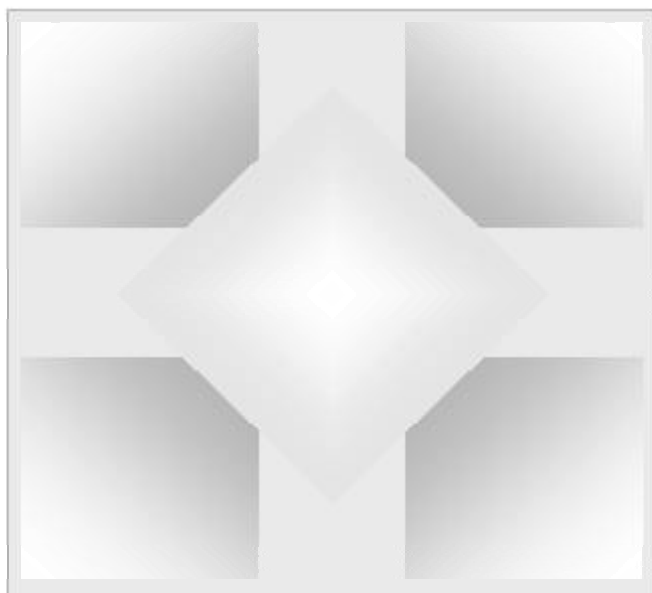


# FY 97 Awards

## TEACHER PREPARATION AND NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION



Division of Undergraduate Education  
Directorate for Education and Human Resources



NATIONAL SCIENCE FOUNDATION

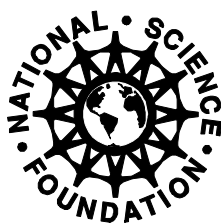
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The Foundation provides awards for research and education in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for the research findings or their interpretation.

The Foundation welcomes proposals from all qualified scientists and engineers and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research and education related programs described here. In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

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**DIVISION OF UNDERGRADUATE EDUCATION (DUE)**  
**TEACHER PREPARATION AWARDS**  
**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION**  
**AWARDS**

**FISCAL YEAR 1997**

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## Foreword

The National Science Foundation (NSF)'s Directorate for Education and Human Resources (EHR) is responsible for providing national leadership and support for improving the quality of science, mathematics, engineering, and technology (SME&T) education, kindergarten through graduate school. In exercising this responsibility, the Directorate has established the SME&T education of future K-12 teachers as one of its highest priorities. The ultimate goal is to achieve excellence in the preparation of the nation's future teachers – teachers who are knowledgeable in the content areas and in the practice of teaching, creative and enthusiastic, and dedicated to life-long learning.

Teacher preparation is a complex undertaking. In fact, every component of the nation's educational enterprise must be engaged to achieve success in this critical endeavor, including, for example: undergraduate institutions and, in particular, their mathematics, science, and education faculties and departments; practicing K-12 teachers; schools and school districts and their administrators; organizations responsible for teacher certification and licensure; developers of national standards in the sciences and mathematics; providers of informal educational experiences (science centers, museums, zoos); and parent, community and business organizations. The entire educational enterprise will benefit, both directly and indirectly, through a focus on improving this educational workforce.

The NSF effort in teacher preparation bridges several divisions of EHR. Primary programmatic emphasis and responsibility for coordination resides in the Division of Undergraduate Education (DUE), reflecting the fundamental role of undergraduate education in the preparation of teachers. The NSF Collaboratives for Excellence in Teacher Preparation (CETP) program, with additional support within other programs of the Division, is central to EHR's efforts to effect long-lasting institutional reform in teacher preparation. The Collaboratives are developing the state and regional approaches necessary for systemic change, engaging a broad range of stakeholders in the design of exemplary courses and programs.

The projects described in this book received either new, continuation, or supplemental awards in Fiscal Year 1997. Included are projects funded through the Collaboratives program, projects funded through other programs managed by DUE, and projects funded through other EHR Divisions which include a teacher preparation component. These projects provide models of exciting programs in teacher education; all of them have the potential for significant national impact. They are rich in content, current in pedagogy, serve a diverse set of students and institutions, and respond to the call for new directions. The projects set high standards for future efforts in SME&T teacher preparation. We are proud of these projects and commend the individuals who have designed and are implementing them.

Luther S. Williams  
Assistant Director  
Education and Human Resources

**NATIONAL SCIENCE FOUNDATION**  
**Directorate for Education and Human Resources**  
**Division of Undergraduate Education**

**Teacher Preparation Awards**  
**NSF Collaboratives for Excellence in Teacher Preparation Awards**

**INTRODUCTION**

**Overview**

The National Science Foundation (NSF) is undertaking a major effort to improve significantly the mathematics, technology, and science education of prospective elementary and secondary teachers. A basic premise of the Foundation's efforts in this regard is that the mathematics, technology, and science that prospective teachers learn as part of their undergraduate education, and the manner in which the courses are presented, have a critical influence on the quality of their teaching. Knowledgeable teachers who are excited about the subjects they teach will ensure that their students in K-12 are well prepared in science and mathematics and are technologically literate. Because of the great importance of this undergraduate experience, the design and implementation of teacher preparation programs require leadership from faculty in all science, mathematics, engineering, and technology (SME&T) disciplines working in partnership with their colleagues in education and teachers in the K-12 community, each providing their special expertise. The overall responsibility for the NSF teacher education effort resides within the Directorate of Education and Human Resources, with primary focus on the preparation of future teachers placed within the Division of Undergraduate Education.

In FY 97 the Division of Undergraduate Education (DUE) managed two major programmatic efforts in teacher preparation:

1. The **NSF Collaboratives for Excellence in Teacher Preparation (CETP)** program, which supports large-scale systemic projects designed to significantly change teacher preparation programs on a state or regional basis and to serve as comprehensive national models.
2. Support of projects concentrating on one course or a series of related courses through proposals submitted to the various DUE programs. These include the **Advanced Technological Education (ATE)** program, the **Course and Curriculum Development (CCD)** program, the **Instrumentation and Laboratory Improvement (ILI)** program, and the **Undergraduate Faculty Enhancement (UFE)** program.<sup>1</sup>

In addition to these programs, NSF also promotes national leadership through activities such as conferences, workshops and published proceedings and reports.

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<sup>1</sup> In FY 99 a realigned Course, Curriculum and Laboratory Improvement (CCLI) program will consolidate the former CCD, ILI, and UFE programs.

## Summary of Awards

### NSF Collaboratives for Excellence in Teacher Preparation

Collaborative projects typically involve cooperative efforts that include science, mathematics, and education faculty and their departments working in consort with school personnel and appropriate institutional administrators. Since attention to introductory science and mathematics courses is essential, the Collaboratives feature strong leadership by the faculty and departments responsible for these courses. Each year, since the inception of the program in FY 1993, NSF has funded three to four projects at a level of \$500,000 to \$1,000,000 per year for up to five years.

*New Projects:* Each of the three collaboratives newly funded in FY 97 serves a broad region of their state and includes a diverse set of two-year, four-year, and comprehensive institutions. A total of 26 institutions of higher education are involved. The Science, Technology, Engineering, and Mathematics Teacher Education Collaborative (STEMTEC) involves an existing consortium of five colleges—the University of Massachusetts at Amherst and Amherst, Hampshire, Mount Holyoke, and Smith Colleges—collaborating with Springfield Technical, Holyoke, and Greenfield Community Colleges and seven local school districts. Course revision teams include science, mathematics, and education faculty as well as K-12 teachers who previously participated in NSF-sponsored teacher preparation projects. The Massachusetts Statewide Systemic Initiative (SSI) is also a participant in the Collaborative. The Oregon Collaborative for Excellence in the Preparation of Teachers (OCEPT) includes Portland State University, Western Oregon University, the University of Oregon, the University of Portland, Portland Community College, Pacific University, Oregon State University, Eastern Oregon University, and Central Oregon Community College. Both the Oregon State System of Higher Education and the Oregon Department of Education are participating. This project is strengthening the curriculum, courses, and field experiences for prospective teachers to reflect current research on teaching and learning and includes a strong faculty development program to introduce science and mathematics faculty to current advances in research on pedagogy. The New Mexico Collaborative for Excellence in Teacher Preparation (NMCETP) includes New Mexico State University, the University of New Mexico, Western New Mexico University, New Mexico Highlands University, Eastern New Mexico University, Northern New Mexico Community College, Dine Community College, San Juan College, and Sante Fe Community College. It includes a strong focus on support for teachers through their first years of teaching and development of an engineering related approach to a teacher preparation program.

*Continuing Projects:* The 13 Collaboratives initiated in FY 93 through FY 96 continued to be supported in FY 97. More than 130 institutions are involved. The projects represent a rich diversity of approaches to comprehensive change in teacher preparation, offering different models for educational reform in mathematics and the sciences. Each project differs from the others in its needs, resources, participating institutional types, population, geography, and cultural and political traditions. Eight of the projects – those from Arizona State University, California State University at Dominguez Hills, the City University of New York, Harvard University, San Jose State University, Temple University, the University of Texas at El Paso, and Virginia Commonwealth University – are urban centered; six projects – in Louisiana, Maryland, Montana, Oklahoma, New Mexico and Oregon – encompass institutions distributed throughout the state; and two – from northern Colorado and Massachusetts– are regional in character. All include strong leadership and participation from faculty in mathematics and science departments working collaboratively with faculty from departments of education.

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The projects represent a variety of approaches. The Arizona Collaborative is designing an interdisciplinary course examining the nature of matter. The Los Angeles Collaborative is organizing its students in cohort groups and is creating strong ties across two year and four year institutions within the Los Angeles Basin. The El Paso Collaborative is closely integrating its activities with those of other systemic initiatives in its region. The City University of New York is designing materials for its courses, which reflect the urban setting of the institutions involved. Participants in the Colorado project are cooperating to integrate courses in pedagogy with mathematics and science courses. The cooperating institutions in Philadelphia are designing new courses in science and cognitive psychology for inclusion in a new five-year program leading to teacher certification. Louisiana is experimenting with ways to encourage campuses throughout the state to design programs which answer the needs of each institution but are integrated into the overall state plans for reform of mathematics and science education. Maryland is pioneering ways to use telecommunications to facilitate joint curriculum reform throughout the state and has integrated an interesting set of research laboratory and science museum internships for pre-service teachers. Montana is concentrating on introducing hands-on science courses and the Harvard calculus model throughout the state university system. The project has expanded its outreach to include seven tribal colleges within the state and many model school sites with a high population of Native Americans. The Virginia Urban Corridor Collaborative involves a cadre of outstanding K-12 teachers who enhance the in-school experiences of prospective and new teachers. The San Francisco Bay Collaborative includes curriculum reform relevant to the preparation of both elementary and secondary teachers and provides activities ranging from recruitment from underrepresented groups to support networks for new teachers. The statewide consortium of K-12 schools, two- and four-year institutions comprising the Oklahoma Teacher Education Collaborative is focusing on the early years of teaching. Engineering faculty participate in the design of general education courses for teachers.

## **Teacher Preparation Supported Through Other Programs within the Division of Undergraduate Education**

Proposals that seek to improve the science, mathematics and technical preparation of prospective teachers are given high priority in all DUE programs. Projects with a focus on teacher preparation benefit from and add to the research base concerning student learning of SME&T. Supported projects may affect courses specifically designed for pre-service teachers or courses in which prospective teachers are part of a larger student population. The **Advanced Technological Education (ATE)** program supports initiatives which benefit students seeking preparation as technicians in science and engineering fields. Included are projects to prepare teachers for secondary and associate degree level technological education. Design of new courses or modification of existing courses is supported by the **Course and Curriculum Development (CCD)** program. The **Instrumentation and Laboratory Improvement (ILI)** program supports the purchase of laboratory equipment and exemplary use of laboratories. Workshops and educational activities for faculty concerned with science, mathematics, engineering, and technology courses, which enroll prospective teachers, are supported by the **Undergraduate Faculty Enhancement (UFE)** program.

Projects supported in FY 97 feature: courses and curricula in mathematics, engineering, and the sciences; students preparing to be elementary, middle, and secondary teachers; innovative uses of technology, and recruitment of undergraduates to teaching careers. A great range of activities is represented by these projects. A CCD project at Duke University is developing a pilot program for encouraging engineering students to become certified for secondary school teaching careers. The ConCEPT project at California State University at Fullerton in collaboration with local community colleges is developing a standards-based science curriculum for pre-service teachers. At Lake Erie College (OH) prospective teachers will learn science in the context of a study of local natural resources under a new curriculum being developed by faculty from the arts and sciences in collaboration with education faculty. At CUNY Queens College, a

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new mathematics program called TIME 2000 integrates the psychology of learning with mathematics content and pedagogy. Symmetry provides the unifying theme for a multi-disciplinary series of courses developed for non-science majors at the University of Wisconsin as a CCD project. At the University of Alabama in Huntsville a CCD project is developing software modules to add simulation activities to the introductory statistics course. Two projects under the Institution-Wide Reform of Undergraduate Education in Science, Mathematics, Engineering, and Technology program have a teacher preparation component. Alverno College (WI) is expanding the quantitative reasoning requirement for all students through a revised curriculum that integrates quantitative reasoning and assessment activities throughout the curriculum, serving as a model for prospective teachers. The campus-wide reform initiative at the University of California-Irvine includes the development of new teacher preparation courses as part of major curricular and course revisions in mathematics, engineering, and computer science.

Of the numerous ILI projects receiving teacher preparation funding, many provide equipment that supports courses primarily enrolling pre-service teachers and include the use of technology in ways that reflect how students will use it in their future school settings. Laboratories to support such courses are being developed at Converse College (SC) (chemistry), University of Missouri (engineering), California State University at San Marcos (CA) (life sciences), Kutztown University (PA) (mathematics), and Bloomsburg University of Pennsylvania (geography), among others. As part of an innovative ILI project in the geosciences at Occidental College (CA) a research vessel provides an interactive oceanographic classroom and field experiences to prospective teachers, including students in 2-year colleges. At the University of Missouri-Columbia, laboratory facilities are being upgraded to include Computer-Integrated Manufacturing technology with an interdisciplinary Integrated Systems Laboratory providing a model laboratory for preparing Technology Education teachers.

A UFE project conducted by the Mathematical Association of America is providing college faculty with the knowledge and skills to implement cooperative learning in undergraduate mathematics courses. Activities include a summer workshop and an academic year apprenticeship period with mentoring and electronic networking. A project at Towson State University pairs science faculty who have taught less than five years with more experienced science education faculty to design strategies for improving the preparation of future teachers in the sciences with an emphasis on the urban environment.

An ATE project at Jones County Junior College provides training in network technology for faculty to enable the implementation of a computer network management curriculum for technical students including prospective teachers.

*Continuing Projects:* The focus on teacher preparation is also evident in the large, comprehensive projects funded by DUE in FY 95 and FY 96 and continuing in FY 97. All four projects begun in FY 95 under the *Systemic Changes in the Undergraduate Chemistry Curriculum* initiative (based at Beloit College [WI], University of California at Berkeley, University of Wisconsin at Madison, and at City University of New York's City College) include a focus on teacher preparation with activities and learning experiences designed specifically for teachers, as well as providing a model for teaching chemistry using current pedagogical techniques. An FY 96 project continuing at the University of California, Los Angeles addresses the preparation of primary and secondary science teachers by involving them as active participants in the lower division courses of the molecular science curriculum. By working with the modules, associated learning methods, and electronic delivery system that undergird the project, these students obtain a practical perspective on science teaching as well as the ability to utilize current technology to direct learning activities. All projects funded in the *Mathematical Sciences and their Applications throughout the Curriculum* initiative are continuing to receive partial funding for teacher preparation activities. An important component of the project spearheaded by the State University of New York at Stony Brook involves faculty reworking all aspects of the curriculum for future mathematics

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teachers to reflect the needs of the NCTM Standards. Similarly, the consortium project led by University of Nebraska and Oklahoma State University involves a multidisciplinary approach to mathematics with attention to the needs of pre-service teachers. At Dartmouth College (NH) sweeping interdisciplinary curriculum reform based upon the learning and applications of mathematics at all levels of the undergraduate curriculum includes attention to the needs of prospective teachers. Input is included from expert consultants and practicing teachers. The project based at Rensselaer Polytechnic Institute (NY) includes a significant teacher preparation component at two partner schools, the University of Delaware and Siena College (NY). An important component of the project at the State University of New York at Stony Brook involves faculty revising all aspects of the curriculum for future mathematics teachers to reflect the NCTM standards. Similarly, the comprehensive curricular reform project undertaken by the University of Nebraska includes attention to the needs of pre-service teachers.

Three ATE centers continuing in FY 97 include a focus on teacher preparation. An important component of the South Carolina Advanced Technological Education Center of Excellence features efforts at Clemson University and other four-year colleges to help prepare the middle and secondary school technology teachers of the future. The Maricopa Advanced Technology Education Center (MATEC), which is focusing on technician education for advanced semi-conductor engineering, is helping prepare future grades 7-12 teachers through a partnership with Arizona State University. The New Jersey Center for Advanced Technological Education involves the preparation of secondary school teachers through an articulation agreement between a new program training engineering technicians with the baccalaureate program in technology education at the College of New Jersey. The Center at Middlesex County College (NJ) is working with Trenton State College's technology education program to prepare secondary teachers for the schools of tomorrow.

Information about Division of Undergraduate Education projects can be accessed through the Division's Web site at <<http://www.ehr.nsf.gov/EHR/DUE/>>.

## Workshops and Conferences

In FY 97, DUE awarded support to, or hosted, a number of dissemination activities including a workshop to resolve the issues attendant to National Visiting Committees (NVC) for large systemic projects, *Shaping the Future* related workshops on undergraduate education that specifically focus on teacher preparation, and publication of the recommendations of Deans of Science and of Education formulated at an American Association for the Advancement of Science conference on responsibilities for SMET teacher preparation. The workshop on the NVC was attended by representatives of the CETP National Visiting Committees. Their deliberations resulted in an informational brochure. One of the *Shaping the Future* related workshops was held during FY1997. The Montana STEP project hosted a regional meeting attended by delegations of faculty and administrators from nine western states (from Alaska to South Dakota) to explore the role of university science, mathematics, engineering and technology faculty in teacher preparation.

## Teacher Preparation Efforts in Other EHR Divisions

Teacher preparation is supported throughout the Directorate of Education and Human Resources. The Divisions of Elementary, Secondary, and Informal Education (ESIE), Educational Systemic Reform (ESR), and Human Resource Development (HRD) all contribute to the NSF-wide effort to improve the science, mathematics, and technology preparation of pre-kindergarten through grade 12 teachers. The Teacher Enhancement Program within ESIE includes projects linking in-service teacher education with pre-service teacher preparation programs. Projects under ESIE's Instructional Materials Development Program develop materials and activities of use to pre-service as well as in-service teachers. With support from

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ESR several Statewide and Urban Systemic Initiatives are collaborating with institutions of higher education to improve teacher education. Under HRD, the Alliances for Minority Participation Pre-Service Teacher Preparation initiative (AMP-TP) seeks to increase the number of individuals from groups underrepresented in the science and mathematics workforce preparing to teach SME&T. A number of teacher preparation projects focusing on gender equity are supported by the HRD Program for Women and Girls which seeks to increase the participation of women and girls in science, engineering, and mathematics.

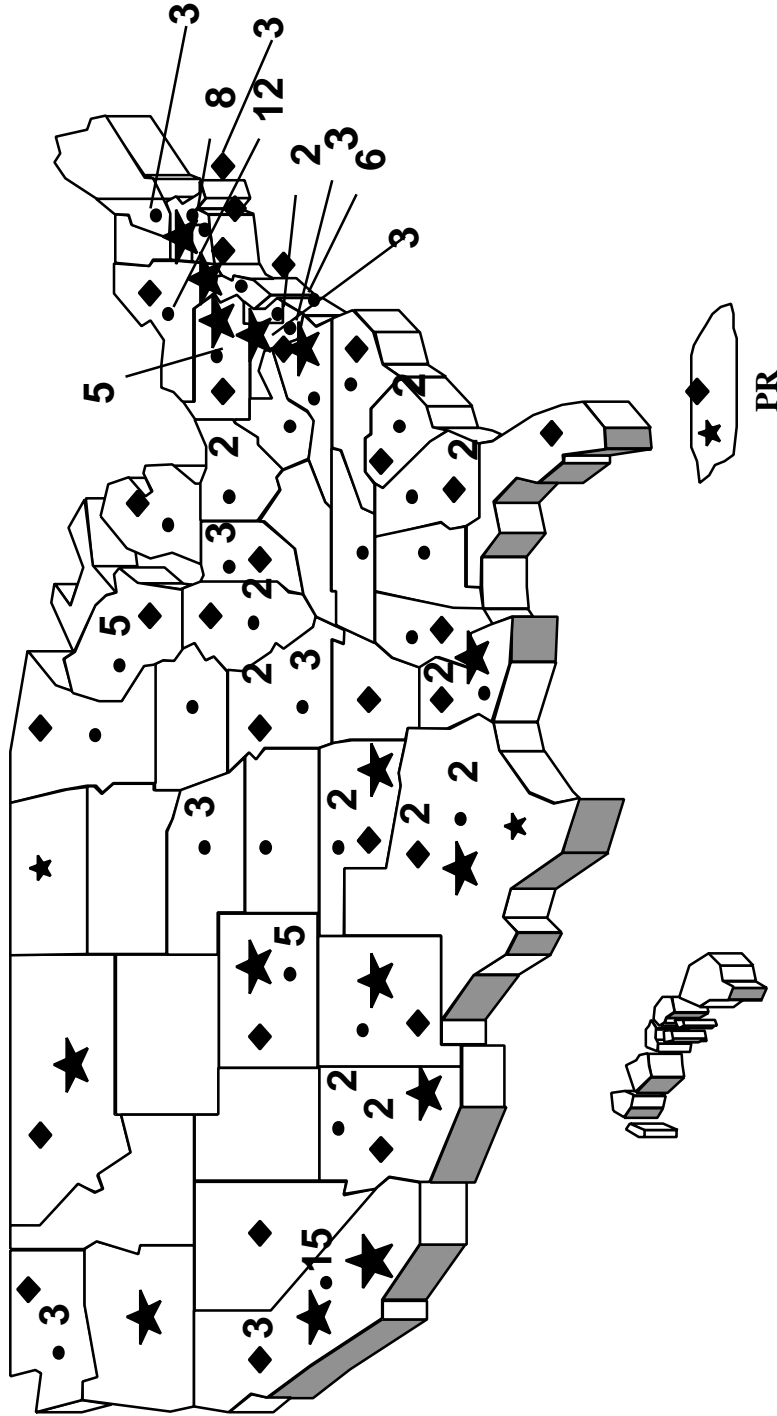
Additional information about programs within the NSF Directorate for Education and Human Resources can be accessed through the Web site at <<http://www.ehr.nsf.gov>>.

## **Teacher Preparation Efforts in Other Agencies**

Included in Appendix 3 is a list of Web sites providing links to teacher preparation projects sponsored by other federal agencies.



# FY 97 CETP/TP Collaboratives and Projects



- ★ CETP Collaboratives
- ★ Development projects
- DUE Teacher Preparation projects
- ◆ Other EHR Teacher Preparation projects

**National Science Foundation  
Directorate for Education and Human Resources  
Division of Undergraduate Education**

**PROJECT DESCRIPTIONS: FISCAL YEAR 1997**

**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION (CETP)  
FULL COLLABORATIVES FOR FY 97**

**Science, Technology, Engineering, and Mathematics Teacher Education Collaborative (STEMTEC)**

Morton Sternheim  
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DUE-9653966  
\$4,999,414

The Science, Technology, Engineering, and Mathematics Teacher Education Collaborative (STEMTEC) links the members of the Five Colleges, Incorporated consortium - the University of Massachusetts Amherst and Amherst, Hampshire, Mount Holyoke and Smith Colleges - with the three area community colleges, Springfield Technical, Holyoke, and Greenfield, and the neighboring school districts in a collaborative effort to promote reform in the science and mathematics preparation of teachers. PALMS, the Massachusetts NSF State Systemic Initiative program, and the Continental Cablevision Corporation are also participating. In order to improve the preparation of pre-service teachers, stimulate the interest of undergraduate science and mathematics majors in the teaching profession, and increase the educational effectiveness of science and mathematics courses, the collaborative draws on its expertise to make use of effective active-learning strategies: cooperative learning, investigation-based teaching, educational technology, new assessment techniques, and opportunities to teach. Teams including college science, mathematics, and education faculty members are re-designing existing college courses and creating new ones. The teams include K-12 teachers who participated in earlier NSF supported collaborative ventures to improve teacher preparation, and who have adopted these teaching strategies in their own classrooms. The project is developing strategies to attract students to science and mathematics teaching, especially women, under-represented minorities, and rural and inner city residents. Strong assessment and dissemination components are accompanying a comprehensive program of course reform and preservice teacher education that can serve as a national model.

## **Oregon Collaborative for Excellence in the Preparation of Teachers (OCEPT)**

Marjorie Enneking  
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The Math Learning Center  
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DUE-9653970  
\$4,999,988

The Oregon Collaborative for Excellence in the Preparation of Teachers is a collaborative effort among the two- and four-year public and independent colleges in Oregon (including Portland State University, Western Oregon University, the University of Oregon, the University of Portland, Portland Community College, Pacific University, Oregon State University, Eastern Oregon University, and Central Oregon Community College) to promote reform in the teaching and learning of mathematics and the sciences in the preparation of teachers of science and mathematics for grades K-12. The project strengthens the curriculum, field and other out-of-class experiences, and selected science, mathematics and education courses so as to reflect current research on teaching and learning and to encourage cross disciplinary development. Science, mathematics, and education courses are designed to be consistent with the National Council of Teachers of Mathematics' and the National Research Council's standards in mathematics and the sciences and are developed within the context of improving the institutions' program for prospective teachers. The project also stresses recruitment and retention of promising students in the teaching profession, with particular attention to students from underrepresented groups. The project establishes mechanisms to enable the science, mathematics and engineering faculty and mentor teachers to learn about and implement new techniques in pedagogy.

## **New Mexico Collaborative for Excellence in Teacher Preparation**

Ricardo Jacquez  
Peggy Blackwell, Kenneth Brooks, Edmund Casillas, Michael Fischer  
New Mexico State University  
Las Cruces, NM 88003  
*rjaquez@nmsu.edu*

DUE-9653973  
\$4,999,998

The New Mexico Collaborative for Excellence in Teacher Preparation (NMCETP) is a partnership of five universities, four community colleges, 11 public school districts, two state agencies, and two national laboratories. Institutions include New Mexico State University, the University of New Mexico, Western New Mexico University, New Mexico Highlands University, Eastern New Mexico University, Northern New Mexico Community College, Diné Community College, San Juan College, and Santa Fe Community College. The purpose of the collaborative is to improve the science, mathematics, and technology preparation of future K-12 teachers and their effectiveness as educators in these vital areas. This goal will be achieved by accomplishing the following objectives: 1) reforming content and teaching by designing an innovative, integrated curriculum; 2) developing policies, which require improved mathematics and science preparation of teachers; 3) supporting novice teachers through a strong support system during their critical early years; 4) increasing diversity in the teaching profession through innovative recruiting, retention, and instruction designed to serve diverse groups, particularly American Indians; and 5) disseminating results--including innovative materials--to institutions nationwide.

Among the innovative features of NMCETP are novel plans for: 1) science, mathematics, engineering, and technology (SMET) departments to integrate future teachers into their culture; 2) teacher placement in the schools and early professional development; and 3) mechanisms to recruit individuals who already have degrees but either are not certified to teach or lack a strong SMET background.

## CETP FY 97 DEVELOPMENT GRANTS

### Texas Project for Teacher Preparation

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 Texas Engineering Experiment Station  
 College Station, TX 77843  
*m-castro@tamu.edu*

DUE-9653962  
 \$100,000

This project is beginning to implement a plan developed by faculty from nine Texas institutions to improve the preparation of science and mathematics teachers in Texas. Project activities include: 1) designing and developing a series of inquiry-driven, technology-infused modules to be concurrently integrated into the science and mathematics curriculum at the nine partner universities; and 2) organizing a subset of Texas Presidential Awardees, comprised of Texas/ nominees for the NSF Presidential Award for Excellence in Science and Mathematics Teaching, to serve in an advisory capacity to faculty on these campuses, and to assist in developing the Texas Presidential Awardees Alliance, comprised of all 168 of the state's Presidential Awardees.

These two interrelated activities involve teams of university faculty from science, mathematics, and education representing nine universities; teams of exemplary science and mathematics teachers from approximately 20 school districts; and administrators from K-12 schools, community college and university partners. Importantly, these objectives are integrally tied to the continued development of a full implementation plan to improve science and mathematics teacher preparation programs across the state.

### North Dakota Project for Mathematics and Science Teacher Preparation

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DUE-9653963  
 \$99,380

This is an 18-month planning project to provide increased involvement of scientists and mathematicians in preservice teacher preparation. The project includes a two-day summer conference for North Dakota scientists and mathematicians. Two other trial initiatives are part of this planning grant. The first of these is the establishment of three teams, each consisting of a preservice mathematics teacher and a university mathematician working together to teach a university calculus class at a local high school. The second initiative involves undergraduate science majors working for approximately ten hours per week as teachers' assistants to master teachers at a local junior, or senior, high school. Each science major meets with his/her academic science advisor, and science educator, once every two weeks. These meetings provide an opportunity to talk about teaching, its rewards, its challenges, and the possibility of preparing for dual careers in science and science teaching.

## **Puerto Rico Excellence in Science and Mathematics Teacher Preparation**

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DUE-9653975  
\$50,000

Eight of the universities that prepare over 80% of all K-12 science and mathematics teachers in Puerto Rico have formed an alliance with the Puerto Rico Department of Education, through the Resource Center for Science and Engineering to carry out a strategic planning process for the reform of science and mathematics teacher preparation programs as part of an ongoing K-16 systemic educational reform. Building on the Puerto Rico Statewide Systemic Initiative and the Puerto Rico Alliance for Minority Participation, a Blueprint for Achieving Excellence in Science and Mathematics Teacher Preparation in Puerto Rico is being developed through the collaborative efforts of these eight institutions and K-12 teachers participating in the standards-based reform. Three island wide conferences are being held to: 1) define and build consensus on the central issues and specific changes needed to align Teacher Preparation Programs (TPP) with Content and Professional Standards for science and mathematics; 2) facilitate a strategic planning process at the institutional level to reform TPP that ensures a highly participative process; and 3) elaborate a Blueprint for Achieving Excellence in Science and Mathematics Teacher Preparation in Puerto Rico, which will integrate the diverse institutional strategic plans. The Blueprint produced through this project will serve as the basis for the reform of science and mathematics teacher preparation in Puerto Rico.

## **ADVANCED TECHNOLOGICAL EDUCATION (ATE) PROGRAM**

### **Network Training for Educators**

Catherine Cotten  
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DUE-9752060  
\$410,330  
Interdisciplinary

This project creates a statewide infrastructure that provides education and training in network technology for 2-year college and secondary school computer technology faculty that, in turn, enables the implementation of a computer network management curriculum for 2-year technical students and a related curriculum for secondary students, and enables the utilization of computer networks as an instructional tool. Teacher preparation is a significant element of this program. Many of the students in the program are future K-12 teachers who will be introducing, teaching, and maintaining information technology systems in the K-12 schools. This project provides the foundation for a smooth transition from high school to community college in the field of information technology. This is being achieved through the following objectives to: 1) establish an approved infrastructure to implement the training of secondary and post-secondary faculty in local area networks and telecommunication networks; 2) educate and train a core of 2-year college faculty who are qualified to implement an approved networking curriculum for technical students throughout the state and to utilize computer networks as instructional tools; 3) educate and train a core of secondary faculty qualified to teach a networking curriculum and to manage and utilize computer networks for instructional purposes; and 4) provide the training and resources to use the World Wide Web as a teaching and learning resource.

**Validation & Implementation of a Coordinated Precision Agricultural Curriculum with K-12, Community Colleges, Universities and Industry**

Terry Brase  
 Hawkeye Community College  
 Waterloo, IA 50704  
*agfdtech@forbin.com*

DUE- 9752081  
 \$300,000

Hawkeye Community College, along with Kirkwood Community College and Lansing Community College, is currently validating and implementing a coordinated precision agriculture curriculum in the Midwest. This precision agriculture model incorporates modules and courses in precision farming, environmental science, and geographic information systems with a core of applied mathematics and science courses to augment the Agriculture and Food Technology curriculum. Each of the participating community colleges is forming a linkage with K - 12 school(s) and a university. Preservice teachers and current teachers are being offered workshops in precision agriculture technology and conferences are being held to coordinate discussion on articulation between educational levels. An outcome of this effort is a coordinated Precision Agriculture curriculum that provides a seamless career pathway while providing mathematics and science skills necessary for advanced technological careers.

**COURSE AND CURRICULUM DEVELOPMENT (CCD) PROGRAM**

**Teaching in Secondary Schools as a Career Option for Engineering Students**

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DUE-9652778  
 \$93,536  
 Engineering

A national pilot program for encouraging engineering students to enter the teaching profession as teachers of science and mathematics in secondary schools is being created at Duke University. The program will be self-sustaining and will become a permanent part of the School of Engineering curriculum. The year long program for senior engineering students includes experiences in pedagogy, teaching techniques, and field trips to classrooms. The program provides advice and counseling on career development. Options for certification are discussed. The participating faculty includes an engineering professor interested in education, a mathematician teaching student teachers, a director of a Master of Arts in Teaching program and a public school teacher. The program is being professionally evaluated with feedback from students providing an important component of these evaluations. An information kit is being prepared including a video presentation of the experiences. The tape will be sent to all interested engineering schools.



### **Contextual Coursework for Elementary Pre-Service Teachers (ConCEPT)**

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DUE-9652800  
\$199,992  
Interdisciplinary

To increase the quality and quantity of science instruction in the state's elementary classrooms, California State University, Fullerton (CSUF), in collaboration with five local community colleges, is developing Contextual Coursework for Elementary Pre-Service Teachers (ConCEPT). Because most elementary teachers fulfill their science requirements at community colleges, ConCEPT targets prospective elementary teachers at CSUF and the community colleges (a pool of 3,500-4,500 students). ConCEPT draws on existing exemplary curriculum materials to develop three 3-unit courses, including laboratory experience, designed to help future K-6 teachers understand science concepts, acquire science process skills and implement the K-6 National Science Education Standards. The courses are cross-disciplinary, with a contextual approach to science and a hands-on, inquiry-based pedagogy. ConCEPT's immediate impact will be to change the way future elementary teachers at the six participating institutions experience science. The ConCEPT courses will be applicable at any institution where future elementary teachers fulfill their general education science requirements and, after successful field testing, will be disseminated to institutions throughout the U.S. Beyond the course design, ConCEPT will establish an innovative model for higher education collaborations generally and course development specifically, creating a new approach to articulation between community colleges and four-year institutions.

### **Learning to Teach School Mathematics with Technology**

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DUE-9652810  
\$159,975  
Mathematics

The Learning to Teach School Mathematics with Technology (LTSMT) project is developing a combined methods and content course for preservice teachers focusing on the use of computer and calculator technology in secondary school mathematics. Goals of the LTSMT project for the preservice teacher are to: 1) develop confidence and ability in the use of commonly available mathematics software; 2) build an understanding of the importance of providing accessibility to software for students as a matter of equity, of developing meaningful conceptual understanding, and of promoting mathematical power in all; and 3) develop a reflective attitude that brings about a serious examination, in light of available software, of beliefs about what mathematics is, what topics belong in the curriculum, and what roles the teacher and learner should play in classroom interaction. Seven modules organized by content area involve students in individual and cooperative-group investigations. Students use a function grapher, a data analysis package, a dynamic geometry program, a programming language, and a symbolic manipulator. Problems and investigations from recent NSF-funded middle and high school curriculum development projects are being incorporated into the materials, coordinated with a systematic examination of their pedagogical implications. The three-year project will create, pilot, and evaluate these materials, with the goal of publishing the results for use in preservice programs throughout the U.S. The flexible, modular design of the materials will allow teacher educators to customize their use in a variety of course formats, hardware and software configurations, and personal inclinations toward mathematics content.

**Pilot Project: An Integrated Science Curriculum for Undergraduate Non-Science Majors**

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DUE-9652828  
 \$185,000  
 Geosciences

This project focuses on science courses for undergraduates who are not majoring in the sciences, including students preparing for careers in elementary and early childhood education. As an alternative to the standard approach to fulfilling distribution requirements, consisting of several unrelated sciences courses, this pilot project consists of a four-semester sequence of integrated science courses focusing on the general theme of environmental science. All four courses are suitable for students enrolled in teacher preparation programs. The courses being developed include 1) *Ecosystems: Their Formation, Function, and Impact on Life*; 2) *Environmental Health*; 3) *Global Change*; and 4) *Quantitative Methods in Environmental Science: Non-linear Dynamics, Fractals, and Chaos in Nature*. These interdisciplinary science courses emphasize the role of science both in students' everyday lives and in public policy. Students work in small groups to carry out research projects, and cooperative learning strategies are employed. Each course includes a laboratory component and three of the four include a series of all-day field trips to nearby sites. University resources are being supplemented with personnel and facilities drawn from a variety of local industrial and governmental organizations. The primary goal of the pilot project is to demonstrate that this approach improves the scientific and environmental literacy of students, relative to traditional course offerings for non-science majors. Evaluation efforts include close monitoring of relative outcomes for students majoring in early childhood and elementary education, who will be assigned randomly to the standard curriculum and the pilot courses. If successful, the pilot project will serve as a model for the development of thematically organized cross-disciplinary science courses for non-science majors, including education majors.

**Trying Science: Undergraduate Science Curriculum Reform**

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 Interdisciplinary

This project creates new opportunities for undergraduate students to experience scientific investigation in real-world problem contexts. The Grand River, a local resource, serves as an important connecting theme and an outdoor laboratory. The project involves a three-year curriculum reform at Lake Erie College that will impact 75% of the 700 students.

Faculty from arts, sciences and education are creating new or modified science courses specifically designed for the General Education requirement and to attract non-science students and education majors to the excitement of scientific inquiry. Students are collaborating in active learning experiences that will require cross-disciplinary connections and the application of scientific problem-solving skills. To establish connections between the campus, the community and the local environment, summer learning experiences engage local scientists and concentrate on local natural resources. Students and faculty are developing multimedia presentations reflecting the learning outcomes of the new science courses. Local case studies serve as a vehicle for student data collection and evaluation. Students are creating databases to be shared with community agencies.

## **An Interdisciplinary Approach to Enhancing Mathematics and Science Curricula**

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Interdisciplinary

A multidisciplinary, general education level quantitative reasoning course that uses basic algebra is being developed to: 1) increase student awareness of connections between mathematics and science; 2) enhance critical thinking and problem solving skills; and 3) upgrade the ability of future teachers to incorporate mathematics into their classrooms. Assessment includes comparison of students in newly developed and preexisting courses through value-added testing, performance on standardized tests, and tracking student success in subsequent courses.

## **Virtual Laboratories in Statistics**

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DUE-9652870  
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Mathematics

This project is improving the undergraduate introductory statistics course and enhancing student understanding of statistics by applying a “rule of three”. Each major topic in the course is explored from three points of view: 1) mathematical - the usual mathematical derivation and formulation of the statistical methods; 2) data analysis - the application of the statistical methods to data, preferably from real problems, yielding numerical and graphical results; and 3) simulation - simulations of the statistical methods that make the conceptual foundations clear in a way that words, static pictures, and data analysis cannot.

The project is developing a set of software modules that function as virtual laboratories, allowing a student to replicate a statistical procedure thousands of times in a matter of minutes with the output displayed in customized tables and graphs that create a rich learning environment. A special web site is being used to help with evaluation and dissemination. The third year of the project focuses on preservice teachers.

## **A Capstone Course: Learning Mathematics through Original Sources**

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Mathematics

The upper division mathematics course, *Great Theorems: The Art of Mathematics*, presents the motivating problems and original solutions that inaugurated various branches of mathematics (e.g., integration, number theory, analysis, abstract algebra). By reading the original sources, students witness the genesis of history's most revolutionary ideas in mathematics. The course serves as a capstone experience for students majoring in science, engineering, education, and mathematics. Mathematics education majors benefit from the course by learning the origins of topics they will be teaching in high school. The course provides a variety of models of teaching techniques. A book, *Discovery of Ideas: Revolutionary Theorems in Mathematics*, is being produced to fulfill the need for an appropriate collection of annotated original sources.

## Teaching Improvements through Mathematics Education 2000: An Integrated Undergraduate Program to Improve the Preparation of Mathematics Teachers (Time 2000)

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 Interdisciplinary

The TIME 2000 project seeks to improve the preparation of mathematics teachers by recruiting prospective teachers from the pool of high quality high school mathematics students, underrepresented minorities, women, and persons with disabilities, into a newly designed, mathematics education program. TIME 2000 is developing a freshman year program that conceptually integrates the mathematics, the psychology of learning, and mathematics pedagogy. The Mathematics Components of the program integrate such topics as calculus, probability, statistics, and discrete mathematics and employ the latest technology and teaching strategies. In the Psychology-Mathematics Education Component of the program students are given the opportunity to confront their personal beliefs about the nature of mathematics, the learning of mathematics and the teaching of mathematics with respect to their learning experiences in the mathematics component of the program. In addition to the coursework, students meet with project staff on a regular basis for seminars, for special projects, for advisement, and to obtain feedback regarding the project.

The New York Collaborative for Excellence in Teacher Preparation in Mathematics, Science and Technology is the medium through which project staff share those ideas and activities that have been evaluated as effective. The materials developed will be made available to facilitate replication throughout the CUNY system and the United States.

## Looking Into Mathematics: A Visual Invitation to Mathematical Thinking

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 \$154,871  
 Mathematics

The objective of this project is to engage and sustain students' interest in mathematics by genuinely involving them in mathematical thinking. Instructional materials, activities, and software tools are being developed within an interactive, visual, experimentally-oriented curriculum that conveys the spirit and flavor of modern mathematics emphasizing a variety of key and central perspectives (such as local/global, intrinsic/extrinsic, dynamic/static, discrete/continuous, and algebraic/geometric). This will enable semi-rigorous interactive experimentation--both manual and virtual--with a rich variety of complex, interesting mathematical objects like curves, surfaces, linkages, knots, and braids. Students explore these areas using new visual tools that are both powerful and empowering. The audiences targeted by the project include first-year college students who do not intend to major in mathematics or science and future mathematics teachers. Pilot sections will be taught at Brandeis University, Harvard University, Clark University, and the University of Massachusetts, Boston. Materials are being developed for use in a wide variety of colleges and universities, either in introductory mathematics courses or for enhancement of existing courses. Both text and software will be made freely available for adoption and dissemination.

### **Interactive Multimedia for Developing Critical Thinking in Biology Based on the New Benchmarks Curriculum Model**

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DUE-9653034  
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Life Sciences

The new Benchmarks Curriculum provides an alternative to the traditional curriculum, fostering the development of in-depth content mastery along with the critical thinking and problem solving skills students need to successfully apply their anatomy and physiology knowledge. This project amplifies the impact of the new NSF supported Benchmarks Curriculum by providing the multimedia support the students need. The project has developed formal ties with the CUNY teacher preparation project, an NSF Collaborative for Excellence in Teacher Preparation. Workshops will be conducted for faculty to help them incorporate modules produced into courses designed for or including students who are preparing to be teachers.

### **CalcLab: A Hands-On Learning Environment for Enriching Students' Understanding of Calculus**

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DUE-9653068  
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Mathematics

This project is developing, refining, and investigating CalcLab, a calculus learning environment based on a set of interactive physical devices, with computer interface. Students are guided by written materials in activities that involve exploration, experimentation, and problem solving around the central concepts of calculus. This learning environment provides access to calculus to those students who have traditionally not been well served by courses in the subject, in addition to deepening all students' understanding of the subject. This project builds on themes underlying the current calculus reform movement and implements research findings of the Principal Investigators on a research project funded for the last four years by the National Science Foundation. Pre-service and in-service high school mathematics teachers are benefiting through the opportunity to think deeply about the central concepts of calculus. The principal activities include: 1) refining CalcLab devices to be more robust; 2) writing, in collaboration with college science teachers, materials to guide students in the use of these devices; 3) developing an instructor's manual; 4) studying students' learning in this environment and publishing the results; and 5) enhancing instructors' professional development in connection with the use of such environments.

### **Integrated Science General Education by "Hybrid" Interdisciplinary Methods**

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DUE-9653070  
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Interdisciplinary

This project completes the development of a three-course series fulfilling the entire 16-unit science general education requirement for 1,350 students per year from 30 majors in 4 non-science Colleges at the host campus, with likely replication to 22 other campuses in the California State University system. The major

objective of the courseware is to enable non-science students to achieve a deep understanding of the most important theories and mechanisms of seven sciences (Astronomy, Physics, Chemistry, Geology, Biology, Computer Science, and Mathematics) presented, not by discipline, but by common features across the disciplines as advocated by a recent report of the American Association for the Advancement of Science. Several years of intensive, interdisciplinary pre-integration of the subject matter by faculty from the seven sciences are being captured in 60 multimedia modules of 180 hours average study time distributed on a Library of Integrated Science General Education CD-ROMs. More than 100 detailed case studies are presented, each demonstrating how the Integrative Process is similar in key processes within each science and across the sciences. The multimedia portion also includes a study of the Scientific Method as compared across the sciences. The project will result in five products that are easily replicated and will be widely disseminated: an Integrated Science Library of multimedia CD-ROM's to deliver the pre-integrated, interdisciplinary content; a student Handbook to accompany the multimedia lessons; a Workbook of Integrated Science Small-Group and Skill-Training Exercises; a unique Lab book of Interdisciplinary Protocols; and a series of Workbooks on Dissemination.

### **Elementary Physics Course Based on Guided Inquiry**

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\$45,575  
Physics

This course, appropriate for pre-service teachers, embodies a number of recent innovations in educational theory and practice. The breadth of topical coverage has been substantially reduced from standard levels, in order to ensure that what is covered is actually learned and retained by the students. The theme of "energy" is used as a conceptual pivot to tie together the various topics. Students' pre/misconceptions regarding physical phenomena--as determined by pre-testing--guide the presentation, activities, and discussion. The pretests form the basis for a thorough class discussion of the predictions made by students regarding the outcome of various experiments. Investigations to test their predictions are carried out by the students, working in small groups, through guided "mini-research-projects." Class discussions, centered around the results of the student investigations (and comparison with the predictions), lead to a systematic summing-up by the instructor to provide perspective, and tie into the next topical area under the theme "energy transformation and conservation." During course delivery, ongoing testing and other assessment guide the pacing and depth of the topical coverage. The target audience is prospective elementary and middle school teachers, and other non-technical students.

### **Symmetry Across the Curriculum: Symbolic and Visual Learning In the Arts, Mathematics, and Basic Science**

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Interdisciplinary

The long-term goal of this project is to propose strategies for development of multi-disciplinary courses that convey the cumulative impact of several subjects, including mathematical analysis and modeling, to address and solve a scientific or environmental problem of broad societal interest. A sequence of course-modules are being developed to cover a variety of topics in which symmetry, geometric transformations and geometric

structures play a key role in an interdisciplinary context. Modules from the Arts, Biology, Chemistry, Mathematics, Physics and Psychology have been specifically selected to form a coherent multi-disciplinary general undergraduate course that illustrates how the arts and humanities enrich the teaching of science. None of the modules requires mathematics and science beyond standard high school level. Each of the modules has two components: 1) text and other forms of multi-media materials that convey information regarding the topic at hand; and 2) software pieces that encourage the students to experiment with hands-on computational aspects of the topic, through simplified numerical and symbolic computations, and visualization.

Special emphasis is being placed on attracting future teachers of science and mathematics, and encouraging them to experiment with similar course-development ideas, proposing modifications of the software and the text to suit the K-12 audience that they will teach. The evaluation plan includes teaching pilot courses at the University of Wisconsin (Madison) and Montana State University (Bozeman), and Rutgers University (Newark). The dissemination plans include publication of a text and accompanying multi-media software through major commercial companies and placement of materials on the WWW. Some of the course-modules are suitable for adaptation in alternative educational programs, e.g. using distance learning or in the context of extended and informal education.

### **Modeling Effective Teaching and Learning in Chemistry**

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\$125,049  
Chemistry

A new chemistry course provides future teachers with the solid underpinning needed to understand chemical concepts, and an experience base from which they can draw upon in their teaching. The course designed jointly by university chemistry instructors, students, and practicing teachers, uses hands-on, learner-centered, and inquiry-based pedagogies to promote deeper learning. The course offers strong chemical content and provides students with a model of effective science teaching. Students define, design, and carry out investigations of real-world issues. There is a focus on the human side of science through inclusion of historical, cultural, and environmental perspectives. This project is producing a model of effective chemistry teaching that will be applicable to any undergraduate non-majors or majors chemistry course.

### **Formation of a Claremont Colleges Intercollegiate Program in Neuroscience**

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DUE-9653140  
\$209,862  
Interdisciplinary

The Claremont Colleges is developing a six-college intercollegiate, interdisciplinary neuroscience program. At the core of this program, a new interdisciplinary, introductory neuroscience course is being developed that focuses more on the fundamental neuroscientific issues from a philosophical, historical, and methodological point of view than is typically the case. This approach is expected to be beneficial to the

general education student and potential majors in neuroscience. This course is preparing students to understand, appreciate and comment upon future developments in the neurosciences. Students electing to subsequently major in neuroscience will be prepared for related advanced coursework in the discipline. A significant part of the project involves opportunities for students and faculty to work with pre-college students and teachers to develop science education in elementary and secondary schools,

In addition to the introductory course, new upper division courses are being developed within two tracks, representing the principal division in neuroscience today: cellular-molecular and cognitive neuroscience. A senior capstone course is also being developed that will serve both tracks. The capstone course brings faculty and students together to reconsider fundamental issues raised in the introductory course, but from a more sophisticated vantage point.

### **Investigative Science at Alfred: How the World Works**

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DUE-9653164

\$114,930

Interdisciplinary

A new year-long, introductory, interdisciplinary course for non-science majors at Alfred University, entitled *How the World Works*, enables students to experience the fun and creative side of science. An overall theme for the course such as "Living in Space" or "Survival on a Greenhouse Planet" will be provided each year. The students design the course as they pose questions related to the theme. As they participate in these self-designed activities, students rediscover the fun of science at the same time that they are learning to think and analyze critically, broadening their scientific and mathematical backgrounds, and appreciating the interrelationships that exist between mathematics and all of the scientific disciplines.

One of the largest potential impacts of this proposal is its promise for improving teacher preparation. It is expected that most students not majoring in science will enroll in *How the World Works* to satisfy science and mathematics requirements. In addition to becoming scientifically and quantitatively literate, future teachers learn hands-on examples of teaching approaches, investigative experiences, cooperative learning, interdisciplinary perspectives, and quantitative analysis, applicable to teaching at all grade levels. Upper level undergraduates majoring in math, science, and/or education are employed as peer mentors to facilitate classroom activities.

### **Campus Ecology: Experimental Field Sites as Tools for Teaching Ecological Principles**

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DUE-9653190

\$99,884

Life Sciences

This project is improving grades 6-16 biology education through the production and dissemination of a manual describing small scale, campus-based, long-term ecological research sites (LTER). Using school-based LTER sites pre-service and in-service teachers are actively involved in ongoing short- and long-term ecological research. For the Rocky Mountain West, long-term experiments are presented to address the effects of nutrient availability, enhanced water availability and grazing on short grass prairie succession. Experiments that have greater relevance to other regions of the country are also being developed. All



experiments are tied to the national science standards. The campus-LTER sites also enhance the current ecology and science methods curriculum at UNC.

### **Multi-layered Learning Program for Problem-Based Learning Classrooms**

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Interdisciplinary

A new course, *Tutorial Methods of Instruction*, is incorporating a pre-service teacher focus to support problem-based learning (PBL). This course involves training undergraduates as peer tutors who assist faculty in facilitating classroom problem-solving groups. The sessions focusing on pre-service science teachers address the adaptation of problem-based learning strategies to middle and high school settings. Topics include classroom management techniques for using group and inquiry-based instruction and the development of problems and other curricular materials and appropriate assessment materials. The course helps pre-service teachers link problem-based learning to “hands-on” classroom activities. A Science Fellows Program provides opportunities for pre-service teachers to receive practical experience working with middle or high school students and teachers or serving as problem-based learning peer tutors in the university. The project is also developing an interdisciplinary science course for in-service middle and high school teachers.

### **Student Preceptors and Investigative Laboratories in Introductory Psychology**

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Interdisciplinary

To provide a laboratory setting for students to carry out scientific inquiry originating in the introductory course in psychology, and to stimulate interest in teaching, St. Olaf College is developing: 1) investigative laboratories as a part of an introductory course for 120 students a year; and 2) a preceptor program offering students interested in teaching, an opportunity to teach in the laboratories during a subsequent term. Students in introductory psychology participate with a faculty member in class for three hours per week and then work an additional three hours per week in rotating laboratory sessions conducted by three faculty and preceptors. The laboratory involves groups of 15 students in each of ten different laboratory sessions. It provides opportunities for students to translate the curiosity psychology arouses into testable hypotheses, researchable questions, and to design experiments as well as to collect and analyze data.

Preceptors follow the laboratory rotation with a group of introductory students, teaching, fostering student inquiry, helping students in the learning process, and evaluating their work. The goals of the project are to: 1) teach psychology as an investigative laboratory science on a college level from the very first course; 2) encourage students, interested in college or secondary school teaching, to teach psychology as an investigative science; 3) encourage students to work together as a research community in the library, the laboratory and the field; and 4) design a replicable model that will facilitate construction of investigative laboratory sciences at other colleges and universities.

## The CAES Strategy for an Urban University

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Interdisciplinary

Based on results from a prior NSF project, the Cognitive Apprenticeships in Environmental Studies (CAES), is fostering interdisciplinary research perspectives among undergraduates at an urban university. The approach consists of a series of exercises placed throughout the traditional science curriculum. The exercises: 1) unify a set of disparate courses through a focus on a specific, local environmental catastrophe; and 2) foster the exchange of samples and data collected by students. Students in different courses become part of the same interdisciplinary research team investigating problems that potentially affect their lives. In addition, students participate in internship programs, advisement services and other activities that build a student community aware of environmental science. The project emphasizes: 1) development of more course materials; 2) implementation of modules in courses for nonmajor and future teachers; and 3) dissemination of the CAES strategy through presentations at professional societies and Internet publications.

## Introductory Weather and Climate Laboratory Modules Utilizing Computer-Based Learning Technology

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Earth Sciences

Building on classroom materials developed for the National Weather Service (NWS), the COMET Program is creating an innovative pilot module of interactive, laboratory investigations for undergraduate introductory atmospheric science courses. The pilot module *Weather Satellites: Types, Imagery and Applications*, engages non-science majors in active and visual representations, replacing existing, static laboratory materials with four-dimensional illustrations of atmospheric sciences concepts and weather phenomena. The project provides interactive data collecting activities, and related field experiment guidelines. Additionally, it provides imbedded K-12 classroom activities for the estimated 20% of introductory course students who will go on to teach. Materials are developed in the context of the "best teaching practices" and science content standards published by the National Research Council (1996).

## Action Based Research Science and Mathematics Partnerships for Excellence in K-12 Teacher Preparation

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DUE-9653980  
\$200,000  
Interdisciplinary

This pilot program provides a beginning model for systemically reforming and improving undergraduate content courses, with particular attention to the teaching models they provide for students preparing to be teachers. Action Based Research Teams (ABRT) are redesigning the courses. There are three ABRTs,

each composed of a scientist/mathematician, a science/mathematics educator, a pre-service teacher, and an in-service teacher with each team responsible for a specific course. The three courses being redesigned are: a two semester introductory chemistry course (about 2000 students, approximately 20% intend to become teachers); a year long biology course (about 250 students, approximately 80% intend to become elementary school teachers); and a one semester introductory geology course (about 50 students) designed specifically for students preparing to become K-8 teachers. Courses are being restructured to help students better understand the concept of the science while at the same time providing models for activities that can be used for teaching these same concepts to elementary or high school students.

### **A New Model for Physics Education in Physics Departments: Improving the Teaching of Physics from Elementary through Graduate School**

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DUE-9727648  
\$1,500,990  
Physics

A comprehensive, multifaceted program conducted by the Physics Education Group in the Physics Department at the University of Washington consists of a group of interrelated projects that focus on undergraduate course improvement, teacher preparation and enhancement, and university faculty development. The goals for the project are: 1) to expand the knowledge base of how students learn physics; 2) to increase student learning in the introductory physics course; 3) to prepare K-12 pre-service and in-service teachers to teach science as a process of inquiry; 4) to improve the teaching effectiveness of present and future college and university faculty; and 5) to nationally disseminate the work in research, curriculum development, and instructional innovation. Ongoing investigation of student understanding in physics guides the development of instructional materials for introductory physics students and for pre-service and in-service teachers. The project is conducting workshops for undergraduate faculty and precollege teachers to promote the use of two major curriculum development projects: *Tutorials in Introductory Physics* and *Physics by Inquiry*.

### **NECC 97: NSF Special Sessions**

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DUE-9711534  
\$4,100

Special sessions at the National Educational Computing Conference (NECC) feature speakers who are past and current recipients of DUE grants who share their expertise and experience with the NECC audience. The speakers selected for their work in pre-college education and teacher preparation interact with other educators involved in computer-based education.

## COURSE AND CURRICULUM DEVELOPMENT Institution-Wide Reform

### Campuswide Reform Initiative for Undergraduate Education

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\$199,529  
Interdisciplinary

The University of California, Irvine (UCI) Campuswide Reform Initiative for Undergraduate Education focuses on developing students' scientific and technological literacy skills that are needed for the 21st century. The Campuswide Reform Initiative includes: 1) major curricular and course content changes, especially in mathematics, engineering, and computer science; 2) the infusion of educational technology throughout the undergraduate curriculum; and 3) a change in the campus climate regarding curricular innovation and reform. This project builds on current efforts at UCI to improve undergraduate education, including: the California Alliance for Minority Participation (CAMP); the Southern CA Coalition for Education in Manufacturing Engineering (SCCEME); UCI's new Interdisciplinary Minor in Global Sustainability, a collaborative effort across five of UCI's schools; and Project SMART (Science and Mathematics Articulated Roads Toward Teaching), a national model for teacher preparation. The project includes several campuswide planning retreats, the creation of multidisciplinary curricular committees, a mini-grants program for faculty, instructional technology training for students and faculty, and a Teaching Colloquy series focused on effective uses of instructional technology. Additional curricular components include the development of four new courses (an engineering literacy course, an expansion of the "*Idioms of Science*" course for non-science students, and two teacher preparation courses), new "dual competency" minors in computer science, and new models of instructional technology.

### Mathematical and Quantitative Reasoning Across the Curriculum

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DUE- 9653689  
\$200,000  
Mathematics

Alverno College is building on the success of its earlier curricular reform by expanding the quantitative-reasoning requirement for all students, not only mathematics and science majors, beyond the introductory level. Appropriate quantitative reasoning and application experiences, as well as quantitative assessment activities, are being integrated throughout the Alverno curriculum. Non-mathematics/science faculty are receiving training in exposing the quantitative dimensions and applications already inherent in course content, and in designing appropriate quantitative instructional and assessment strategies, including the use of technology. This project serves as a model for the many Alverno students who go on to teach at the K-12 level.

## INSTRUMENTATION AND LABORATORY IMPROVEMENT

### Implementing Experiential Education in the Anatomy and Physiology Laboratories

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Life Sciences

The Biology Department is implementing experiential learning in anatomy and physiology through the use of computers and other digital technology. The new equipment, coupled with an on-line laboratory manual and Internet access in the laboratories, allows both major and nonmajor biology students to explore physiological and anatomical concepts in both supervised and independent laboratory experiences. The project greatly enriches introductory-level courses for non-majors, many of whom are preservice teachers. By modeling computer-enhanced instruction and experiential learning for preservice teachers, the project has a significant impact on science teaching at the K–12 level. It also allows biology majors to conduct more sophisticated senior research projects in physiology and anatomy.

The equipment enables students to become active participants in physiological experiments by using computer interfaces to record, compare, and analyze data. Four new mobile computer workstations, each equipped with digital data acquisition technology, are being used in conjunction with an on-line laboratory manual to allow students to have hands-on experience in physiological investigation. Students are also using a computer-based anatomical package and digital camera to capture, modify, and link three-dimensional anatomical images and to record dissections. Students are able to compare homologous structures from representatives of multiple taxa. The equipment also allows biology faculty to help students link form and function in physiology and anatomy courses.

### A Computer Laboratory for Geography and Earth Science

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DUE-9750573  
\$26,410  
Social Sciences

This project is modernizing the curriculum in the Department of Geography and Earth Science Department with the addition of a computer laboratory, which is significantly affecting the curriculum in several ways: 1) increasing the exposure of majors to the tools of geographic information systems and remote sensing in four of the upper-level courses; 2) enabling the department to incorporate a vast array of available multimedia and Internet resources into the introductory courses; 3) undergirding a new course for students preparing to be K-12 teachers, called *Geography for Life*, and enabling implementation of at least one other course for teachers, *Computer Tools for Earth Science Teachers*; 4) supporting design of advanced courses that use mathematical or computer models; and 5) providing a facility for students to use for projects, independent research, and presentations.

### **Computer Laboratory/Classroom for Instruction in Calculus, Linear Algebra and Differential Equations and for Teacher Preparation**

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DUE-9750683  
\$51,210  
Mathematicas

This project is developing a computer laboratory to strengthen undergraduate mathematics education and teacher preparation. Problem-solving skills, situational strategies, and solid understanding of concepts are resulting from the laboratory format. The calculus sequence and linear algebra are using the laboratory format, as are other upper-level courses. The laboratory is also having a strong impact on the preparation of secondary education mathematics majors. An in-depth exposure to this format is developing an understanding of the interdependence of analytical, numerical, and graphical methods, which is carrying over to the way these potential instructors will teach mathematics. A course is being developed emphasizing technology, in which students can create lessons (using Maple, Geometer's Sketch Pad, Cabri Geometry, spreadsheets, etc.), review software for their teaching, create on-line exams and assessment activities, and search the World Wide Web to obtain material involving mathematics education. Secondary education mathematics majors are participating in "Mentor to Mentor" workshops that use university students to "mentor" the high school teachers in using Maple, while the in-service teachers "mentor" the students in mathematical pedagogy.

### **Instrumentation for Undergraduate Lab Instruction in Molecular Cell Biology Using Non-Radioactive Labels and Computer Data Analysis**

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Life Sciences

Preparing undergraduates for careers in the biological sciences requires a laboratory-rich curriculum, which includes hands-on experience with current technologies. Many methods in cell and molecular biology involve exposure to toxic and radioactive chemicals. The new instrumentation is part of an effort to redesign the bioscience curriculum around non-radioactive, nontoxic methodologies. Exercises that teach quantitation of nucleic acids and proteins (including PCR products), DNA, RNA, and antibody blotting, analysis of SDS-PAGE, DNA sequencing, protease and nuclease assays, gel-shift assays for DNA-binding proteins, CAT reporter assays, and protein phosphorylation assays used in signal transduction studies can be performed with non-hazardous fluorescent labels instead of toxic or radioactive detection reagents. The new instrumentation also provides for computer data analysis, designed to improve student understanding of computational tools in biology and help them to process and report their data. This approach to laboratory instruction in the molecular biosciences is broadly applicable and is particularly important for attempts to increase the number of students preparing to be teachers who select biology as a science option.

### **Improvement of Biology Teacher Education**

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DUE-9750728  
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Life Sciences

The objectives of this project are: 1) to increase preservice biology teachers' knowledge of the use of computer based technologies in the sciences, including video microscopy, digital imaging, and computer interfacing with data collectors; 2) to allow students to develop inquiry-based laboratories using the above technologies; and 3) to provide opportunities for students to practice integrating these technologies with their teaching as they give demonstrations to other biology classes and to inservice teachers. During the teaching methods courses for secondary and middle school biology preservice teachers, students participate in a variety of inquiry-based laboratories and demonstrations using computer-based technologies. After becoming familiar with the equipment, they develop their own lessons and teach lessons to their peers. In addition they are further developing their teaching skills by conducting demonstrations and workshops for the elementary teachers' biology course, graduate students who teach the introductory biology courses, and inservice teachers.

### **Improvement of Lower Level Biology and Chemistry Courses by the Addition of Computer Assisted Spectrophotometers to the Laboratory Curriculum**

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Chemistry

The objective of this project is to improve the laboratory curriculum in lower-level biology and chemistry courses by introducing computer-assisted spectrophotometers into the laboratories. The courses affected by this project serve mainly non-science-majors, many of whom eventually major in education. The ease of use and speed of the computer-assisted spectrophotometers allow their introduction into the larger, lower-level classes, while the number of variables that can be investigated with this equipment opens up the possibility of doing more complex laboratory experiments. Exposure of non-science-majors, especially those entering the teaching workforce, to computer-assisted technology can make them feel more comfortable with the science and technology of this field.

### **Portable CAS Laboratories**

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\$26,204  
Mathematics

This project is adapting ongoing graphics calculator and computer algebra system (CAS) projects for use with the new TI-92 and Calculator Based Laboratory (CBL). The project focuses on calculus instruction, with extensions to precalculus, physics, engineering technology, and teacher training courses at various colleges. Existing CBL/TI-82/CAS activities are being adapted and new activities developed for the new hand-held system.

### **Improving an Undergraduate Program in Field and Experimental Ecology**

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 \$40,926  
 Life Sciences

This project modernizes the environmental and ecological curriculum at Eastern Washington University with a major infusion of investigative field and laboratory research into the course activities. The main objective of the project is to equip a local field station, a teaching and research facility established by the U.S. Fish and Wildlife Service, with modern ecological and environmental biology equipment for undergraduate student use. The new equipment allows students to use a variety of modern ecological research techniques to query important ecological questions. The close proximity of the field station to the main campus enables the department to provide invaluable field experience for environmental biology students and pre-service teachers as part of the regular curriculum. Students are also gaining more experience designing and conducting studies and analyzing and presenting their own data.

### **Computer Classroom and Laboratory for the Enhancement of Teacher Preparation in Mathematics**

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 Mathematics

With the goal of producing innovative mathematics teachers, this project is providing pre-service teachers with a variety of pedagogical methods in a technology rich environment. Visualization, experimentation, and real applications are being used to foster the understanding of mathematics. To achieve this goal, the department has begun several initiatives, including the integration of graphing calculators and computer software into the courses. Twenty-five Power Macs, software packages, and a laser printer are being purchased to equip one classroom and an adjoining laboratory. This project is being piloted through four courses: calculus III, mathematical modeling, linear algebra, and geometry. All majors enroll in the first three courses in K-12 teaching options, and all future secondary mathematics teachers enroll in geometry.

### **Application of Computing Tools and PC-Instrumentation for Science Students: Enhanced Learning Through Visualization and Exploration**

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 7\$38,748  
 Interdisciplinary

The specific goals of this project are to: 1) introduce students to PC-driven instrumentation for data acquisition; 2) introduce students to computing tools that allow them to interpret difficult science concepts and processes visually as well as mathematically; and 3) develop skills important for the marketplace.



Curricula are being developed for two laboratory courses: *PC-instrumentation for Science Experiments*, and *Exploring Scientific Computing Tools*. With the use of PC- instrumentation, laborious manual measurements and data recording are being replaced by automated data acquisition. Students can manipulate "live" data/formula and visualize the change "on-the-fly." The main beneficiaries of this project are upper sophomore and lower junior science students, as well as pre-service science teachers.

### Technology Education Integration Systems Laboratory

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DUE-9751170  
\$47,899  
Engineering

The objective of this project is to significantly enhance an interdisciplinary Integrated Systems Laboratory (ISL) technology teacher education facility for both pre- and in-service teacher preparations at the University of Missouri-Columbia. This is resulting in a model laboratory, unique in Missouri, for preparing secondary-level Technology Education teachers to work within an interdisciplinary environment. Additionally, students throughout the College of Education utilize the laboratory, with specific emphasis given to science and mathematics education majors as well as students from the Industrial and Mechanical & Aerospace engineering departments. To insure broad scale integration and use, the specifications for this laboratory have been developed jointly by faculty from technology education, science, mathematics education, and engineering.

### Laboratory Improvement in Plant Biology

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DUE-9751176  
\$7,485  
Life Sciences

This project enhances the plant biology curriculum by utilizing instruction that increases critical thinking skills. The objectives of the project are to increase student quantitative skill levels, provide students with exposure to the process of science, increase the level of interest in plant biology, and allow more opportunities for student research projects. These objectives are being met by utilizing modern scientific methodology and computer-assisted data analysis in Botany, Advanced Plant Biology, and Research Project courses. The Plant Biology course enrolls a significant number of K-12 prospective teachers.

An ultraviolet/visible spectrophotometer with computer analysis software is used to examine absorption spectra of isolated plant pigment, measure enzymatic rates, and monitor protein during column chromatography. A photosynthesis package that includes a leaf chamber, oxygen sensor, data logger, and software is used to measure photosynthetic rate, light compensation point, light saturation curves, and photosynthetic action spectrum. Mini SDS-PAGE equipment is used to examine protein changes during stages of plant development. A notebook computer is interfaced to facilitate data collection from multiple instruments and including use of the photosynthesis package in the greenhouse. A scanner facilitates analysis of electrophoresis gels so that protein bands can be quantified using public domain software. The success of the project is based primarily on measurements of student performance and by student evaluations.

### Use of GC/MS for Improvement of Undergraduate Education at All Levels of the Chemistry Curriculum

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\$18,317  
Chemistry

This project enhances undergraduate chemical education at all levels by integrating a Gas Chromatography/Mass Spectrometer (GC/MS) into the curriculum. The GC/MS provides user-friendly interfaces and the presence of network connections in classrooms and laboratories allow for remote access. Students in an introductory course for nonscience majors are being introduced to the instrument through analysis of familiar substances such as spices, coffee and perfumes; within this context, concepts relevant to chemical literacy are introduced. This course is required for students interested in elementary education, and the approach of giving such students access to major instrumentation, if successful, will be adapted to a variety of educational programs concerned with teacher education. In the courses for majors, the instrument provides increased capabilities for analysis of organics in air, water and soil samples in environmental chemistry, and is an important addition to the laboratory program in organic chemistry and instrumental analysis. The instrument also provides an important tool for pursuing the departmental goal of increasing undergraduate research.

### Enhancing Prospective Teachers' Mathematical Understanding through Computer Based Modeling

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DUE-9751212  
\$53,955  
Mathematics

This project enhances Elementary and Secondary Education students' understanding of the mathematics they will teach through the use of computer-based modeling and explorations. The institution is purchasing 30 Macintosh computers for a mathematics computer laboratory. The facility is being used to support class discussions, small-group explorations, and individual efforts to make mathematical models of real-world phenomena. The project supports development of a deep conceptual understanding of mathematics and fosters an appreciation for technology as a powerful tool for teaching and learning. The university offers four core mathematics courses for prospective elementary teachers, which allow faculty to plan for the integration of several computer-based explorations in a systematic way.

### Integrating Techniques of DNA Analysis Across the Biology Curriculum for Majors and Non-Majors

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DUE-9751280  
\$18,242  
Life Sciences

This project is designed to address a systemic lack of laboratory experiments in molecular biology in majors' and non-majors' courses at West Virginia Wesleyan College. The proposed project is of interest because of its focus on DNA-related techniques across a broad spectrum of questions to be investigated, the way in which

technical skills are reinforced throughout the majors' curriculum, and the emphasis on non-majors' as well as majors' courses. Over 200 students per year enroll in the affected non-majors' courses, including all elementary education majors, for whom one of the enhanced courses fulfills a state requirement. Experiments centered on DNA analysis enhance student understanding of major biological concepts and scientific reasoning. Teams of students carry out experiments in forensics, phylogenetic, population genetics, cell biology and animal behavior at the freshman through senior level. This equipment also supports student-faculty research in a project that uses microsatellites to assess genetic relatedness. Techniques to be introduced include agarose and polyacrylamide gel electrophoresis, use of restriction enzymes and analysis of restriction fragment length polymorphisms, DNA isolation and quantitation, the polymerase chain reaction, reverse transcription-PCR, Southern transfers, use of chemiluminescent probes, computer-based image analysis, bacterial transformation and colony screening.

### **Advanced Neuroscience Learning Laboratory**

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DUE-9751339  
\$23,849  
Life Sciences

The Advanced Neuroscience Learning Laboratory is providing students with a broad and integrative education in neural and brain studies. The laboratory also provides students with background in the four foundation areas of neuroscience: behavior, neuroanatomy, neurochemistry, and neurophysiology. This laboratory serves a broad group of students, including majors, K-12 teachers seeking re-certification, and students preparing to be teachers who will earn subject endorsements in psychology, chemistry, and biology. It significantly enhances their research and laboratory experiences. This equipment serves majors as part of a comprehensive education in neuroscience, physiology of behavior, development, cognition, learning, and psychopathology. Health science, biology, and chemistry majors also use the facility.

The laboratory is an integral part of the department's curriculum, providing experiences in the classroom and opportunities for independent undergraduate research. The laboratory uses off-the-shelf technology and techniques that are easily mastered by undergraduate students. Behavior is studied by examining exploratory behavior, learning and conditioning, and neuromotor development. Neuroanatomy is studied using prepared neuroanatomic slides and examples of human pathology. Neurochemistry is studied with neurohistochemical techniques, as well as gel electrophoresis and thin layer chromatography, to reveal neurotransmitter function and distribution. Neurophysiology is studied with a student-oriented computer interface, which permits studies of EEG, EMG, GSR, and several other physiologic and behavioral systems.

### **Equipment Acquisition/Development of a Multi-Use Physical/ Computer Science Laboratory**

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\$37,670  
Interdisciplinary

A new computer laboratory equipped with the latest imaging and multimedia related hardware for use with Physics, Astronomy, Chemistry and Computer Science courses is designed to: 1) improve the instructional quality in all courses; 2) develop and implement new multidisciplinary service courses aimed primarily at improving the "quantitative science experience" for non-science students; 3) modernize existing courses and

develop innovative courses within the newly acquired computer science and data processing/programming and systems curricula; 4) accommodate object oriented programming with languages such as Java; 5) support imaging, applications, digital video and multimedia development tools; 6) expand the computer based laboratory utilization to include multidisciplinary training in physical science, computer literacy, imaging and multimedia applications for practicing professionals such as photographers, fine and graphic artists; and 7) assist with the training of new elementary education teachers and in-service elementary and secondary educators.

### **An Inquiry Based Laboratory for First Semester Biology Majors**

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DUE-9751385  
\$68,061  
Life Sciences

This project improves the quality of the laboratory component of two key courses in our department: the freshman entry-level biology course taken by approximately 250 biology majors each year, and the second semester of the biology sequence taken by students in the NSF Maryland Collaborative for Teacher Preparation (MCTP) track of the Elementary Education Major. Four of the topics studied in the biology laboratory are experimentally investigated in the MCTP course. Since courses for both sets of students share the same laboratory space and equipment, the new instrumentation allows both majors and the MCTP students to perform experiments of their own design and to learn to use computers to collect and analyze data.

The pedagogical approach in the MCTP class encourages students to work cooperatively to design experiments and to critically analyze their data. This project provides the instrumentation to allow them to carry out experiments involving quantitative data and to make the transition to computer-assisted analysis of those data. The new biology laboratory is inquiry-based and provides students with the opportunity to actively participate in the design and implementation of experiments.

### **A Computer Laboratory for Mathematics Instruction**

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\$41,118  
Mathematics

The Department of Mathematics and Statistics is strengthening the undergraduate program in mathematics by providing students with the technological tools necessary to solve complex and realistic problems. Faculty efforts focus on five key courses: multivariate calculus, linear algebra, mathematical statistics, numerical analysis, and the undergraduate research project in mathematics. These courses are using Maple, MATLAB, and SPSS with the goal of helping students develop a strong conceptual understanding of mathematical ideas, the ability to apply mathematical ideas in meaningful and complex contexts, and the ability to clearly communicate mathematical ideas orally and in writing.

This project is establishing a computer classroom dedicated solely to mathematics and statistics instruction. The classroom consists of 20 computers networked to a server and connected to the World Wide Web. The addition of this facility is making possible the implementation of a technology-intensive mathematics program. The department has previously used the computer facilities to pilot sections of multivariate

calculus, linear algebra, and numerical analysis. The revised mathematical statistics course is drawing from faculty experiences teaching elementary statistics in a computer laboratory.

Half of the mathematics majors in the department are preparing to become secondary mathematics teachers. The program directly impacts these students in two ways: 1) improving the mathematical and technical skills of future teachers by emphasizing the use of modern technologies; and 2) preparing future teachers to implement the NCTM standards by actively involving students in their own learning.

### **Computer-Assisted Instruction in Introductory Biology Laboratory**

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DUE-9751418  
\$12,688  
Life Sciences

The introductory biology laboratory course is being revised to incorporate data analysis and discussion of concepts into the laboratory portion of this course. This large course enrolls 300 students per year, approximately 10% of whom are biology education majors. Computers, printers, and software are being purchased for the revision of biology laboratories. Computer programs with integrated word processing and spreadsheet capabilities enable the students to prepare laboratory reports with a more extensive analysis of the data and concepts.

### **Web-Based Support for Synthesizing Visual and Analytic Strategies in Mathematics and Computer Science Undergraduate Education**

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DUE-9751419  
\$50,000  
Mathematics

This project is a joint effort of faculty from the Departments of Mathematics/Computer Science and Middle-Secondary Education/Instructional Technology. The project improves learning in mathematics and computer science courses, especially courses taken by preservice teachers, through the development of World Wide Web-based course materials, tools, and methods and a synthesis of visual and analytic pedagogical strategies. The work is part of a general project to reconceptualize undergraduate mathematics and science courses by coordinating pedagogy with methods taught in the College of Education.

A combination of INTEL-based Windows NT workstations and Silicon Graphics UNIX workstations are used in a dedicated laboratory and an open technology center. The project develops and implements teaching methods using materials, which are designed for this equipment. An interdisciplinary team from mathematics, computer science, and education directs the production and application of the integrated collection of information, dynamic applications, and tools that are enhancing teachers' ability to teach and improving their understanding of how students learn.

### Expansion of Laboratory Facilities through Acquisition of a GC-MS for Undergraduate and Precollege Use

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\$33,750  
Chemistry

A gas chromatograph-mass spectrometer system, and associated computer and peripherals and databases, is being integrated with the existing laboratory equipment and educational program. Students using this instrument are gaining experience in data analysis and spectral data base searching. There is significant impact on all science students but particularly on those science majors (Chemistry, Biology, and Molecular Biology) who continue with courses such as organic and analytical chemistry. Non-science majors, education majors, and high school students are also benefiting. The involvement of a high school teacher with adjunct faculty status at Goshen College is a unique feature of this project.

### Instrumentation for Archaeological Studies

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DUE-9751512  
\$57,392  
Social Sciences

The Archaeological Studies Program is comprehensive and interdisciplinary. The curriculum includes coursework in prehistoric archaeology, classical archaeology, human osteology, geoarchaeology, historical archaeology, cultural anthropology, and cultural resources management. All of these fields are integrated by the unifying theme of cultural ecology. A minor in geoarchaeology is being added in 1997.

This program is actively involved in the preparation of new classroom teachers as it provides School of Education students with hands-on learning in the science of archaeology and prepares them to incorporate this training into their classrooms. Classes offered to teachers include *Archaeology for Teachers*, *Archaeology Field School for Teachers*, and *Laboratory Methods for Teachers*. The new laboratory facilities will enable this program to significantly improve these courses. The staff members of the Archaeology Education program are certified teachers, and therefore able to help education majors incorporate appropriate material into classes designed for students from kindergarten to the 12th grade level.

### Transforming 3D Space with Virtual Reality Modeling Language

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Mathematics

Virtual Reality Modeling Language (VRML), a three dimensional extension to the World Wide Web, is being used to incorporate 3D visualization into two courses offered by Indiana University of Pennsylvania's Mathematics Department. Students in the *Introduction to Linear Algebra* course are using VRML to

explore the relationships between matrices and linear transformation and to apply linear algebra concepts to applied problems. In a new liberal studies course entitled *Building 3D Models for the Web*, students from various majors are learning to use 3D coordinate systems and linear transformations to build 3D models related to their disciplines. The project is affecting a large number of preservice secondary school mathematics teachers as approximately 75% of the mathematics majors plan to teach.

### **Developing the European Corn Borer into a Model Organism for Teaching**

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Life Sciences

Introductory biology enrolls large numbers of students many of whom are elementary education majors. This project fully develops the use of the insect *Ostrinia nubilalis* as a model animal system in investigative laboratories in beginning biology. Current work with *Ostrinia* in introductory biology laboratory courses has resulted in successful learning experiences for students. The insect has great potential for development as a model organism with its short life cycle (approximately 5 weeks) and ease of culture.

### **Dominguez Hills Information Technology Laboratory**

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DUE-9751640  
\$35,636  
Geoscience

The Dominguez Hills Information Technology (DoIT) Laboratory focuses on the integration of remote sensing and GIS technologies. The missions of the laboratory are: 1) making available technical training in the earth and environmental sciences to student groups that traditionally have not had access to such programs and to future elementary and secondary school teachers; 2) providing access to remote-sensing facilities and instruction for students of the four other state university campuses in the southern California area, including extension programs; and 3) providing access to communications, data and programs only accessible to this audience via the Internet.

### **Interactive Oceanography: Linking Shipboard and Classroom Learning Activities**

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\$41,914  
Chemistry

This institution owns and operates an 85-foot research vessel, the R/V Vantuna. In addition to meeting the instructional demands of students enrolled in marine science courses, the R/V Vantuna is involved in educating and giving field-based experiences to students in teacher preparation programs. This project augments the equipment on the boat with sophisticated electronic sampling and photodocumentation gear that allows students to learn state-of-the-art techniques and collect numerical and visual data to support integrative studies. The uniqueness of this project comes from the extended use of oceanographic data in linking field and classroom activities. Not only are many students, and especially future teachers, being given

access to sophisticated equipment to learn modern oceanographic techniques, but the high quality data they collect is being made universally available for analysis through an extensive database. This approach is extending the value of the oceanographic experience beyond those groups traditionally served, and benefiting off-campus groups who can sample the database by searching the Internet.

### **A Central Molecular Biology Laboratory for Curriculum Enhancement of Undergraduates**

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DUE-9751735  
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Life Sciences

The objective of this project is to set up a central, state-of-the-art molecular biology laboratory to enhance the learning experience of students from various departments including Biology, Chemistry, and Clinical Laboratory Science. The laboratory is equipped to teach methods of nucleic acid studies and recombinant DNA techniques. The project not only enhances the learning of the undergraduates at the university, but also is of benefit to the community because course enrollment includes secondary school teacher certificate students who will bring their knowledge to the local schools. To increase the impact of the project, molecular biology workshops are conducted to demonstrate the ease of incorporation of the techniques into an existing science curriculum.

### **The Establishment of a Remotely Controlled Astronomical Observatory at Angelo State University**

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\$22,563  
Astronomy

Angelo State University is establishing a remotely controlled astronomical observatory to enhance its astronomy education program. The remotely controlled and robotic observatory is a multipurpose facility performing university teaching, teacher education, research, and community outreach. It is also providing an avenue for the university to begin a distance education program with area high schools.

## **UNDERGRADUATE FACULTY ENHANCEMENT**

### **Linguistics and the Language Sciences: New Computer Based Methods and Materials for Undergraduate Education**

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\$61,517  
Interdisciplinary

A six-day workshop conducted at the national Linguistic Society of America biennial meeting at Cornell University is designed to: 1) provoke rethinking of current approaches to undergraduate education in linguistics; 2) redirect attention to the fundamental properties of linguistics as a science, and as a medium for teaching essential concepts of scientific inquiry; and 3) introduce, disseminate and exchange current



developments involving computer assisted teaching materials which foster this essential aspect of the field of linguistics. Three current projects are featured in the curricular part of this workshop, including: 1) *Grammar as Science*, developed at SUNY-Stony Brook; 2) the teacher training program at Wheelock College (one of the largest producers of K-12 teachers in Massachusetts), a program focused on discovering how implicit knowledge of language can be used to develop an explicit grasp of the constructivist nature of scientific inquiry which uses linguistics to teach scientific inquiry to 7th to 11th graders and teaches this method to undergraduates preparing for teaching careers; and 3) The Cornell University Network of Language Labs in the Cognitive Studies Program, a program coordinating the study of linguistics with related subfields of Cognitive Studies (psychology, computer science, and philosophy) by developing a unified, laboratory-based curriculum.

### **Missouri Undergraduate Mathematics Faculty Enhancement Program**

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DUE-9653373  
\$89,970  
Mathematics

This project is providing opportunities for Missouri undergraduate mathematics faculty to review and consider the implications of emerging secondary and undergraduate curriculum reform/materials. Four conferences serve as the forum in which faculty can learn about and discuss reform. In two of these conferences, teams of high school mathematics teachers and college faculty are participating to further systemic efforts at mathematics reform across multiple levels. Significant follow-up activities are taking place to encourage and support reform efforts across the state. The specific objectives of the project are facilitation of: 1) college/university mathematics faculty in their review of NSF-sponsored undergraduate curriculum materials and the development of related instructional materials for courses they teach; 2) discussion and study of undergraduate curriculum-related issues including new mathematics content, new instructional approaches, and emerging technologies; 3) college/university mathematics and high school mathematics faculty and teachers in their review of NSF-sponsored secondary curriculum materials and the development of related instructional materials for courses they teach; and 4) discussion and study of secondary curriculum and examination and revision of Missouri mathematics teacher preparation programs. Monographs generated from each conference are being provided for each participant and each mathematics department chair in the state of Missouri.

### **Broadening Horizons in Mathematics Instruction through Technology and Applications**

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DUE-9653381  
\$75,000  
Mathematics

Twelve workshops for college faculty focusing on technology and applications in undergraduate mathematics will be conducted over three summers from 1997 through 1999. The four workshops offered each summer include a one-day overview workshop, a three-day workshop on calculators in undergraduate mathematics emphasizing applications in entry level mathematics, a three-day workshop on computer algebra in undergraduate mathematics with participation by professional engineers showing working applications of mathematics, and an Internet workshop which enables participants to learn about all forms of electronic communication and facilitates establishment of their own presence on the Internet. Of particular note is the involvement of secondary school teachers in the workshops, and recruitment strategies and workshop

activities that target faculty involved in pre-service teacher preparation courses and programs.

Additionally the project will sponsor two three-day conferences during the summers of 1998 and 1999 on the applications of computer algebra systems to education and research in the mathematical sciences. Oklahoma State University supports the research portion of the conferences. These conferences feature a strong interaction among mathematics educators and researchers.

### **Cooperative Learning in Undergraduate Mathematics Education: Developing a Comprehensive Program for College Faculty**

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DUE-9653383  
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 Mathematics

Cooperative Learning in Undergraduate Mathematics Education (CLUME) is a national program to provide faculty with the knowledge, skills, and experience to implement cooperative learning in undergraduate mathematics courses. This project focuses on cooperative learning as a strategy applicable to course at all collegiate levels from remedial to majors.

The cornerstone activities are a 12-day summer workshop providing intensive training in the theory and practice of cooperative learning, an academic year apprenticeship period with mentoring and electronic networking, and a three-day follow-up workshop during the succeeding summer. In addition to the workshop cycle, the project includes shorter introductory experiences; mini-courses at national American Mathematical Society/Mathematical Association of America (MAA) meetings, and short courses and panels at MAA sectional meetings and national conferences. CLUME will result in a cadre of experienced practitioners of cooperative learning capable of providing training for others. Materials developed, as part of the workshop experience will be available to the mathematics community at large. Of particular interest are the CLUME activities targeting faculty and departments who have large responsibilities for pre-service teacher preparation. Special attention is paid during the recruitment phase to securing the participation of those faculties, and specific components of the workshop activities focus on cooperative learning in the K-12 setting.

### **Reciprocal Science Success: Visions and Strategies**

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DUE-9653423  
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 Interdisciplinary

The purpose of this two-year project is to facilitate reciprocal science success for college/university science faculty who have taught less than five years and science education faculty who have taught five or more years, in order to improve the preparation of future teachers, especially those planning to teach in urban environments. In all, 24 participant pairs will attend four-day workshops, plan and implement collaboration for at least one full semester at their home institution, and, assisted by project staff, conduct an outreach activity on their own campus. Participants have on-site urban science experiences at the elementary, secondary, and collegiate level and instruction in strategies to engage minorities in active learning, the use of American Association for the Advancement of Science standards and assessment techniques. Teams construct: 1) rubrics and performance assessments to evaluate their own home-based collaboration; and 2)

outreach projects with particular attention to ways to improve science education for future teachers by encouraging science education faculty to become more connected to local science research activities.

### **Undergraduate Faculty Enhancement in Earth Sciences**

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\$228,384  
Geosciences

The American Geological Institute (AGI) is offering a series of regional workshops to help faculty develop improved teaching skills in introductory earth science, earth science-related interdisciplinary courses, and/or courses in science teacher preparation. The goal is to encourage faculty to be intellectually vigorous in science courses, to gain experience in effective teaching methods and educational technologies, and to explore the beneficial outcomes of reform-based strategies for student learning. Participating faculty are provided with methods and materials that integrate the Geosciences with other academic disciplines. Instructional methods demonstrated include problem-solving exercises; an issue-based model in which the teacher plays the role of facilitator; integrated learning environments that incorporate field work, experiential learning, and technological access to data into more traditional classroom/laboratory activities; development of communities of science learners by establishing student teams and by building a greater regional or national community through telecommunication access; and use of local and regional issues to demonstrate relevance and to foster in students a sense of stewardship in their communities. Participants continue workshop activities as they develop strategic plans for collaborative teams at their home institutions. Follow-up reports, including evaluative assessment of plan outcomes, such as implementation strategies, student learning achievement, and dissemination beyond the workshop, provide information useful to others interested in improving their educational programs in introductory earth science, earth science-related courses, and courses in (earth) science teacher preparation. This information is being compiled into a database accessible to the community through AGI's Clearinghouse for Earth Science Education, including hard copy and electronic format.

### **Interdisciplinary Summer Institute on Puget Sound**

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Earth Sciences

This project upgrades the technical content knowledge of faculty from two- and four- year colleges in Washington State relative to the cultural history, current environmental issues, and the ecology of Puget Sound. The Sound provides an ideal environment for studying a variety of interdisciplinary topics and issues. The Summer Institute provides the opportunity to learn about new interdisciplinary curricular designs, and to learn and try out new field techniques and new pedagogical approaches appropriate to interdisciplinary instruction. Three six- or seven-day interdisciplinary summer institutes focusing on Puget Sound are offered over the two-year period of the grant involving a total of 75 faculty participants from two- and four-year colleges. Follow-up activities include a small seed grant program, follow-up sessions, an end-of-project symposium on Puget Sound, and communication among the participants via Internet and a newsletter. Products of the project include a slide set, an annotated bibliography, and a resource guide.

## SPECIAL PROJECTS

### **A Workshop to Enhance Native American Faculty/Teacher Aides in the Use of Calculators in Teaching (ENACT)**

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DUE-9616685  
 \$182,254  
 Mathematics

The Mathematical Association of America, through its Strengthening Underrepresented Minority Mathematics Achievement program, in partnership with Arizona State University and in collaboration with the High Plains Rural Systemic Initiative, is conducting a 30 month Workshop to Enhance Native American Faculty and teacher aides in the use of Calculators in Teaching (ENACT). The teacher enhancement project involves 30 tribal college mathematics faculty members and 50 American Indian teacher aids. The Project Director with five other senior staff members are teaching the use of the Texas Instruments TI-83 graphing calculator in teaching. Modern pedagogy is demonstrated in two workshops.

### **Improving Teacher Preparation in Science, Mathematics, Engineering and Technology**

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 Interdisciplinary

The Division of Postsecondary Policy and Practice of the National Research Council's Center for Science, Mathematics, and Engineering Education is undertaking a three-year program of activities in teacher preparation organized into three initiatives: 1) deepening understanding; 2) improving practice; and 3) enhancing infrastructure in mathematics and science teacher preparation. Communities involved in and addressed by this work include: scientists, mathematicians, and engineers; science, mathematics, engineering and technology faculty, teacher educators, and educational researchers; and leaders and policy makers for states, institutions of higher education, and other organizations.

A set of eight interrelated projects are being conducted to advance the three major initiatives. Projects include: developing a brochure about the fundamentals of teacher preparation; creating a report which offers a critical synthesis of recommendations, research base, and indicator system for a workshop and proceedings about helping mathematics teachers learn content more effectively; a report synthesizing research in mathematics and science teachers preparation in a way that would help improve practice; and a white paper from a panel of university presidents and state education personnel commenting upon reform of teacher preparation policy at the state and national levels. The project also includes a strategic effort to inform, interest, and engage the membership of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine in teacher preparation issues. The projects capitalize on the two most effective mechanisms of the NRC: convening expert groups for the purpose of generating consensus, and producing objective, highly visible and thoroughly reviewed reports.

## Invitational Forum on Teacher Preparation for Deans of Science and Education

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Interdisciplinary

The American Association for the Advancement of Science conducted an invitational “Forum on Teacher Preparation for Deans of Science and of Education” on February 21-23, 1996. Fifty institutional teams (each composed of a dean of education and a dean of science from major research universities and comprehensive universities with large teacher preparation programs) attended the meeting to consider ways in which collaborations among their academic divisions and school personnel can better prepare future teachers of K-12 science and mathematics. The purposes of the Forum were: 1) to present a summary of the research results on the teaching and learning of science and mathematics; 2) to consider exemplary teacher preparation programs that model collaboration among university science and education departments and local schools or school districts; 3) to engage the deans in discussion of the issues associated with the design and implementation of such exemplary programs; and 4) to inform the deans of opportunities, such as the National Science Foundation’s Collaboratives for Excellence in Teacher Preparation program, to engage in large-scale systemic projects designed to change significantly teacher preparation programs, on a state or regional basis, which will serve as comprehensive national models. Based upon discussions and models presented at the Forum, a set of Proceedings, including recommendations for collaborations and the components of model teacher preparation programs, is being produced and made available to participants and others interested in improving teacher preparation.

## PROJECTS WITHIN OTHER NSF DIVISIONS CO-FUNDED BY DUE

### Learning To Teach Secondary Mathematics in Two Reform-Based Teacher Education Programs

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REC-9605030  
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Mathematics

This study is providing systemic information about the nature of two reform-based teacher education programs and their impact on prospective teachers. The researchers are following a number of preservice secondary mathematics teachers as they participate in two university-based teacher education programs and through their first two years of teaching, in order to study closely how teacher education impacts their learning and development as mathematics teachers. Data is being gathered predominantly through semi-structured interviews, observations, and the collection and analysis of artifacts. The data gathering process is organized around participants’ knowledge and beliefs, participants’ teaching, university teacher education experiences, and public school experiences. Products include conference presentations, peer-reviewed journal articles, and postings to a Web site.

**The Math Forum**

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 Mathematics

The Math Forum is implementing a full-scale version of a virtual center for mathematics education integrating three key activities: 1) community-building across the many groups involved in math education; 2) user construction, assessment, and organization of materials and projects; and 3) online educational mentoring and facilitation. Partners represent a range of interests including: curriculum and software publishers; summer mathematics program developers; assessors of systemic initiatives in school reform, pre-service teacher education, interactive Internet services, teacher and student mentoring projects; and a variety of professional organizations covering all grade levels and encompassing many different socioeconomic and cultural communities.

**REU-Site Undergraduate Teacher Training in Materials Synthesis and Processing**

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 \$66,000  
 Interdisciplinary

The Departments of Chemistry and Biochemistry, Chemical, Biology, and Materials Engineering, Physics and Astronomy, and the Center for Solid State Science at Arizona State University (ASU) are establishing a Research Experience for Undergraduates (REU) site at ASU. The goal of the REU program is to introduce basic materials synthesis and processing to prospective middle and high school teachers. The REU site is designed to attract undergraduate students that are engaged in education and teacher training at ASU and at institutions where the opportunities to participate in research programs are limited. Student participants from universities, community colleges, and tribal colleges in Arizona are involved in research, which includes bioactive surface coating for medical implants, semiconductor corrosion from process residuals, and binary and ternary semiconductor alloys. The student participants are developing teaching modules for the pre-college classroom under the joint guidance of the science and education faculties at ASU. This project targets an important sector of the undergraduate student population: future middle and high school teachers, and has the potential for a broad-reaching impact on the science education of future generations.

**Unidata: 1993 to 1998**

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ATM-9742854  
 \$50,000  
 Interdisciplinary

The mission of the Unidata Program is to empower universities, through innovative applications of current computing and networking technology, to make the best use of atmospheric and related data for enhancing education and research. To this end, the Unidata Program Center and the university community have

jointly built a nationwide computing and communications system that provides universities with easy, cost-effective access to atmospheric data and has transformed how the atmospheric sciences are taught on campuses across the nation.

### **Integrating Research and Education: Contemporary Research in the Education of Teachers**

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\$20,309  
Interdisciplinary

Kansas State University (KSU), one of ten recipients of the National Science Foundation's Recognition Awards for the Integration of Research and Education, has been integrating research experiences with faculty and discovery-based learning into the undergraduate education of future K-12 teachers and the post-graduate development of inservice K-12 teachers. Innovative courses for current and future teachers have been developed through collaborations between faculty in science departments and the College of Education. Science and education faculty also collaborated to provide a capstone research experience for elementary education students. Through these collaborations, faculty and students in the College of Education are enriched by involvement in cutting edge research and members of the science faculty learn the results of the latest research on learning and teaching. The university's efforts to integrate research and education have been designed with specific outcomes in mind: increasing the science content knowledge of K-12 teachers; increasing the confidence level of current and future K-12 teachers in their ability to learn and teach science; improving the performance of student teachers in their first classroom teaching experience; and publishing research papers documenting the initiatives and their results. Activities include: establishing the KSU Program for Integrating Education and Research dedicated to expanding faculty participation in integration activities; documenting the process used to create new courses; creating and presenting workshops at professional society meetings and other universities to highlight this approach; creating multimedia versions of the workshop for distribution on CD-ROM and through the World Wide Web; and developing new research-based introductory science and engineering courses and courses for teachers in other science and engineering disciplines.

## SUPPLEMENTS AND CONTINUATIONS

### Reforming the Preparation and Professional Development of Elementary and Middle School Mathematics Teachers

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ESIE-9354104  
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Mathematics

This project is producing mathematics content course modules for use in teacher preparation and teacher enhancement for elementary and middle school teachers of mathematics. Modules address: number sense with whole and rational numbers, proportional reasoning, measuring, spatial sense and geometry, exploring data, chance, patterns and functions, and mathematical change. The materials developed provide course instructors the opportunity to model the types of instructional delivery expected of teachers in grades K-8, both in their classroom and through the inclusion of videos of student interviews and classroom episodes from grade K-8 situations. Modules will be available nationwide upon completion. The modules will be in software and CD-ROM format giving each instructor the capability to modify the material to meet their individual needs.

### The Development of Proof Understanding, Production, and Appreciation (PUPA) with Undergraduate Mathematics Majors

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REC-9355861  
\$185,890  
Interdisciplinary

This project has the potential to break new empirical and theoretical ground and further the understanding of what it means to understand mathematical proof and how that understanding develops. The knowledge gained from this study has the potential to impact significantly the way pre-service teachers develop their own abilities to teach proof and ultimately how mathematics and mathematical proofs will be taught and learned in school and college settings.

### Institute in the History of Mathematics and Its Use in Teaching

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DUE-9455088  
\$122,937  
Mathematics

The Mathematical Association of America (MAA), in cooperation with The American University, has created an Institute in the History of Mathematics and its Use in Teaching (IHMT). The goal of the Institute is to encourage the incorporation of history into the undergraduate mathematics curriculum at all levels. Special attention is focused on including the history of mathematics in teacher preparation programs, as called for in the NCTM Standards. Through intensive three-week programs in two successive summers, 80 mathematics faculty members are being prepared to teach special courses in the history of mathematics, as well as to use history to improve their teaching of courses in the standard mathematics curriculum. Thirteen historians of mathematics lead explorations of the history of mathematics from antiquity through the twentieth-century, stressing applications and links between different areas of mathematics. Specific techniques for incorporating



history into undergraduate mathematics courses are a central theme. The information and techniques of IHMT are being disseminated nationally through presentations at national and regional mathematics meetings, publications, and electronic communications.

### **Activity Based Physics: Curricula, Computer Tools, and Apparatus for Introductory Physics Courses**

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\$1,780,000  
Physics

Three related activity-based introductory physics curricula, Workshop Physics, Tools for Scientific Thinking, and RealTime Physics, have been developed based on the findings of physics education research. All are activity-based and involve the design of computer hardware and software for investigation, data analysis, and dynamic modeling. This three-year collaboration between Dickinson College, University of Maryland, University of Oregon, Tufts University, and Millersville State University extends, enhances, evaluates and disseminates activity-based curricular materials, apparatus, and computer tools for teaching introductory physics. The ultimate goals of this program are to continue full-scale efforts to improve the scientific literacy of introductory physics students through the mastery of physics concepts, investigative skills, and mathematical modeling techniques and to motivate students to learn more science. Particular attention is being given to developing physics activities suitable for courses designed for future technicians at two year colleges and preservice teachers.

### **A New Model for Introductory Biology at Two-Year and Community Colleges**

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\$335,000  
Life Sciences

In recognition of the importance of introductory biology courses at two-year and community colleges to the development of scientific literacy among college-educated individuals, BSCS is conceptualizing, writing, testing, and evaluating a set of innovative curriculum materials for biology students at the college level. Collaborating in the 36-month project are fifteen partners: biology faculty at eight community colleges (including several that offer programs in biotechnology and environmental technology); the American Association of Community and Junior Colleges (AACJC); the two-year college section of the National Association of Biology Teachers (NABT); the Society for College Science Teaching (SCST), the American Mathematical Association of Two-Year Colleges (AMATYC), the American Institute of Biological Sciences (AIBS), Ward's Natural Science Establishment, Inc., and Kendall-Hunt Publishing Company (college division). The completed program will offer an integrated and coherent approach to helping students achieve three major goals of biological literacy: 1) to understand the basic unifying principles of biology; 2) to develop the fundamental skills of critical thinking and scientific reasoning; and 3) to recognize the applications of science, especially relationships among science, technology, and society. The project will impact future teachers of science at the elementary and secondary levels. Students are encouraged to reflect on the overall design of the program, the strategies that help them learn, and the efficacy of the various teaching techniques and assessment practices employed in the course. Project products include student materials (readings, activities, and laboratory exercises) supporting both semester- and year-long introductory biology courses and an instructor's guide with extensive background reading and specific implementation support. The materials use a hands-on, open-ended inquiry, collaborative approach to learning and emphasize the relationships among

science, technology, and society. The project includes faculty development workshops (based on a model designed and tested by the partner faculty) to be supported after the end of the project by revenues realized from sales of project materials.

### ChemLinks Coalition: Making Chemical Connections

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\$655,000

The ChemLinks Coalition is undertaking a five-year project to change the way students learn chemistry, increase scientific literacy for all students taking chemistry, and promote the process of educational reform. Collaboration among faculty from different disciplines and a number of institutions supports and reinforces those who want to make changes. The coalition consists of leading liberal arts colleges (Beloit, Carleton, Colorado, Grinnell, Hope, Kalamazoo, Knox, Lawrence, Macalester, Rhodes, Spelman, St. Olaf, Wooster) and research universities (Chicago, Washington - St. Louis) which already have experience working together on chemistry curricular reform. In collaboration with the *ModularChem* Consortium, faculties are developing, testing, and disseminating modular course materials, focused on the first two years of the chemistry curriculum, that use active and collaborative approaches to learning. These materials start from interdisciplinary themes important to students and to society (e.g., the molecular basis of life, the environment, and technology), and are designed to develop an appreciation of how science is actually done. This approach is designed to reach a broader student audience more effectively than do traditional courses. The audience includes students who are members of groups traditionally under-represented in science, non-science majors and those taking chemistry as a supporting course, as well as chemistry majors. By providing a model for students preparing for careers in teaching, this approach has an impact on Teacher Preparation programs. In addition, an alliance with the Advanced Technology Environmental Education Center's coalition of two-year institutions assures an impact on Advanced Technological Education Programs. By using the extensive Project Kaleidoscope network to promote reform, the ChemLinks Coalition involves a large and diverse group of institutions in making systemic and sustainable changes in undergraduate chemistry education.

### A Workshop Chemistry Curriculum

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Chemistry

The City College Consortium, which includes ten senior and community colleges at the City University of New York, and the Universities of Pittsburgh, Pennsylvania, and Rochester, is developing and applying widely a new model of teaching chemistry. This model, called *Workshop Chemistry*, introduces participation and mentorship by recent graduates of the course. Each week two hour-long student-led workshops complement the lecture and laboratory components, by providing a collaborative learning experience that increases student involvement and supports a new role for students as mentors. In *Workshop Chemistry*, students learn the problem solving, communication, and teamwork skills crucial for success in the workplace while learning chemistry more effectively. Working together with the faculty, students become an active part of the community of the department. A prototype workshop model has been developed at City College in a general chemistry course for science and engineering majors, and is being expanded and refined for a broad range of courses including preparatory chemistry, chemistry for allied health sciences, organic chemistry, instrumental, and analytical chemistry. The experience of students as workshop leaders provides a natural introduction to teaching that is being formalized through a Teacher Preparation

## *Supplements and Continuations*

component of the project. The workshop method is also being exploited and applied in curricula for technician training, an initiative relevant to Advanced Technological Education. The project evaluates the *Workshop Chemistry* approach and disseminates it beyond the bounds of the consortium. Student Manuals that include the problem solving, model building, and simulation activities of the workshops are being produced for each course.

### **Sweeping Change in Manageable Units: A Modular Approach for Chemistry Curriculum Reform**

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DUE-9455924  
\$705,000  
Chemistry

The purpose of this program is to develop new curricula, materials, and teaching methods, which will enhance the appreciation and learning of science, especially chemistry, for every undergraduate student. To this end, a modular approach to teaching chemistry in the first two years of the undergraduate curriculum is being developed and evaluated. Modules of one to four weeks present fundamental chemistry to students in the context of a real-world problem or application and emphasize the links between chemistry and other disciplines. In collaboration with the ChemLinks Coalition, modules are being developed, tested and refined at the two- and four-year colleges and research universities comprising the two consortia. Curriculum materials, including text, laboratory manuals, and multimedia components suitable for students from diverse cultural and ethnic backgrounds and usable at a wide variety of undergraduate institutions are being produced and distributed by an established publisher. Teaching methods, which utilize current understanding of learning processes and emphasize active learning and the full spectrum of modern technologies, are being supported, tested and promulgated. A framework for continuous improvement of curricula resulting from the work will be institutionalized within the consortium. Faculty workshops and sessions at national and regional meetings will be conducted to guarantee dissemination. Since the consortium institutions participate significantly in pre-service teacher preparation and the education of advanced science or engineering technicians, special modular materials appropriate to the task of educating future teachers and technicians are being developed.

### **Establishing New Traditions: Revitalizing the Curriculum**

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DUE-9455928  
\$899,941

This project establishes new traditions in the chemistry curriculum that optimize opportunities for all students to learn chemical facts and concepts, develop and pursue interests in chemistry and chemistry-related disciplines, and appreciate how an understanding of chemistry is important to life and living. Project materials and methods are intended to change fundamentally the ways students, faculty, and administrators view their roles, creating a student-centered, active-learning emphasis. Five main areas are addressed: student-focused active learning; inquiry-based/open-ended laboratories; interdisciplinary course clusters to create learning communities; a topic-oriented curriculum; and information technology/computer tools. Each development in each area is carefully evaluated. Evaluation provides important information about the process of transfer of innovations among institutions of different types. To insure that reforms are useful for all students, the consortium includes industry, public and private four-year institutions, minority institutions, and two-year colleges. The project gives special emphasis to students who choose teaching as a career by mainstreaming these students in courses, which benefit them in both

content and pedagogy. Students, including those in Science Education, are fully integrated in the development and implementation of the project, working on both research topics and evaluation. The project also gives special emphasis to community college students in Advanced Technological Education programs to ensure that they benefit from the newly developed curricula.

### **Mathematics Across the Curriculum**

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DUE 9552462  
\$700,000  
Mathematics

This project integrates the study of mathematics with courses in physics, chemistry, geology, biology, social science, economics, art, music, philosophy, computer science, architecture, medicine, engineering, and literature. Faculties representing these disciplines at a large number of institutions are cooperating with faculty from Dartmouth to develop course materials for use in a variety of ways: in conjunction with other texts; as independent reference materials; and as bases for new interdisciplinary courses. Support materials for faculty, including documented software, on-line materials, and videotapes, are being developed. The project is expected to result in fundamental changes at the institutions in the project. In addition, through the materials being developed and a series of intensive summer workshops, the project will benefit faculty and institutions other than those directly involved in the project. The project will impact students in both upper and lower division courses, students taking courses in their majors as well as students taking courses as part of their general education, and students preparing to be teachers. Some materials, as appropriate, will be adapted for use at the secondary level.

### **Mathematics and its Applications in Engineering and Science: Building the Links**

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DUE-9552465  
\$700,000

This project overcomes the traditional separation of courses into many different departments that often makes it difficult for students to grasp the intimate connections that exist between mathematics and its applications in engineering and science. Its three primary strategies are: 1) to stimulate greater cooperation among faculty in mathematics and other disciplines in the creation of instructional materials; 2) to encourage interactive teaching and learning strategies; and 3) to continue pioneering efforts in the application of contemporary technology for educational purposes. An important component of the project is the development of hypertext documents that link important mathematical topics with contemporary applications in fields of engineering and science. This involves collaboration among faculty at Rensselaer and a number of other institutions, including the University of Delaware, Siena College, Virginia Polytechnic Institute, Central State University, Hudson Valley Community College, and the University of Maryland. Through visiting faculty opportunities and workshops, additional institutions will become involved as the project develops. After careful testing and evaluation, the library of hypertext documents will be available on World Wide Web, on CDs, and in printed form. The project is expected to have broad impact, benefiting students at a variety of types of institutions. Two particularly important audiences for the project are students preparing to be K-12 teachers and students seeking careers in advanced technological areas.

## New Jersey Center for Advanced Technological Education

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DUE-9553749  
\$997,544  
Engineering

The New Jersey Center for Advanced Technological Education is restructuring engineering technology education beginning in grade eleven, continuing through the associate degree, and articulating with baccalaureate programs. Project work covers interrelated curriculum and instructional materials development, faculty and teacher enhancement, and student outreach. Overall project management takes place at Middlesex Community College which serves as the lead institution in a consortium that includes Essex Community College (ECC), Mercer Community College (MCC), County College of Morris (CCM), Rariton Valley Community College (RVCC), the New Jersey Institute of Technology (NJIT), and Trenton State College (TSC). Each component of the Center's mission is being coordinated by a member institution: MCC is coordinating the curriculum development component; CMM is coordinating faculty development; ECC coordinates Student Outreach; TSC coordinates articulation of high school, associate degree and baccalaureate degree programs and courses; NJIT concentrates on strengthening partnerships with business and industry; MCC operates the NJCAT communications clearing house; and RVCC coordinates efforts relating to social, environmental and ethical issues. Mecomtronics (MEchanical/ COMputer/ teleCOMmunications/ elecTRONICS), the new program to be created under this plan, will respond to the widespread demand for a multifunctional engineering technician. An articulation agreement between the mecomtronics program and Trenton State's baccalaureate program in technology education is helping prepare secondary school teachers.

## Powerful Ideas in Physical Science

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DUE-9554625  
\$561,621  
Physics

The American Association of Physics Teachers (AAPT) is encouraging and enabling colleges and universities to provide physical science courses which are appropriate to the entry-level background of students, which honor the learning process, and which are attuned to the exit-level needs of future elementary school science teachers. The AAPT is providing a carefully orchestrated program of awareness and training sessions and follow-up support activities for physics and physical science faculty using *Powerful Ideas in Physical Science: A Model Course* which is based on well-documented research findings about science learning. It features a hands-on constructivist approach, represents a "less is more" philosophy, includes content selected specifically for the needs of future primary teachers, and uses both traditional and alternative assessments. Physical science faculty from colleges and universities across the nation are being trained to use the model to reform their physical science courses for prospective elementary teachers.

**Faculty Advancement in Mathematics (FAIM)**

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DUE-9554736  
\$128,314  
Mathematics

This project includes three workshops (scheduled for the summers of 1996, 1997, and 1998). The workshops are of two-weeks' duration, with 25 participants per workshop. The focus of each workshop is contemporary applications of mathematics in the broadly defined areas of mathematical modeling, discrete mathematics, and geometry. The workshops will feature mathematical topics of increasing emphasis and importance.

**Long Term Field Studies for Undergraduate Education: A Snapshot in Time**

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DUE-9554807  
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Life Sciences

To address the dichotomy between teaching and research, the establishment of a long-term field experiment to improve undergraduate teaching in ecology and environmental science is being developed. The long-term experiment is designed to address topics of ecological succession contrasting the effects of mowing and fertilizer treatments in upland and lowland abandoned farm fields. Elementary, middle and high school pre-service and in-service teachers, and students taking courses in Southern Illinois University's Environmental Studies Program (as a minor for a wide range of major degree programs) participate in the establishment, management, data collection and analysis of the field experiment. The students participating in the experience assess the advantages, disadvantages and limitations of field experiments, and are prepared to integrate research data and results in an understanding of ecology. Students gain a better appreciation of the role of scientific research in understanding the natural world.

**The Restructuring at SUNY Cortland of Science, Mathematics, and Pedagogy Experiences for K-6 Pre-Teachers**

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DUE-9555152  
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Interdisciplinary

Building on a prior NSF Development Grant, faculty from the sciences, mathematics and education departments at SUNY Cortland, which has the largest elementary teacher preparation program in the State of New York, along with science/math faculty from five regional Community colleges are developing the curriculum and instructional materials to implement a 27 credit hour block of experiences based on course outlines developed for a restructured math/science/pedagogy/composition program for K-6 pre-teachers. A research/assessment team from Cornell University will evaluate all aspects of the project. Level One content courses specifically designed for K-6 pre-teachers will be taught utilizing a conceptual change approach.

## *Supplements and Continuations*

Pedagogy courses in both science and math will be taught in conjunction with Level One content courses and will involve pre-teachers in experiences with elementary school-aged students. The Level Two block is an integrated and interdisciplinary math/science experience in which students will be introduced to problem solving strategies and will utilize the strategies to investigate six significant real world science problems. The mathematical concepts will be developed through the context of science content. During the Level Two block, pre-teachers will work with elementary-aged children in a math/science lab setting. In a culminating math/science experience, the pre-teachers will participate in a Science, Technology and Society (STS) block in which they will be engaged in conducting real world STS research under the guidance of a faculty facilitator and a business/industry mentor. Each curricular block will be pilot tested three times before the curriculum is integrated into the academic program of the host institution and that of the five satellite campuses.

### **Long Island Consortium for Mathematical Sciences throughout the Curriculum**

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A consortium of faculty at ten colleges and universities on Long Island, in conjunction with the State University of New York (SUNY) system, is designing a comprehensive, multi-faceted project to develop an environment for interconnected learning in mathematics courses and in mathematically based disciplines. Headquartered at the State University of New York at Stony Brook, other institutions of the consortium include: C. W. Post College, Dowling College, Nassau Community College, New York Institute of Technology, St. Joseph's College, Suffolk Community College, SUNY Agricultural and Technology College at Farmingdale, SUNY College at Old Westbury, and CUNY York College. The model for interconnected learning developed on Long Island is being extended to SUNY-wide implementation (64 institutions), and is being actively disseminated to other institutions inside and outside New York State. The enhanced learning environment has three components: 1) systemic change in instructional practices; 2) creation of new courses and curricular materials; and 3) development of human resources. The connections in this project involve: collaboration and cooperation in instruction among faculty across quantitative disciplines; regional networking of energized faculty at different types of institutions; and the enhanced effect of combining change in modes of instruction with curricular reform, educational technology, and coordination of instruction among departments.

Major project activities include: 1) changing modes of faculty instruction and student learning; 2) day-to-day and general coordination of instruction across the curriculum; 3) extensive use of educational technology across the curriculum; 4) completing reform throughout the calculus sequence and undertaking reform before calculus; 5) reworking all aspects of the curriculum for future mathematics teachers to reflect the needs of the NCTM Standards; 6) developing new multidisciplinary courses; 7) addressing student needs in Advanced Technological Education programs such as engineering and science technology through the development of appropriate mathematics courses and other mathematically oriented materials; 8) assisting groups that are underrepresented in quantitative disciplines; and 9) developing unified courses in statistics and other mathematical science topics now taught in multiple departments. This project involves an extensive organizational structure with: 1) departmental teams at each institution; 2) institutional coordinating committees; 3) consortium-wide disciplinary committees; and 4) task forces for specific projects such as development of new courses.

**Multimedia Mathematics: Across the Curriculum and Across the Nation**

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 Mathematics

The goal of this consortium project led by the University of Nebraska and Oklahoma State University is to integrate the teaching and learning of mathematics and its applications in science, engineering, and quantitative subjects. This is being accomplished through a modern curriculum that provides students with a holistic view of mathematical science coherently tying together fundamental concepts from many disciplines. A critical success factor is a communications structure bringing together educators from many disciplines to share ideas, goals, and strategies. The project puts in place services and materials that encourage experimentation with and development of curricular innovations as well as new modes of presentation. The program focuses on the needs of many students from many disciplines and backgrounds. An especially important group consists of those students preparing for careers in K-12 teaching. The implementation plan provides for students who change majors or institutions. The curriculum is easily adaptable by other colleges and universities.

The primary product of the Oklahoma-Nebraska Consortium is integrated core mathematics, science and engineering curriculum based on a collection of cross-curricular, multimedia mathematics learning module clusters. Each module is a topic or application in itself, but is also be part of a larger vertical and horizontal structure. The horizontal focus refers to fundamental concepts from other disciplines that fit naturally with fundamental mathematics concepts learned at the same time. The vertical focus incorporates a program, which has students revisit topics on more than one occasion and in more than one course, showing the power of mathematics as it unfolds. This structure provides motivation for mathematical development, an appreciation for topics students are currently studying, and an understanding of how fundamental ideas from many disciplines fit together.

**Molecular Science**

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 Chemistry

*chapman@chem.ucla.edu*The University of California Los Angeles - California State University Fullerton (UCLA-CSUF) and the Community College Alliance (24 area community colleges that have worked together for more than 15 years) are restructuring the lower division chemistry curriculum and the auxiliary learning and assessment processes. The restructured curriculum emphasizes problem solving and exploratory learning and focuses on developing key skills, traits, and abilities of the students. The new curriculum, the Molecular Science Curriculum, cuts across departmental and disciplines to embrace all activities that involve the study of atoms and molecules. In particular, environmental science, materials science, and molecular life science have important positions in the lower-division chemistry curriculum. The new curriculum reflects current practice in research and the chemical industry. Students use problem-based modular learning units that define the molecular science curriculum; data sets organized for exploratory learning; prepackaged molecular, mathematical, and schematic models illustrating important principles and phenomena; and a client/server system that manages education. The learning units are used by several of the community



### *Supplements and Continuations*

colleges in technology programs, including programs for science technicians and hazardous materials technicians at Mount San Antonio CC. New assessment vehicles including cumulative electronic portfolios of group and individual work provide new insight into student development and potential.

The project also addresses the preparation of primary and secondary science teachers by involving them as active participants in the lower division courses of the molecular science curriculum. At both UCLA and CSUF, these students gain experience with the modules, associated learning methods, and electronic delivery system. These experiences result in teachers with a practical perspective on science teaching as well as the ability to utilize current technology to direct learning activities. The electronic delivery system enables students at UCLA to work with the science education faculty at CSUF to obtain certification. The alliance includes two high schools (Aliso Niguel and Crossroads) that have the facilities for exposing students, experienced teachers, and future teachers to both the content and learning methods of the molecular science curriculum.

### **Pac-Tec: Pacific Technological Education Center**

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DUE-9602345  
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Engineering

The Pac-TEC Project is a grassroots, collaborative network of 24 faculty from eleven schools, from middle school grades through university level whose objective is to increase the number of traditionally underrepresented groups in science and engineering technician fields. In Phase I of the project, teachers are defining learning and teaching styles and preferences typical of many in traditionally underrepresented groups. Based on this information, teaching strategies are being developed and tested. Phase II of the Pac-TEC project is expanding the network of participating teachers and other professionals. The project is also broadening its research, establishing a center that coordinates and disseminates information, training preservice teachers, presenting models for authentic student assessment tools, and producing a second edition of its innovative manual for national distribution.

### **Maricopa Advanced Technology Education Center**

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Engineering

The Maricopa Advanced Technology Education Center (MATEC) is operated by the Maricopa County Community College District (90,000 students), the nation's second largest community college system. Maricopa is partnering with (a) ten semiconductor manufacturing/supporting industries, including Intel, Motorola, SGS-Thompson, and Microchip Technology; (b) two Tech Prep consortiums with 13 secondary school districts (60,000 students); (c) Arizona State University, the nation's largest public university (43,000 students); (d) three other Community College Districts in Arizona and Oregon; and (e) Albuquerque Technical-Vocational Institute.

The primary objectives of the Center are to: 1) create new curricular systems/materials which reduce the gap between what is taught and learned in schools and what is needed by technicians in semiconductor manufacturing/related supporting industries; 2) provide technical support, instructional support, and access

to resources that faculty/trainers who are preparing students for careers as technicians need to ensure continuing relevance to workplace needs; and 3) increase the number of students, especially women and minorities, who prepare for and become employed as technicians in the semiconductor manufacturing/supportive industries. Targeted programs are Semiconductor Manufacturing/Processing Technology, Circuit Design Technology, and Facilities Maintenance Technology. MATEC's three components are Curriculum/Materials Development, Staff Development/Support, and Workforce Development Support. Examples of strategies are: Computer-Based Instructional Design System, Continuous Quality Curriculum System, Multimedia "Virtual" Materials, Electronic Resource Center/Form, On-line Q/A, Faculty Internships, Scholarships, and Workshops/Seminars for a national audience. There is also work with Arizona State University to help prepare the secondary school teachers of tomorrow for the programs in grades 7-12 that ensure the students who enter these programs are prepared to succeed. The Center is closely coordinating its work with the Phoenix Urban Systemic Initiative and the Arizona State Collaborative for Excellence in Teacher Preparation.

### **South Carolina Advanced Technological Education (SC ATE) Center of Excellence**

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DUE-9602440  
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Engineering

The South Carolina Advanced Technological Education (SC ATE) Center of Excellence is creating a learning environment that models the new technologically sophisticated work environment. Objectives are focused in three broad areas including curriculum reform, program improvement, and faculty development. Curriculum reform centers on developing integrated engineering technology core curricula using a systems-based approach. Program improvement encompasses recruitment/retention reforms as well as the development of an electronic communications infrastructure for statewide curriculum design and delivery. Faculty development emphasizes the use of interdisciplinary/intercampus teams for designing and implementing curriculum reforms. The primary target audience of the SC ATE Center is technical college students enrolled in, or desiring to enroll in, engineering technology programs with a particular emphasis on attracting women and underrepresented minorities. The Center seeks to impact the educational pipeline from middle school through the baccalaureate level. A particular emphasis involves working with Clemson University and other four-year colleges to help prepare the middle and secondary school technology teachers of the future. Collaborative partnerships encompass over twenty-five educational, governmental, and business/industrial entities including the State Department of Education, Clemson University, South Carolina State University, the Virginia Community College System, the Governor's Math/Science Advisory Board, the Governor's Commission on Women, the South Carolina Department of Commerce, AMP, Inc., Bell South Telecommunications Inc., Michelin North America, Bose Corporation, Robert Bosch Corporation, and NCR Corporation. A strong evaluation component, headed by the Academy for Educational Development, will facilitate the development of program improvement processes and curriculum products which will have a significant impact on engineering technology education nation wide.

## Teacher Certification Program at MIT

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Interdisciplinary

Continuing work begun under the NSF Collaborative for Excellence in Teacher Preparation, TEAMS-BC, the MIT Teacher Education Program (TEP) is being developed into a full Teacher Certification Program during the academic years 1997-99. Education course revisions include an emphasis on educational technology and a focus on effectively understanding the lives and learning of inner city youth. The TEP staff is being expanded to include a mathematics teacher at the primary internship site, Cambridge Rindge and Latin High School, and a current MIT faculty member drawn from the Schools of Science or Engineering.

## Preparation of Preservice Mathematics and Science Teachers: Completion of TEAMS-BC Reform Program

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Interdisciplinary

The design and implementation of a new course initiated under the TEAMS-BC Collaborative is being completed. This course is designed to develop the distinction between evidence and inference as a conceptual framework in the context of mastering a few science concepts. Examples are explicitly drawn from the Standards with conclusions linked to the Standards.

The first three weeks of the course explore the distinction between evidence and inference using a few common exemplars, e.g., the heliocentric view of the solar system and the nature of floating and sinking. Examples are drawn from both the life and physical sciences. The method of teaching is based on the constructionist approach developed by the Epistemology and Learning Group at the MIT Media Lab (<http://lcs.www.media.mit.edu/groups/el/>), among others. This approach is characterized in the following way: (1) the intended outcome must be clearly understood by the students; (2) achieving the outcome must require the students to act; and (3) students must be able to tell whether their actions are taking them closer to or further from the intended outcome.

## Teacher Preparation in Mathematics and Science at the University of Massachusetts Boston

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Interdisciplinary

Courses designed or revised under the TEAMS-BC Collaborative are being further developed and integrated into the teacher preparation curriculum. New courses in mathematics, science, and technology for prospective teachers are being developed. Faculties involved in the project are conducting formative evaluation research on student learning in newly developed and revised courses. Relationships with two Professional

Development Sites, one elementary school in Boston and one in Cambridge, will be strengthened by the development of on-site courses for student teachers and greater cooperation with the school systems.

### **Teacher Education Addressing Mathematics and Science at Wheelock College**

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\$163,727  
Interdisciplinary

This project is: 1) developing and finalizing science and mathematics courses at the undergraduate and graduate levels which were revised and/or introduced during the first three years of TEAMS-BC; 2) completing the revision of the initial mathematics course sequence for Wheelock undergraduates; 3) continuing the development of two new programs at Wheelock focusing on mathematics and science education (Specialty in Teaching Mathematics and Science, Certificate in Teaching Mathematics); 4) continuing to collaborate with cooperating teachers on mentoring and science and mathematics teaching at three professional development sites - the Holmes School and the Young Achievers School in Boston and the King School in Cambridge; and 5) preparing portfolios of key courses for dissemination within the college and to other institutions.

### **CalcLab: A Hands-On Learning Environment for Enriching Students' Understanding of Calculus**

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\$149,813  
Mathematics

This project is developing, refining, and investigating a calculus learning environment, called CalcLab, which is based on a set of interactive physical devices, with computer interface. In this environment, students are guided by written materials in activities that involve exploration, experimentation, and problem solving around the central concepts of calculus thereby enriching their understanding of these concepts. This learning environment provides access to calculus to those students who have traditionally not been well served by courses in the subject, in addition to deepening all students' understanding of the subject. This project builds on themes underlying the current calculus reform movement and implements research findings of the Principal Investigators on a research project funded for the last four years by the National Science Foundation. In addition to those students in college calculus courses who will be helped by the CalcLab learning environment, pre-service and in-service high school mathematics teachers will benefit through the opportunity to think more deeply about the central concepts of calculus than they have in their past training. The principal activities over the 2 1/2 year funding period include the following: 1) CalcLab devices will be made more robust; 2) materials that will guide students in the use of these devices will be written in collaboration with college calculus teachers; 3) an instructor's manual will be written based on these collaborations; 4) in-depth studies of students' learning in this environment will be carried out and published; and 5) instructors' professional development in connection with the use of such environments will be undertaken.

**WWW and Internet Dissemination of Biology and Computer Labs for Prospective Elementary Teachers and of a Biology Test for Conceptual Understanding**

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\$52,531  
Life Sciences

The goals of this project are to: 1) disseminate biology lessons that have been developed for prospective elementary school teachers with each lesson including a hands-on laboratory activity, a computer-based knowledge construction activity, and a Teachers Guide; 2) develop and disseminate a multiple choice test for conceptual understanding of biology that will be useful for assessing learning among prospective elementary school teachers, other non-science majors, and biology majors so as to measure progress within a course and comparisons among courses; and 3) develop, refine and test several new biology lessons designed to provide tools to elementary school teachers for teaching about evolution through in-class studies of population.

The biology lessons are organized into three laboratory manuals: *Molecular Biology*; *Organismal Biology*; and *Population Biology*. Each biology laboratory is accompanied by "knowledge construction exercises" supported by the SemNet software. These exercises provide guidelines for organizing knowledge in the form of active, working mental models and include a mix of individual and collaborative work. Laboratories are available in both printed and electronic form. Potential users include undergraduate instructors of prospective elementary teachers, undergraduate education majors, and pre-service and practicing teachers. The project is developing a two-tiered, multiple-choice test to measure conceptual understanding of biology. The first part of each question assesses student knowledge about a biological phenomenon; the second part requires the student to explain the reasoning s/he used.

**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION  
PROJECTS INITIALLY FUNDED IN FY 96**

**The San Francisco Bay Area Collaborative for Excellence in Teacher Preparation**

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The San Francisco Bay Collaborative for Excellence in Teacher Preparation, led by San Jose State University and San Francisco State University and including San Jose City College, Evergreen Valley College, City College of San Francisco, and the College of San Mateo, identifies and establishes a core group of incoming freshmen – especially from underrepresented groups – who are interested in becoming teachers. Major components of the program are: 1) recruitment of future teachers from several target populations; 2) attention both to science and mathematics majors preparing for secondary school teaching and to students entering elementary school teaching; 3) extensive early field experiences; 4) tutor-mentor-advisor programs; 5) workshops for science and mathematics faculty resulting in their significant involvement in curriculum reform; 6) revision of core science and mathematics courses and creation of innovative capstone/integrated courses; and 7) a support network for new science and mathematics teachers. The project affects approximately 4000 students per year.

**Virginia Collaborative for Excellence in the Preparation of Teachers**

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The Virginia Collaborative for Excellence in the Preparation of Teachers is a joint effort of the liberal arts, science, and education faculties of universities and colleges that train the large majority of prospective teachers within Virginia's urban corridor (College of William and Mary, Longwood College, Mary Washington College, Norfolk State University, The University of Virginia, and Virginia Commonwealth University), the region's Community Colleges (Germana, J. Sargeant Reynolds, and Tidewater), the Virginia Mathematics and Science Center, and the regional school systems. The goal of the Collaborative is to implement programs that will prepare K-8 teachers who have strong science and mathematics backgrounds, who enjoy science and mathematics, who understand what is known about the types of teaching that enable students to learn, and whose teaching will reflect their scientific and pedagogical knowledge. All science and mathematics courses taken by prospective K-8 teachers are being renewed and reformed by adapting the "best practices" being developed nationwide. Course revision teams include faculty from scientific disciplines, education departments, and master teachers from the school systems. A cadre of clinical faculty (outstanding K-12 teachers) play a crucial role in all aspects of teacher preparation reform, including the in-school experiences of prospective and new teachers and the professional development of discipline faculty. Recruitment and retention efforts enlist pre-service students to work with the faculty as Teaching Associates. The Collaborative includes two cross-fertilization/dissemination activities: an annual week-long science and mathematics colloquium and an annual four week long institute featuring courses which are being developed by Collaborative institutions. This Collaborative will impact policies required for preparation of K-8 teachers, improve the nature and quality of instruction in mathematics and the sciences, improve in-school

experiences of prospective teachers, enhance recruitment of qualified teachers of science and mathematics (particularly for underrepresented groups), and promote the dissemination of materials and approaches within the Collaborative and beyond.

### **Recruitment, Training, and Retention of Oklahoma Science and Mathematics Teachers**

Robert E. Howard

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The Oklahoma Teacher Education Collaborative (O-TEC), a consortium composed of K-12 schools and two-year, and four-year institutions from across the state addresses concerns in the teacher preparation system, from recruitment through pre-service training and into the early years of teaching. A series of summer academies recruits talented youth from under-served populations and allows potential teachers to work under the direction of classroom teachers to present model lessons in science and mathematics. Activities at two-year institutions of higher education feature the development of courses articulated with four-year institutions and formulation of a curriculum for para-teachers. Engineering faculty are participating in development of general education courses that are appropriate for teachers, and particular attention is given to retention of new teachers and their professional growth during the early years of teaching. O-TEC is training experienced teachers and building administrators to provide support in science and mathematics teaching through state entry-year committees. A summer in-service program brings new teachers together after their first year to share experiences and address concerns about content and pedagogy. O-TEC sponsors sessions for entry-year teachers at meetings of the Oklahoma Science Teachers Association and Oklahoma Council for Teachers of Mathematics to encourage professional participation. O-TEC institutions also provide consulting for entry-year teachers who experience difficulty and provide some equipment to new teachers. Use of technology is a component of all activities and several modes of evaluation provide feedback for guidance.

**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION  
PROJECTS INITIALLY FUNDED IN FY 95**

**New York Collaborative for Excellence in Teacher Preparation**

Rosamond Welchman

DUE-9453606

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\$4,999,996

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Five colleges of the City University of New York (Brooklyn College, College of Staten Island, City College, Hunter College and Lehman College) together with New York University, are part of the New York Collaborative for Excellence in Teacher Preparation formed to restructure the preparation of prospective teachers of K-12. The Collaborative goal is to increase the number of college graduates entering science and mathematics teaching at all academic levels, and better equip them for teaching these subject areas to New York's culturally, ethnically, economically and linguistically diverse population. New links are being created: on the college campus, between education and liberal arts faculties, and among the various science and mathematics faculties; in each borough, between colleges and school districts; in the university community, among various colleges; and city-wide, between all participants and local science-rich institutions and museums.

The Collaborative is engaged in six interrelated clusters of activities, including: 1) developing new approaches to teaching and assessing science and mathematics in college courses, so that prospective teachers themselves experience learning in ways envisioned by national reform efforts, and become familiar with exemplary curriculum resources; 2) establishing a new program for middle school teachers; 3) developing new training materials with special emphasis on design of curriculum units which reflect collaboration among faculty of varied disciplines and school teachers, and that utilize the urban context; 4) providing student support and career development, including follow-up of first year teachers and internships in settings such as college tutoring centers, school classrooms, and local science museums; 5) recruiting promising students into teaching; and 6) developing exemplary field sites for student teachers.

**Los Angeles Collaborative for Teacher Excellence (LACTE)**

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Ten institutions form the Los Angeles Collaborative for Teacher Excellence (LACTE): five universities/colleges (California State University, Dominguez Hills; California State University, Los Angeles; California State University, Fullerton; Loyola Marymount University; and Occidental College) paired with five allied community colleges (El Camino; East Los Angeles; Fullerton; Santa Monica; Glendale Community Colleges).

The goals of the Collaborative are to: 1) increase the number of mathematics/science majors from underrepresented groups who are planning on teaching as a career; 2) refine the present course of study at



each institution to reflect the necessary integration of mathematics, science and technology in the pre-service content preparation of undergraduate students; 3) develop an experiential component for future elementary mathematics/science specialists and secondary science and mathematics teachers; 4) establish a support network for the prospective teachers; and 5) promote professional development in education for mathematics and science faculty.

### **Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT)**

Susan Wyckoff

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\$4,989,864

The Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT) is comprised of a large complex of public higher education institutions which serve urban and rural areas in Arizona with high ethnic minority populations. The Collaborative consists of Arizona State University (science, engineering, and mathematics faculty), Maricopa Community College District (10 colleges in the Phoenix metropolitan area), and the Dine` College (formerly Navajo Community College). ACEPT collaborates with and has its goals aligned with the Phoenix Urban Systemic Initiative project. Through the Arizona Systemic Collaborative, ACEPT has established a formal affiliation with many other private and publicly funded science and mathematics teacher preparation reform projects in the Phoenix area.

Specific innovations are focused on the mathematics and science preparation of pre-service teachers. They include: 1) a new middle school endorsement with a secondary certification which has science and mathematics options; 2) reform of elementary curricula - introductory physics, chemistry, geology and mathematics; 3) reform of secondary curricula – biology, mathematics, and physics; 4) a new integrated curriculum, project oriented laboratory science course, *Patterns in Nature*, intended as a capstone science course for elementary education majors; 5) incorporation of computers and other multimedia devices into the reformed curricula; 6) increased field experiences for pre-service teachers; and 7) a significant increase in the number of teachers well-prepared in science and mathematics who are members of underrepresented groups. The particular experiences planned for the novice teachers include: being paired with supervising teachers who will support appropriate pedagogical methods for teaching science and mathematics; and receiving rich and stimulating field experiences which will allow them to utilize the teaching methods learned from the ACEPT curriculum within their own classrooms.

### **The El Paso Partnership for Excellence in Teacher Education (PETE)**

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DUE-9453612  
\$4,641,407

The El Paso Partnership for Excellence in Teacher Education includes the University of Texas at El Paso (UTEP), the El Paso Community College, and the three major public school districts in El Paso County in a fundamental transformation of teacher preparation that is grounded in and contributes to systemic reform in

K-12 education. The Partnership will sponsor activities contributing to five major goals: 1) to recruit more students into mathematics and science teacher preparation, particularly more students from underrepresented groups, and provide support and financial incentives for those planning to become teachers; 2) to revise and enhance curriculum at both the lower- and upper-division levels so that prospective teachers achieve high levels of both content knowledge and pedagogical skills; 3) to enhance the teaching skills of mathematics, science, and teacher education faculty so that they can both better impart content knowledge and model exemplary pedagogical behaviors; 4) to provide support for new mathematics and science teachers as they enter their profession; and 5) to establish and sustain a continuous conversation among key stakeholders (mathematics, science and education faculty, and public school teachers) on the improvement of mathematics and science teaching and learning.



**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION  
PROJECTS INITIALLY FUNDED IN FY 94**

**Rocky Mountain Teacher Education Collaborative (RMTEC)**

Fredrick M. Stein	DUE-9354033
Kathryn Cochran, Marilyn Taylor, James Loats, Nancy Hartley	\$5,000,000
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The University of Northern Colorado (UNC) with Aims Community College, Colorado State University (CSU) with Front Range Community College, and Metropolitan State College of Denver (MSCD) with Community College of Denver, are partners in the Rocky Mountain Teacher Education Collaborative (RMTEC). CSU, a research-oriented, land-grant university, has the largest secondary science teacher education program in the state; UNC, a university with a state-recognized mission for teacher education has one of the largest elementary and middle school teacher preparation programs nationally; and MSCD, a four-year college in downtown Denver is committed to training teachers for urban schools and is the site of the largest middle and secondary mathematics education program in the state.

Reform efforts are directed toward student-centered, experiential, inquiry-based curricula and instruction developed with sensitivity to the educational needs of women and people of color. The goals of the project are: 1) to develop collaboration between the primary institutions, community colleges, and local school districts; 2) to improve the ways in which mathematics and science preservice teachers are prepared for careers in teaching, with emphasis on restructuring, reforming and/or developing innovative curricula and instructional methods for teaching education, mathematics, and science; and 3) to recruit and retain those sensitive to issues of women and ethnic minorities into teaching careers in the fields of mathematics and science.

Restructuring efforts include field-based, interdisciplinary “linked classes” in which students register simultaneously for two separate classes taught in conjunction with one another. Other restructuring efforts involve the redefinition and combining of classes into new class offerings. For example, general education methods classes and discipline-based methods classes have been combined into one two-semester offering taught by education and discipline-specific faculty. Other reforms occur within individual classes introducing such innovations as Small-Scale Science, multicultural mathematics and science, and cooperative learning. Teachers-in-residence (secondary schoolteachers recruited from local school districts to work on campus) join the RMTEC community as educational partners in the redesign and implementation of educational reform. At the end of their term with RMTEC, most teachers-in-residence return to their local secondary schools but continue to play many roles within the RMTEC institutions; serving as cooperating teachers for RMTEC student teachers; aiding in the selection of other like-minded cooperating teachers; and providing faculty inservices for local school districts based upon their RMTEC experiences. RMTEC provides a multitude of faculty development opportunities involving all members of the RMTEC community including workshops, Curricular Reform Seminars, and regularly scheduled team meetings.

**Collaboratives for a New Model for K-12 Teacher Preparation Focused on Enhancing Math/Science Knowledge, New Methodologies and Technology**

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DUE-9354034  
\$3,900,000

The Temple University's Colleges of Arts & Sciences, Education, and Engineering & Architecture, the Community College of Philadelphia, and the School District of Philadelphia are developing a new model for the education of prospective K-12 teachers which integrates new teaching methodologies with mathematics and science core content courses. Since Temple University, in conjunction with the Community College of Philadelphia, is the major teacher preparation institution for the Philadelphia School District, this will have a systemic impact on the more than 200,000 students in the Philadelphia School District and serve as a national urban model. The Collaborative is revising selected basic college mathematics and science courses to reflect closely the pedagogy and content that the students will need as teachers. These revisions include enhanced faculty/student interaction, appropriate instructional materials, and inquiry-intensive methodologies as well as new technologies. Several courses are being developed and modified, including, for example, a team-taught cross-disciplinary science course and a cognitive psychology course. Prospective teachers are participating in practica early in their pre-service training at selected Professional Development schools. Practicum supervisors join pre-service teachers in seminars to reinforce content and pedagogy. The model includes expansion of Temple's five-year teacher education program in which students who major in Arts & Sciences and minor in education are certified after completing their 5th year. University and Community College faculty participates in intensive staff development and cross-class visitations with School District teachers.

**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION  
PROJECTS INITIALLY FUNDED IN FY 93**

**Maryland Collaborative for Teacher Preparation (MCTP)**

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Institutions within the University System of Maryland, Anne Arundel Community College, Catonsville Community College, Prince George's Community College, Baltimore City Community College, and Baltimore City, Baltimore County and Prince George's County school districts are designing, implementing, and evaluating an innovative interdisciplinary program to prepare teachers who can provide exemplary mathematics and science instruction in elementary and middle schools. Design and development of the project's course and field experience components are being guided by the following basic principles: 1) Teachers should learn science and mathematics through instruction that models the practices they are being expected to employ during their teaching careers; 2) Courses and field experiences should integrate science and mathematics so that teachers will know and can take advantage of the connections between individual disciplines; 3) Teacher training programs should include substantial field experiences that engage the prospective teachers in the genuine research activities of business, industrial or scientific institutions and the science and mathematics education activities conducted by science centers, zoos or museums; 4) Teachers should develop their ability to use modern technologies as standard tools for research and problem solving as well as for imaginative classroom instruction; 5) Field experiences should be provided in school settings that enroll children of below average and average ability, as well as those in gifted and talented programs; and 6) Teachers should receive sustained support during the critical first years of their induction to the teaching profession. Throughout the five-year development period, continual formative evaluation, research on the process of teacher education, and a variety of dissemination activities are being conducted to inform others of the outcomes of this emerging model of teacher preparation.

**Louisiana Collaborative for Excellence in the Preparation of Teachers (LaCEPT)**

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The primary goal of the Louisiana Collaborative for Excellence in the Preparation of Teachers (LaCEPT) is to reform mathematics and science teacher preparation programs in Louisiana in the spirit of the K-12 national standards for school reform, guided by the objective of making these programs relevant to life in the age of information technology. Other major goals are to increase the quantity and enhance the quality of mathematics and science teachers in the state, and to extend and institutionalize reforms into the 21<sup>st</sup> century.

Funded jointly through NSF and the Louisiana Board of Regents Support Fund, LaCEPT is guided by a Steering Committee composed of campus representatives as well as representatives of other statewide reform programs such as the Louisiana Systemic Initiative Program (LaSIP) and the Louisiana Alliance for Minority Participation (LAMP).

LaCEPT has awarded almost \$4 million in competitive campus renewal project (CRP) grants. Fourteen private and public campuses involved in teacher preparation have received CRPs over the past four years. In addition to the CRPs, a NSF/LaCEPT Teaching Scholars program is designed to recruit minorities and other outstanding preservice students into the teaching profession. The Faculty Mentorship and a Faculty Intern program place subject-matter faculty into LaSIP summer institutes for K-12 teachers and into LaCEPT reformed courses. Each January, LaCEPT sponsors a statewide conference for 400-plus faculty and administrators, featuring presentations by nationally prominent leaders in the reform effort. LaCEPT also encourages intensive summer workshops on topics of current interest for regional or statewide groups of college faculty. During 1997-99, the Regents initiated major revisions to the way in which both Support Fund programs and campus academic programs are reviewed, and created a special funding source from the Support Fund for the continuation of reforms: assuring institutionalization of reforms.

### **Systemic Teacher Excellence Preparation: The STEP Project**

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DUE-9255792  
\$6,000,000

The STEP project is designed to bring about large-scale improvement in the preparation of science and mathematics teachers in Montana and to serve as a national model for rural areas with significant minority populations. STEP is developing new alliances that form a statewide, interactive network consisting of school systems, tribal colleges, community colleges, private colleges, state universities and colleges, the State Office of Public Instruction, the Montana Council of Teachers of Mathematics, the Montana Science Teachers Association, and a number of related on-going NSF funded projects in the state: the Systemic Initiative for Montana Mathematics and Science (SIMMS), Six Through Eight Mathematics (STEM), All Nations Alliance for Minority Participation (AMP), NETWORK Montana (NIE) and Keystone (LSI).

The project is providing the following: at least two years of early career support for mathematics and science teachers in a rural setting; model teacher preparation field sites in K-12 partnership schools; increased numbers and better preparation of mathematics and science teachers from Native American Communities; a telecommunications network-based model for fostering teacher preparation in rural states; strong faculty teams to redesign curricula and courses; strong support for participating faculty and teachers; dissemination of new ideas in preparing teachers; an increase in the number of women and minority teachers in mathematics and science; and use of field sites as “living laboratories” for research on effective mathematics and science teaching, pre-service teacher supervision and the training of university science and mathematics educators in rural settings.

## Teacher Preparation Efforts in Other EHR Divisions

While primary responsibility for teacher preparation resides in the Division of Undergraduate Education, other Divisions within the Directorate for Education and Human Resources (EHR) also provide support to the effort to improve the SME&T preparation of teachers. This section highlights teacher preparation efforts in the Divisions of Elementary, Secondary, and Informal Education; Educational Systemic Reform; and Human Resource Development.

### **DIVISION OF ELEMENTARY, SECONDARY AND INFORMAL EDUCATION**

The Division of Elementary, Secondary, and Informal Education supports projects that enable all students from pre-kindergarten through grade 12 to succeed in science, mathematics, and technology (SMT) and to increase the scientific and technological literacy of all students and adults. The Teacher Enhancement (TE) Program strengthens teachers' content and pedagogical skills and creates an infrastructure of educators, researchers, and administrators to support SMT education reform. Several TE projects link pre-service teacher education programs to in-service teacher enhancement activities. Instructional Materials Development (IMD) Projects create curricula, materials, and student assessments incorporating investigative, hands-on science, mathematics, and technology education activities that are aligned with content, teaching, and assessment standards.

#### **TEACHER ENHANCEMENT**

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#### **Implementation of the National Council of Teachers of Mathematics Standard in Discrete Mathematics, Phase II**

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A nationwide cadre of 300 grade 7-12 teachers at six sites (California, Georgia, Massachusetts, Michigan, Nebraska, and Ohio) are implementing the discrete mathematics standards in their classrooms and sharing instructional experiences with their students and colleagues. Sixty collegiate faculties are participating with the secondary teachers in professional development and are implementing a course in discrete mathematics or topics in discrete mathematics within an existing course that includes pre-service teachers.

#### **Colorado College -- Integrated Science Teacher Enhancement Program (CC-ISTEP)**

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The Colorado College-Integrated Science Teacher Enhancement Program (CC-ISTEP) is a comprehensive teacher enhancement effort that also supports a new graduate degree for teachers. The objectives of CC-ISTEP include the use of teacher development principles to ensure long-term changes in pedagogical skills and the use of CC-ISTEP as a model for teacher development at other colleges.



**Teacher Enhancement Through An Elementary Science Education Partners (ESEP) Program**

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ESIE-9552864  
\$5,699,850

This project involves undergraduate science majors in the professional development of K-5 teachers in the Atlanta Public Schools while also providing teaching experience. Undergraduate “science partners” from Emory University and five collaborating colleges (Clark-Atlanta, Georgia State, Morehouse, Morris-Brown and Spelman) register for a two-credit course or a service learning program, receive training in inquiry-science instruction, and spend 5-6 hours every week in the classroom team-teaching science lessons with an assigned teacher who has participated in in-service training in guided discovery instructional methods of teaching science and mathematics.

**Minneapolis Public Schools (MPS) Systemic Change in Science Initiative**

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ESIE-9619341  
\$5,034,000

One component of the Minneapolis Local Systemic Change project is the development of stronger linkages between the Minneapolis Public Schools’ science program leadership and the state’s higher education institutions that train the majority of future Minneapolis teachers. The goal is to align preservice teacher training in science closer to the MPS standards for science curriculum, instruction and assessment.

**The KITES Project: Kits In Teaching Elementary Science**

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ESIE-9453159  
\$1,800,000

The KITES project, managed by a partnership between Rhode Island College and the East Bay Educational Collaborative (EBEC), is implementing an integrated, hands-on, kit-based science curriculum in the eight school districts in EBEC. Unique to this project is the linking of students in pre-service teacher preparation programs with project teachers providing opportunities to co-teach, engaging students in problem solving and presenting a case-oriented approach to teaching and learning.

**Institute for Science and Technology**

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ESIE-9454331  
 \$1,672,957

This project provides five-week institutes for 290 inservice and 40 preservice teachers of grades K-12. The goals of the project are to provide pedagogical and philosophical foundations for improving science education, develop strategies for increasing student learning of science, and develop a significantly improved delivery system to encourage creativity, problem solving, critical thinking, and communications. The project also includes internships and a mentorship program offered at such places as the Indianapolis Zoo and Lilly Research Corporation.

**Changing the High School System: Implementing the Interactive Mathematics Program in Arizona (AZ IMP2)**

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ESIE-9634034  
 \$1,071,475

Maricopa County Community College District is conducting a 60-month Local Systemic Change project for 187 teachers in grades 9-12 in 5 Arizona school districts and schools in the Utah Colorado Arizona New Mexico Rural Systemic Initiative (UCAN RSI). The project's partners, the unified districts of Chandler, Sunnyside, Nogales, Mingus and Sedona-Oak Creek, Maricopa County Community College, Arizona State University and the Intel Corporation, will implement the Interactive Mathematics Program (IMP) in those districts through: in-service on the mathematics and pedagogy of IMP; follow-up support activities; developing an internal capacity for professional development by establishing school teams for support of teachers and involving teachers from schools considering IMP; articulation with feeder schools; and impacting preservice teacher training.

**Video Case Studies of Extended Investigations in Science**

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ESIE-9553896  
 \$399,906

This project is developing a set of video and print materials to inform and support teachers' understanding of hands-on elementary science teaching and learning. The materials are designed for use in both in-service and preservice teacher education, science center or museum training, and community-based programs. The videos will illustrate a complete teaching/learning cycle in which students explore a single phenomenon.

**Asset Teacher Enhancement Project**

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ESIE-9552856  
\$1,334,322

The Allegheny Schools Science Education and Technology (ASSET) Inc. is a local non-profit consortium of business, education, and community leaders committed to reforming science education initiated in 1993. They are implementing a plan for reform that includes: the development of a comprehensive curriculum for each district; the creation of a regional materials support center; the preparation of coalition resource teachers responsible with scientists for in-service and the support of teachers district-wide; and the improvement of preservice education.

**Mathematics Content/Connections**

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ESIE- 9353364  
\$2,046,903

This four-year project is presenting alternating 3-year programs of mathematics content, pedagogy, and assessment for all elementary school teachers and school administrators in Montgomery County, Maryland. School administrators and teachers of special subjects are involved with focused activities for improving student performance in mathematics. Additional support is being developed through area colleges and universities to provide extended offerings for teachers and in order to use the program as a model for preservice education.

**INSTRUCTIONAL MATERIALS DEVELOPMENT**

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**Linking Curriculum Materials to Science Literacy Goals**

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ESIE-9553594  
\$888,466

The publication of the National Science Education Standards and the Benchmarks for Science Literacy demonstrates a strong national consensus on specific learning goals in science and necessitates a procedure for evaluating the extent to which materials address Standards or Benchmarks. This project is refining the process for evaluating materials for both pre-service and in-service professional development, providing an evaluation mechanism with examples and case studies, disseminating the process, and developing a cadre of developers, teachers and teacher educators who understand it and can advocate for its use.

**A Proposal to Develop a Coordinated Set of Tools for Science Education Reform and Foster their Effective Use**

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ESIE-9618093  
 \$4,746,014

The American Association for the Advancement of Science (AAAS) is continuing the work of science education reform by developing an *Atlas for Science Literacy*, expanding *Resources for Science Literacy*, and supporting educators who want to put these tools, and others already developed by AAAS, to work in their states, districts, and schools. Resources will provide aid to those developing science frameworks at district and state levels; develop workshop guides to help preservice and in-service teachers improve their knowledge and skills in science, mathematics, and technology, along with their instructional skills; and extend the procedure for analyzing science materials to include mathematics and technology materials.

**DIVISION OF EDUCATIONAL SYSTEMIC REFORM**

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**STATEWIDE SYSTEMIC INITIATIVES PROGRAM**

The Statewide Systemic Initiatives (SSI) Program is a major NSF effort to encourage improvements in science, mathematics, engineering and technology education through comprehensive systemic changes in State education systems. The program is competitive and leads to cooperative agreements with State governments that address several objectives: (1) adoption of more effective mathematics and science curricula; (2) use of better materials, technologies, and assessment procedures; (3) higher student achievement in mathematics and science and increased interest in related careers; (4) improvement of science literacy; (5) adoption of new standards and methods for teacher preparation; and (6) improved organizational and decision-making structures.

**Arkansas Statewide Systemic Initiative**

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ESR- 9350027  
 \$10,150,000

The Arkansas Statewide Systemic Initiative (AR SSI) features a professional development component known as the Arkansas Mathematics and Science Crusades, a series of college-level courses offered to K-16 teachers by the higher education institutions in the state. The graduate courses offered through this strategy model good teaching practices, address a variety of integrated content areas, and demonstrate a diversity of teaching methods designed to increase the success of students in these two disciplines. Changes in teacher preparation and certification are included in the SSI goals.

**Connecticut Statewide Systemic Initiative**

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The Connecticut Statewide Systemic Initiative's (CT SSI) efforts are supported by 11 of the 15 institutions of higher education (IHEs) with teacher preparation programs in the state. Co-Teaching Partnerships are formed, whereby K-12 and college faculty jointly teaches both content and pedagogy courses on university campuses and in K-12 classrooms. The State's largest teacher preparation programs, Southern Connecticut State University and Central Connecticut State University, are working with CT SSI to accomplish significant restructuring of their mathematics teacher education programs in accordance with the NCTM standards. Both universities are also restructuring their science teacher preparation programs.

**Massachusetts Statewide Systemic Initiative**

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The Massachusetts Statewide Systemic Initiative, Partnerships Advancing the Learning of Mathematics and Science (PALMS), receives active support from over 75% of the institutions of higher education (IHE) in the state. A statewide network of IHEs serve as providers of professional development. Through their efforts in reforming mathematics and science, new methods courses have been developed, preservice course requirements have changed, co-teaching partnerships have been established involving college faculty members and PALM Teacher Leaders, and increased attention has been given to the placement of student teachers in classrooms that model an inquiry approach to teaching and learning of mathematics and science.

**Louisiana Statewide Systemic Initiative (LaSIP)**

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Attention to the reform of K-8 teacher preparation has been an outgrowth of the involvement of university mathematics, science and education faculty involvement in LaSIP professional development for in-service K-8 teachers. Universities have revised their mathematics preservice program to be more closely aligned to the NCTM standards. Several universities have revised preservice science courses and are collaborating extensively with area parish schools in the placement of preservice candidates in classrooms of teachers who participated in the LaSIP inquiry-based approach to the teaching and learning of science.

**Puerto Rico Statewide Systemic Initiative**

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ESR-9250052  
 \$10,000,000

The Puerto Rico SSI "Reform of Teacher Preparation Programs" has two main thrusts. The first involves an in depth revision and development of science and mathematics teacher preparation curricula and teaching practices at three universities that are disseminating their reform strategies and curricula to other institutions. Science, mathematics and education faculty as well as K-12 teachers are involved in this endeavor. Teacher preparation curriculum is being revised to upgrade subject matter understanding and instructional methods. Partnerships with exemplary Puerto Rico-SSI schools are being established to integrate laboratory experiences throughout the curriculum. The second thrust includes strategies to bridge the gap between theory and practice in the teacher preparation curricula by revising science and mathematics methodology courses and the teaching practicum.

**The Texas Statewide Systemic Initiative**

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ESR-9250036  
 \$8,000,000

Teacher preparation is a key component of this systemic reform effort. Initial efforts in the Texas SSI are focused on the Mathematical Preparation of prospective elementary teachers. These efforts center on the initiation of a statewide network of instructors, a standards document on the mathematics studied by prospective teachers, and support structures for instructors including grants, a curriculum resource center, and professional development conferences.

**URBAN SYSTEMIC INITIATIVES PROGRAM**

The Urban Systemic Initiatives Program (USI) in science, mathematics, and technology education is a comprehensive and systemic effort designed to enable fundamental reform of K-12 science and mathematics education in large urban school systems. Eligibility for the program is limited to school systems in the 28 cities having the largest numbers of school-aged children (ages 5-17) living in poverty as determined by the 1990 Census. Built upon experience gained from the Statewide Systemic Initiatives (SSI) and the Comprehensive Regional Centers for Minorities (CRCM), the program provides significant support for 5 years to cities that have completed comprehensive planning and demonstrate readiness to make systemic and sustainable changes in the policies, practices, and procedures of urban school systems.

**El Paso Urban Systemic Initiative**

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ESR-9453664  
\$14,348,789

The El Paso Collaborative for Excellence in Teacher Preparation (El Paso Independent School District (ISD), Ysleta ISD, Socorro ISD and the University of Texas at El Paso), provides mathematics and science professional development and teacher education for the El Paso USI.

**Fresno Unified School District Urban Systemic Initiative**

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ESR-9452988  
\$11,749,365

Fresno Unified School District has mathematics and science professional development as well as preservice mathematics and science education offered through Fresno State University.

**Milwaukee Urban Systemic Initiative**

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ESR-9554487  
\$5,000,000

The University of Wisconsin at Milwaukee (UWM) is implementing a new Collaborative Elementary/Middle Teacher Preparation Program. All candidates are required to have two focus areas, one of which must be mathematics or science. Candidates must also complete 6 semester hours of core requirements in both mathematics and science, 3 hours of science methods and 5 hours of mathematics methods. UWM is placing K-12 preservice teachers with mathematics and science emphases in MUSI schools for field work and student teaching experiences.

**DIVISION OF HUMAN RESOURCE DEVELOPMENT**

**ALLIANCES FOR MINORITY PARTICIPATION - PRE-SERVICE TEACHER PREPARATION INITIATIVE**

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The goal of the Alliances for Minority Participation - Pre-Service Teacher Preparation initiative (AMP-TP) is to increase substantially the number of minority students with strong academic credential, who are certified to teach science and mathematics in elementary and secondary schools. The majority of activities intended

for NSF support under AMP-TP initiative must focus specifically on attracting more individuals from groups underrepresented in the science and mathematics workforce into undergraduate SMET teacher preparation programs. This includes activities at critical transition points along the education continuum, including the transition from high school-to-college; from 2-year to 4-year colleges; from undergraduate-to-graduate study (where appropriate); and from graduate school through the adjustment to the K-12 teacher workforce. AMP projects with an AMP-TP component include:

**Southern Rocky Mountain Alliance**

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HRD-9623615

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HRD-9353276

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HRD-9350587

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HRD-9353215

**Academic Alliance between HBCU's in the Greater Washington, Baltimore, Hampton Roads Region**

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HRD-9353137



**South Carolina Alliance for Minority Participation (SCAMP)**

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**NCAMP Teacher Preparation Program Supplement**

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**PROGRAM FOR WOMEN & GIRLS**

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The Program for Women and Girls in Science, Engineering, and Mathematics, designed to increase women’s involvement in science, engineering and mathematics (SEM), complements other EHR efforts to improve education from elementary school through graduate school. Implementation and Development Projects are research-based and seek positive change in the academic, social, and scientific infrastructure. Information Dissemination Activities ensure widespread dissemination of strategies, research results, and resources to accelerate efforts to increase the involvement of women in SEM.

**The Preparation of Gender-Sensitive Science Teachers in the University of Delaware’s Secondary Science Education Program**

Kate Scantlebury  
 University of Delaware  
 Department of Chemistry and Biochemistry  
 Newark DE 19716  
*kscantle@udel.edu*

HRD-9450022  
 \$495,988

This project includes the restructuring of the high school science teacher preparation program at the University of Delaware to include gender fair practices, and the translation of these practices into real classrooms.

**“PROMISE”: Geology in a Social & Historical Context: Performing Earth Science Education**

Margaret Rees & Maralee Mayberry  
 University of Nevada-Las Vegas  
 Department of Geology  
 Las Vegas, NV 89154-9900  
*rees@nevada.edu*

HRD-9555721  
 \$658,550

This is an interdisciplinary curriculum project restructuring earth science text & teaching practices. University faculty from the social sciences, geology, women’s studies and education are developing with high school teachers earth science materials, including labs. The project expects to restructure the way earth science is taught, and how teachers are prepared to teach at both the university and high school level.

**Girls in Science: Museum, University, School & Community Connections**

Janet Johnson  
 Cranbrook Institute of Science  
 Bloomfield Hills MI 48303-0801  
*janet\_johnson@cc.cranbrook.edu*

HRD-9453112  
 \$526,533

A collaborative partnership between Cranbrook and Oakland University provides opportunities for university students considering teaching as a career, and “committed education students to learn gender fair and appropriate science teaching methodologies at the university & practices them in formal classes taught at the

museum or “in-school” after school programs for at-risk students. The museum & after school programs allow pre-service students to hone management techniques, while learning science content and ways to convey that content to elementary and middle school learners. The project at the university plans to extend into secondary education programs, creating a K-12 sustained program.

**Teacher Education Mentor Project**

Jo Sanders  
University of Washington  
Seattle, WA 98195  
*jsanders@halcyon.com*

HRD-9555665  
\$901,414

The purpose of this project is to prepare university science methods instructors across the United States to incorporate gender fair methodologies and strategies into their methods courses. Teams of expert methods “mentors” work with faculty in the various universities to help restructure programs such they reflect teaching approaches most likely to develop teachers who can manage diverse learning styles. A handbook and activities book for science methods courses are a by product of the project.

**Plugged In!**

Sue Metzler & Dave Kraemer  
Mid-Continent Girl Scout Council  
8383 Blue Parkway Drive  
Kansas City MO 64133  
(816) 358-8750

HRD-9555724  
\$503,409

This is a collaborative project between the Girl Scout Council & Ottawa University. Gender fair strategies are learned in the methods classes and “practiced” in interactive computer science laboratory experiences designed for the girl scouts by university faculty.

**Gender Equity in Science & Mathematics Education through Institutional Reform (InGEAR)**

Carolyn Thorsen & Robert Pierotti  
Georgia Institute of Technology  
CEISMC, Georgia Institute of Tech.  
Atlanta, GA 30332-0282  
*Carolyn.Thorsen@Ceismc.gatech.edu*

HRD-9453106  
\$821,088

This is a five institution collaborative program to promote equal access & gender equity in science, engineering & mathematics by facilitating the redesign of teacher education programs and providing professional development and resource materials for those who teach pedagogy & content courses.

**LIST OF AWARDS BY STATE**

	<b>Award No.</b>	<b>Page</b>		<b>Award No.</b>	<b>Page</b>		<b>Award No.</b>	<b>Page</b>
<b>Alabama</b>	9652870	8					9653373	30
				9652828	7		9750728	20
							9751170	22
<b>Arizona</b>	9453610	54		9653383	31	<b>Montana</b>	9450369	70
	9602373	46		9706060	33		9255792	60
	9619834	35		9740520	34	<b>Nebraska</b>	9555404	45
	9623615	69	<b>Florida</b>	9255219	70		9751176	22
	9634034	63					9751339	24
<b>Arkansas</b>	9350027	65	<b>Georgia</b>	9453106	72	<b>Nevada</b>	9555721	71
				9552864	62	<b>New Hampshire</b>	9552462	41
<b>California</b>	9153663	69		9751419	26		9751044	21
	9353276	69	<b>Illinois</b>	9350587	69		9751184	23
	9354104	37		9554807	43	<b>New Jersey</b>	9553749	42
	9452988	68		9711534	16	<b>New Mexico</b>	9353215	69
	9453608	53	<b>Indiana</b>	9355861	37		9652872	8
	9455924	40		9454331	63		9653973	2
	9553786	51		9653980	15	<b>New York</b>	9252789	70
	9555605	45		9751473	27		9453606	53
	9602345	46	<b>Iowa</b>	9752081	5		9455920	39
	9652800	6	<b>Kansas</b>	9743179	36		9552465	41
	9653070	10					9555152	43
	9653107	12	<b>Louisiana</b>	9150043	66		9555401	44
	9653140	12		9255761	59		9652972	9
	9653261	15		9550765	69		9653034	10
	9653664	17		9653079	11		9653164	13
	9743482	50	<b>Maryland</b>	9255745	59		9653366	29
	9750703	19		9353364	64		9750521	18
	9751212	23		9554625	42		9751135	21
	9751640	28		9653423	31		9751351	24
	9751728	28		9751385	25	<b>North Carolina</b>	9255239	70
			<b>Massachusetts</b>	9542795	66		9652778	5
<b>Colorado</b>	9354033	57		9550002	61	<b>North Dakota</b>	9653963	3
	9355581	61		9553896	63	<b>Ohio</b>	9652843	7
	9455725	38		9554736	43		9751407	25
	9605030	34		9653029	9	<b>Oklahoma</b>	9450355	70
	9653190	13		9653068	10		9553790	52
	9653274	15		9728964	48		9652867	8
	9742854	35		9728965	48		9653381	30
				9728966	48	<b>Oregon</b>	9653970	2
<b>Connecticut</b>	9634086	66		9729230	49			
				9743265	49	<b>Pennsylvania</b>	9354034	58
			<b>Michigan</b>	9453112	71		9455561	38
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	9751622	28		9653232	14		9750573	18
			<b>Mississippi</b>	9153747	70		9750683	19
<b>District of Columbia</b>	9353137	69		9752060	4	<b>Puerto Rico</b>	9250052	67
	9455088	37	<b>Missouri</b>	9550704	70		9653975	4
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	9616685	33						
	9618093	65						

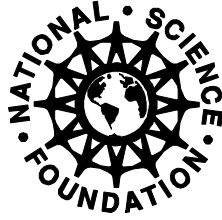
	<b>Award No.</b>	<b>Page</b>		<b>Award No.</b>	<b>Page</b>		<b>Award No.</b>	<b>Page</b>
<b>Rhode Island</b>	9453159	62		9453664	68		9727648	16
				9653962	3		9750920	21
<b>South Carolina</b>	9255165	70		9751735	29			
	9602440	47		9751737	29	<b>West Virginia</b>	9751280	23
	9750748	20						
			<b>Virginia</b>	9553789	51	<b>Wisconsin</b>	9455918	39
<b>Tennessee</b>	9750825	20		9653435	32		9455928	40
							9554487	68
<b>Texas</b>	9250036	67	<b>Washington</b>	3653466	32		9653095	11
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							9751512	27

## **TEACHER PREPARATION EFFORTS IN OTHER AGENCIES**

Information about teacher preparation activities sponsored by other agencies can be accessed through the following Web sites:

Department of Education Fund for Improvement of Postsecondary Education:  
<http://www.ed.gov/offices/OPE/FIPSE>

National Aeronautical and Space Administration Project NOVA: <http://www.eng.ua.edu/~nova>



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