throughout the presentations and discussions, emphasis was placed on how different methods could be adapted for students with various types of learning styles.

On Thursday morning, participants worked on their own teaching projects. The session was quite informal; participants worked either singly or in small groups, and the co-PIs walked around the room and conferred with participants, offering advice and suggestions. On Thursday afternoon, all participants presented their work in progress.

After the workshop, participants were encouraged to test modules developed by other participants and to keep in touch with the project leaders and with each other via the project's Web site and electronic mail. Once completed, the modules were submitted for posting on the Web site. In addition, participants were expected to present at a symposium at the American Chemical Society (ACS) meetings.

Leadership

The Principal Investigator of this project was Sidney Young, a tenured professor in the University of South Alabama (USA) chemistry department. Dr. Young is seen as a leader of educational reform among physical chemists in both his own institution and the

larger field. He has played an important role in incorporating Mathcad into the undergraduate curriculum at USA and has engaged a number of his colleagues in the chemistry department in this effort. Dr. Young and his two Co-PIs, Jeffry Madura and Andrzej Wierzbicki, have been collaborating since 1994 and have coauthored several articles on using software to teach numerical methods in physical chemistry.

Participants

Thirteen participants attended the workshop. Three were female; none were from underrepresented minority groups. Although the majority of the participants were physical chemists, four specialized in other areas (e.g., organic chemistry, biochemistry). Four were from baccalaureate institutions, six were from comprehensive institutions, and three were from research/doctoral institutions.

The project was advertised through brochures mailed to chemistry departments and through announcements in disciplinary journals and on a chemistry discussion list on the Internet. In addition, project staff personally contacted schools within USA's region. The project sought to have a balance of participants in terms of geographic region, university size, and interests in the use of numerical methods in science. These goals were accomplished to some degree, although most participants came from the Southeast United States. The project also sought to include minority faculty, but none applied.

The grant paid for the participants' room and board (participants were housed in a dormitory in the same building as the workshop laboratory), as well as for a host of written materials and copies of the Mathcad software.

Project Impact

Although participants interviewed at the workshop talked about different kinds of outcomes emerging from this experience, all agreed that the workshop had met its goals of helping them gain fluency in Mathcad and developing modules for their courses. All felt that what they had learned would allow them to teach undergraduates more effectively, focusing on inquiry-based learning and deemphasizing mechanical calculations and rote memorization. They felt that this change would enable them to recruit and retain more students.

As stated earlier, participants' modules using Mathcad were placed on the project's Web site, and participants were expected to present at a symposium at American Chemical Society meetings. The Web site and symposium almost guaranteed widespread dissemination, given that the Web site had received more than 500 "hits" a month in the period before the workshop, and the meetings usually had very broad attendance.

Exhibit F-6
SCHEDULE FOR MATHCAD WORKSHOP

Sunday	
9:00 a.m. - Noon	General Introduction to Workshop. Introduction to Mathcad - Sid Young
1:30 p.m. - 5:00 p.m.	Mathcad Lab; begin to work on project
Monday	
9:00 a.m. - Noon	Blending numerical methods into the Physical Chemistry course - invited speaker, Peter Atkins. Calculus methods - Jeffry Madura
1:30 p.m. - 5:00 p.m.	Calculus lab; continue work on project
Tuesday	
9:00 a.m. - Noon	Statistics methods; using Mathcad in the laboratory - Sid Young
1:30 p.m. - 5:00 p.m.	Statistics lab; continue work on project
Wednesday	
9:00 a.m. - Noon	Matrix and differential equations methods - Jeffry Madura
1:30 p.m. - 5:00 p.m.	Free time
Thursday	
9:00 a.m. - Noon	Work on projects
1:30 p.m. - 5:00 p.m.	Progress report on projects; wrap-up

Evenings: Computer time available

(7) INNOVATIVE PHYSICS EXPERIMENTS FOR BEGINNING COLLEGE FACULTY

Principal Investigator:	Deva Sharma
Organization:	Winston-Salem State University, North Carolina
Workshop dates:	July 26-31, 1998
Workshop location:	Winston-Salem State University

Sources of Data

An SRI researcher visited this workshop on July 28-29, 1998. On July 28, the researcher was accompanied by an outside content expert. During the visit, all activities

were observed, and interviews were conducted with the project PI and 18 participants. In spring of 2000, the PI provided written and oral updates.

Project Goals

Most U.S. universities offer freshman-level general physics courses, which generally have large enrollments. Experiments for such courses can be quite expensive. To reduce the courses' costs without sacrificing hands-on work, this project's main goals were to:

- Develop inexpensive innovative experiments for physics faculty.
- Provide beginning physics faculty with knowledge regarding appropriate innovative experiments, and how these can be done inexpensively.
- Have beginning physics faculty develop, test, and evaluate innovative experiments.
- Disseminate experiments to beginning physics faculty.

A related goal was to engender communication and collaboration among faculty from diverse campuses.

Project Description

Activities

This project had a decidedly practical focus. Most presentations focused on demonstrating existing innovative experiments and, especially, discussing how they could be carried out in poorly equipped settings. An entire session titled "How to Build and Maintain an Inexpensive Laboratory" included a discussion of equipment at each participant's campus, ways additional items could be found, how old items could be replaced, and how even broken equipment could be used to illustrate physical principles.

The workshop introduced Internet sites containing materials, videos, lesson plans, instructional activities (e.g., Fermi Labs' Introduction to Particle Physics site), and catalogs of CDs and laser discs that could be used in physics instruction. These types of electronic materials were viewed as particularly useful because they can enable students to perform virtual experiments when equipment is not available.

Teaching methods were a secondary focus of the workshop; most demonstrations included some discussion of teaching methods, and pedagogy was the sole focus of one session, titled "Research in Physics Education and Its Effect on the Classroom and Lab."

An important component of the workshop was participants' hands-on development of new experiments. Because of preworkshop communications from the PI, participants came to the workshop well prepared for this activity. Approximately 20% of the time was allocated for groups of five participants (one senior faculty member and four beginning faculty members) to work on particular physics themes and enumerate activities that could be used to illustrate the themes. During these sessions, all participants were highly engaged at their individual work and in discussions with others in their group. These efforts resulted in 28 new experiments, such as "Projectile Motion," "Index of Refraction Using an Overhead Projector," and "Balloons and Coulomb's Law." Toward the end of the workshop, all experiments were presented by their developers to the entire group.

During the year following the workshop, the new experiments were field tested, evaluated, and refined by the PI and three participants at their institutions. A kit containing a volume with descriptions of the refined experiments, a list of materials needed to conduct them, and many of the actual materials was then sent to each participant. The PI maintained contact with participants during the year after the workshop, and an informal follow-up was held at the 1999 American Association of Physics Teachers (AAPT) meetings, at which several participants presented their experiments. Further dissemination of the experiments took place when the PI presented the experiments at a subsequent AAPT meeting.

Leadership

Dr. Sharma, the PI, has been a professor of physics at Winston-Salem State University (an HBCU) since 1979, teaching mainly introductory physics and physical sciences. The Innovative Physics Experiments project built on 10 previous workshops in physics pedagogy led by Dr. Sharma and on many innovative physics experiments in whose development he had taken part.

Presenters included a past president and the vice president of the American Association of Physics Teachers; the chair of the Physics Department of University of North Carolina, Asheville; and a physics education specialist from North Carolina State University, Raleigh. When participants worked in the computer lab room, college computer staff were available to help troubleshoot any hardware or software problems.

Participants

Twenty-four faculty members—3 females and 21 males—attended the 1998 workshop. Although 12 of the participants were from HBCUs and 3 were from Hispanic-serving institutions, only 1 was African American (2 more were from sub-Saharan Africa), and 2 were Hispanics/Latinos. The plurality of participants (42%) came from 4-year institutions. Approximately 30% came from comprehensive institutions and another 25% from 2-year institutions. One respondent was from a research/doctoral institution. All the participants taught physics and/or physical sciences; however, most came from schools that do not offer an undergraduate degree in physics.

The PI recruited participants by mailing invitations to every HBCU in the country and to all small colleges in the South. Applicants had to be teachers of freshman-level and/or sophomore-level physics. Its primary target was faculty in their first 5 years of teaching physics. Ultimately, participants included 6 senior faculty and 18 faculty in their first 5 years. The project paid for participants' lodging and gave them a stipend for meals.

Project Impact

At the workshop, most participants who were interviewed stated that they expected to incorporate the experiments they had learned during the workshop into their courses the following fall. Interviewees said that part of their motivation was to rekindle students' interest in physics, which was so low at their schools that the very existence of their departments was threatened. Given the low level of demand for physics courses and the fact that many faculty came from departments where physics merely served the needs of other departments, most participants anticipated incorporating the experiments into existing courses rather than developing new physics courses.

The precise number of participants who actually went on to revise their courses is not known; however, 2 years after the workshop, the PI reported having received unsolicited communications from approximately 12 participants indicating that they had incorporated some experiments into their courses.

Exhibit F-7
SCHEDULE FOR WORKSHOP ON INNOVATIVE PHYSICS EXPERIMENTS

July 26, 1998		
7:00 - 7:30 p.m.	Introduction to Workshop	Dr. Sharma
7:30 - 8:30 p.m.	How to Make Physics Fun?	Dr. Ronald Edge-Past President of AAPT
8:30 - 9:00 p.m.	Questions and answers	
July 27, 1998		
9:00 - 10:15 a.m.	Introductions/Distribution of Materials, Discussion of Workshop Agenda	Dr. Sharma
10:30 - Noon	String and Sticky Tape Experiments	Dr. Ronald Edge, USC - Columbia
1:00 - 2:30 p.m.	Review of Existing Experiments	Dr. Sharma and Mr. Van Swearingen
2:45 - 5:00 p.m.	Research in Physics Education and Its Effect on the Classroom and Lab	Ms. Lisa Grable
July 28, 1998		
8:30 - 10:15 a.m.	Innovative Physics Teaching Projects Using Web Lab	Ms. Lisa Grable
10:45 - Noon	Focus on Physics Demonstrations	Ms. Lisa Grable
1:00 - 2:30 p.m.	Some Criteria for Good Demonstrations Leading to Classroom Exercises and Laboratory Experiments	Dr. John Hubisz, NCSU, Raleigh
2:45 - 5:00 p.m.	Begin Development of New Experiments	Group sessions
July 29, 1998		
9:00 - 10:30 a.m.	How to Build and Maintain an Inexpensive Laboratory	Dr. John Hubisz
10:45 - Noon	Development of New Experiments	Group sessions
1:00 - 2:30 p.m.	Experimental Aspects of Physics Through Lecture Demonstrations	Dr. Mike Ruiz, Appalachian State University, NC
2:45 - 5:00 p.m.	Development of New Experiments	Group sessions
8:30 - 9:30 p.m.	WSSU Observatory (Optional - weather dependent)	
July 30, 1998		
9:00 - 10:30 a.m.	Presentation of New and Home Experiments	Participants in Physics Lab
10:45 - Noon	Optical Illusions and Experiments	Dr. Ruiz, UNC, Asheville
1:00 - 2:30 p.m.	Physics Demonstrations	Dr. Chowdhury and Keeth Willingham
2:45 - 3:45 p.m.	Error Analysis	Dr. Sharma
4:00 - 6:00 p.m.	Giggs Gallery and Reynolds Gardens Tour (Optional)	
July 31, 1998		
9:00 - 10:30 a.m.	Physics Demonstrations by Participants	
10:45 - Noon	Summary Session: Evaluation, Web Site and Follow-up Activities	
1:00 - 2:00 p.m.	Certificates, Stipends, Goodbyes	

(8) IMAGE PROCESSING APPLIED TO CLASSROOM TEACHING (IMPACT)

Principal Investigator:	Roxanne Baxter Mendrinos
Organization:	Foothill College/Community Colleges for Innovative Technology Transfer, Inc. (CCITT)
Workshop dates:	August 10-14, 1998
Workshop location:	Foothill College, Los Altos, CA

Sources of Data

An SRI researcher visited the IMPACT workshop on August 12-14, 1998. On August 12 and 13, the researcher was accompanied by an outside content expert. The project proposal was read before the visit. All workshop activities were observed, and interviews were conducted with the project PI, 2 workshop instructors, and 11 participants. In the spring of 2000, an SRI researcher examined the project's Web sites. Written updates were provided by the PI in June 2000.

Project Goals

The project sought to provide faculty with training in four technologies: remote sensing/image processing (RS/IP) and geographic information systems/geographic positioning systems (GIS/GPS). The project's principal objectives were to:

- Train undergraduate faculty in the use of RS/IP and GIS/GPS, using curriculum modules developed by CCITT.
- Develop additional curriculum modules integrating the four technologies into each participant's instructional area.
- Instruct faculty in the use of the Internet and its resources to develop curriculum using the four technologies.
- Assist faculty in developing an awareness of leading-edge ideas and applications that are reshaping the disciplines through the four technologies.
- Adapt and disseminate the curriculum modules developed by the undergraduate faculty participants on the national, regional, and local levels.
- Increase the level of communication and cooperation among participants while developing curricula at their home institutions.

Project Description

Foothill College received the UFE grant on behalf of CCITT, a national coalition of 12 community colleges with government and industry partners including the National Aeronautics and Space Administration (NASA) and NASA contractors, the Universities Space Research Association, the National Center for Advanced Technologies, and the Environmental Systems Research Institute. The grant was used to fund one planning

workshop and seven regional summer workshops in 1998 and 1999 at Foothill College (California), Brevard Community College (Florida), Prince George's Community College (Maryland), University of Houston (Texas), and College of the Mainland (Texas). The 1998 workshops focused on RS/IP, and the 1999 workshops focused on GIS/GPS.

Activities

The majority of the 5-day workshop was devoted to demonstrations of RS/IP and related hands-on activities. Faculty and guest lecturers were experts not only in the technologies but also in their substantive fields. For example, a session on remote access microscopes was given by a professor of genetics, and a session on multispectral images was given by a researcher from the NASA Ames Research Center. A half-day field trip to NASA Ames was also scheduled for participants to observe the use of RS/IS in a real-world setting.

Following each demonstration, the workshop included time for participants to engage in structured hands-on activities. A binder containing all lecture notes, training activities, and a CD-ROM containing interactive activities and data was given to participants at the beginning of the workshop. Some of the activities and curriculum materials had been developed under an earlier NSF Advanced Technological Education (ATE) grant received by CCITT. These resources were expanded, and new materials were developed, under the current grant.

In the last 2 days of the workshop, 5 hours were allocated for participants to work on modules for their own courses. Sessions were held in a classroom equipped with sufficient computers for all participants. Thus, participants were able to work on their modules individually, although a few worked in small groups. During the hands-on sessions, project staff circulated around the room, discussing participants' work and offering assistance as needed. The last afternoon was dedicated to participants' presentations of their modules, including how the modules would be integrated into their courses. Each presentation was followed by feedback and suggestions from other participants and staff.

An interesting feature of this workshop was that it was multidisciplinary, including topics from a broad range of disciplines, including life sciences, earth sciences, physical sciences, social sciences, and dentistry. Although participants tended to interact mainly

with others from similar disciplines, there also was considerable interaction across disciplinary areas. The field trip, a dinner, and scheduled breaks allowed for considerable and fertile exchange of ideas.

Over the course of the grant, the project continued to develop CCITT's existing Web site. A second Web site exclusively for the 1998 Foothill workshop was also developed so that participants could share their curriculum training materials, curriculum abstracts, and lesson plans. As of June 2000, both Web sites still existed, at http://earth.fhda.edu/ and http://impact.fhda.edu/, respectively.

Leadership

The project's PI, Dr. Roxanne Baxter Mendrinos, is Professor and Library Systems Administrator at Foothill College. She has had a long-standing interest in technology in the classroom and is author of *Using Educational Technology with At-Risk Students* (Greenwood Press). Dr. Mendrinos has been involved with technology at Foothill College in a variety of capacities, for example, working with a geology instructor to set up the college's Image Processing and Digital Mapping Center. Dr. Mendrinos organized the Foothill workshops, bringing together a team of instructors. In addition, she worked with a team in the design of the CCITT Web site, virtual classroom, and listserv, and arranged for all guest instructors.

Workshop instructors and guest lecturers included the head of Foothill College's Earth Science Department, a faculty member from the College's Microbiology and Environmental Science Department, two researchers from NASA Ames Research Center, and an Associate Professor of Genetics from California State University, Stanislaus.

Participants

Twenty-one undergraduate faculty attended, 15 males and 6 females. None were from underrepresented minority groups. Fifteen were from the California State Community College system, three were from comprehensive universities, and three were from doctoral institutions. Most participants taught either life sciences or earth sciences, exceptions being an anthropologist, a mathematician, a physical scientist, and an instructor from a dental program. Most participants had tenure.

The workshop recruited participants by sending a brochure and application form to the deans of instruction, science and mathematics department chairs, and faculty members at 2-year and 4-year institutions throughout California. Announcements were posted to newsgroups serving minorities and women in science education. Applicants were required to indicate what they hoped to achieve as a result of the workshop and describe a curriculum module to be developed. A written endorsement from each applicant's department chair or dean was also required. Preference was given to applicants who had been teaching less than 5 years.

All participants received a stipend to cover subsistence for the days of the workshop, and participants from outside the local area also received a subsidy for lodging.

Project Impact

About two-thirds of participants indicated that they would have their students work directly with the technologies they had learned. Examples of anticipated projects included:

- Working in small groups, students would learn problem-solving and critical-thinking skills by making *a priori* hypotheses regarding relationships and then taking measurements to test their hypotheses.
- In a general education natural disasters course, students would use images to interpret the potential for landslides in the San Francisco Bay area, given slope, rock, types of vegetation, and precipitation.
- In a geology class, students would study earthquakes by examining the San Andreas fault as observed from space.

The remaining third of the participants did not anticipate having their students work directly with the technologies, either because of lack of equipment or because their courses had no lab component. However, most of them were looking forward to using the technologies to develop presentations for their classes.

Exhibit F-8
SCHEDULE FOR IMPACT WORKSHOP

Monday, August 10, 1998

9:00 a.m.	Introductions	Dr. Roxanne Baxter Mendrinos
9:15 a.m.	Welcome	Dr. Leo Chavez
9:30 a.m.	Imaging the Earth System; An Introduction to Imaging Systems and Software. Presentation will include using VISTA Archive.	Chris Di Leonardo

10:45 a.m.	Welcome	Dr. Bill Patterson
11:00 a.m.	Get the Picture - An Introduction to Digital Images, Data, Image Enhancement and Histograms	Hands-on activity appropriate for all science disciplines.
1:00 p.m.	Seeing is Believing: Working with Measurements as Calibration of Images and Temporally Registered Data	Hands-on activity appropriate for all science disciplines.
3:00 p.m.	End of Session	

Tuesday, August 11, 1998

9:00 a.m.	Introduction: Issues in Creating an Image Processing Lab	
9:15 a.m.	Features of the Seafloor: Evidence of Plate Tectonics	Discipline areas: Earth, Marine, Environmental, and Biological Sciences
10:45 a.m.	Aerial Waterfowl Counts	Discipline areas: Biology, Environmental Science, Ecology
1:15 p.m.	Relationships Between Trees: Molecular Taxonomy	Discipline areas: Botany Molecular Biology, Evolutionary Biology, Forestry, General Biology
2:10 p.m.	Seeing the Forest Through the Trees: Consideration of Scale, Resolution, and Multispectral Data in Image Analysis	Discipline areas: Forestry, Biological, Environmental Ecosystem Sciences
3:00 p.m.	End of Session	

Wednesday, August 12, 1998

9:00 a.m.	Introduction	
9:15 a.m.	Image Classification using Multi-Spec	Dr. Jay Skiles, Ph.D.-PI with the SETI Institute
12:20 p.m.	Bus leaves for field trip to NASA/Ames Research Center	
1:00 p.m.	Arrive at NASA/Ames Research Center	
4:30 p.m.	Return to Foothill College	
6:00 p.m.	Banquet dinner at the Hyatt Rickey's. Reconstructing Past Environments with Pollen Analysis	Hector L. D'Antonio, Ph.D., Assistant Branch Chief in the Ecosystem Science and Technology Branch, NASA/Ames Research Center

Thursday, August 13, 1998

9:00 a.m.	Remote Access Microscopes in the Curriculum	Dr. Janey Youngblum, Ph.D., Associate Professor of Genetics California State University, Stanislaus
10:30 a.m.	Scanning Demonstration, Video Capture, Flat Bed Scanner, Imaging Microscopy	
11:30 a.m.	Geographic Information Systems and Urban Development	Dr. Len Gaydos, Ph.D., USGS and NASA/Ames Research Center
1:00 p.m.	Work on curriculum integration and the development of plans to be used in one's teaching	
2:10 p.m.	Continuation of group and individual projects	
3:00 p.m.	End of Session	

Friday, August 14, 1998

9:00 a.m.	Introduction
9:15 a.m.	Work on curriculum integration and the development of plans to be used in one's teaching
10:45 a.m.	Work on curriculum integration and the development of plans to be used in one's teaching
1:00 p.m.	Presentation of group and individual projects
3:00 p.m.	End of Session

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