

**DIVISION OF UNDERGRADUATE EDUCATION (DUE)**

**TEACHER PREPARATION AWARDS  
NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION  
AWARDS**

**FISCAL YEAR 1998**

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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 (e.g., 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 SME&T 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 1998. 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.

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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 98 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.

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

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<sup>1</sup> In FY 99 CCD, ILI, and UFE programs will be consolidated and realigned within a new program, Course, Curriculum, and Laboratory Improvement (CCLI).

## 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 concert with school personnel and appropriate institutional administrators. Because 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:* The two collaboratives newly funded in FY 98 include a diverse set of two-year, four-year, and comprehensive institutions. A total of 17 institutions of higher education are involved. The Puerto Rico Collaborative for Excellence in Teacher Preparation (PR-CETP) involves science, mathematics, and education faculty from 6 universities in partnership with the Resource Center for Science and Engineering, Arecibo Observatory, and the Puerto Rico Department of Education. The project articulates with the K-12 systemic reform of the PR State Systemic Initiative (PRSSI) and undergraduate reform of science and mathematics achieved through the PR Alliance for Minority Participation. Content and teaching courses are being redesigned to follow a constructivist approach and to incorporate authentic assessment and the use of educational technology. The Florida Collaborative for Excellence in Teacher Preparation centered at Florida A & M University includes 8 other four-year institutions and 3 two-year institutions in addition to area school districts. Faculty from the participating institutions are developing a core of mathematics and science courses for preservice teachers that are inquiry-based and taught in cooperative learning environments.

*Continuing Projects:* Fifteen Collaboratives initiated in FY 93 through FY 97 and involving 158 institutions continued to be supported in FY 98. 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. Seven of the projects – those from Arizona State University, California State University at Dominguez Hills, the City University of New York, 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, Oregon, and New Mexico– encompass institutions distributed throughout the state; and two – at the University of Northern Colorado, and the University of Massachusetts-Amherst – 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.

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 Massachusetts Collaborative involves an existing consortium of five colleges collaborating with three 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 Oregon Collaborative 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 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.

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. The Montana Collaborative 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 Collaborative involves a cadre of outstanding K-12 teachers who enhance the in-school experiences of prospective and new teachers. The San Francisco Bay Area 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 and 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.

*Follow-on-Funding:* Three collaboratives that have completed five years of funding (Maryland, Louisiana, and Montana) requested and were awarded support to conduct longitudinal evaluation of the project including tracking graduates for three years beyond the original completion date of the project.

Information about CETP projects can be accessed through the Division's Web site at <http://www.ehr.nsf.gov/EHR/DUE/awards/cetp/cetplist.htm>.

## **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 that benefit students seeking preparation as technicians in science and engineering fields. 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 98 encompass: courses and curricula in mathematics, engineering, and the sciences for students preparing to be elementary, middle, and secondary teachers; innovative uses of technology, and recruitment of undergraduates to teaching careers. A CCD project at the University of Wisconsin, River Falls enables preservice K-12 science teachers to acquire experience with research methodology using open-ended software laboratory simulations integrated with Internet conferencing. Faculty members in the Department of Curriculum and Instruction and the Department of Materials Science and Engineering at Iowa State University are establishing an Extended Classroom for Enhanced Learning (EXCEL) to bring the capabilities of the scanning electron microscope (SEM) into elementary and secondary classrooms. Students at the University of California, Santa Barbara are participating in the work of science by collecting real Earth data, making authentic observations on the sea-floor, and analyzing results. Interactive, multimedia modules for a general education class and for preservice

teachers to use in their classrooms is being developed. Through its Rio Grande River Project, Laredo Community College (TX) is developing an interdisciplinary program of studies focusing on the Rio Grande River. This CCD project integrates biology, algebra, trigonometry and the physical sciences using problem-posing, discovery learning, river monitoring and exploration, teleconferencing, microcomputers, and a student-led mini-science symposium as the culminating activity. MIDDLE MATH, designed by a team of mathematicians and mathematics educators at East Carolina University (NC), focuses on improving the undergraduate mathematics preparation of middle grades teachers. The project benefits from a research video laboratory that facilitates the study of teaching and learning with new course materials and methods of instruction.

Of the numerous ILI projects receiving teacher preparation funding, many provide equipment that supports courses primarily enrolling preservice teachers and include the use of technology in ways that reflect how students will use such technology in their future school settings. Laboratories to support such courses are being developed at the University of Maine-Farmington (ME) (physics), Millikin University (IL) (chemistry), Central Washington University (WA) (life sciences), University of North Iowa (IA) (engineering), Mankato State University (MN) (geoscience) and Towson State University (MD) (mathematics) among others. A project at Avila College (MO) is developing an improved algebra-based introductory physics course sequence based on Workshop Physics and other activity-rich curricula. Computer-based laboratories and video capture and analysis are used to model real-world phenomena such as position and time data for a freely falling body. The Department of Biology of Indiana University of Pennsylvania is using ILI funding to develop a new curriculum for Biology majors, stressing hands-on, experiential learning leading to opportunities for semi-independent student research. Preservice biology teachers are assisting with Saturday workshops for in-service teachers and are being given the opportunity to utilize the workstations during their student teaching.

A UFE project conducted by the Mathematical Association of America is providing workshops for faculty from mathematics and a partner discipline (biology or economics) to develop interdisciplinary materials. Field stations and marine laboratories provide the setting for faculty institutes focused on inquiry-based, active learning approaches for reforming undergraduate biology courses conducted by the University of Oregon, Eugene. The PRE-STAT project at Appalachian State University (NC) provides faculty development workshops focusing on improving the statistical skills of preservice teachers. Faculty workshops at Millersville University (PA) focus on the integration of chemistry and art. Preservice and inservice teachers are developing integrated chemistry and art curriculum for high school students.

An ATE project at Jones County Junior College (MS) 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 several of the large, comprehensive projects funded under the *Mathematical Sciences and their Applications throughout the Curriculum* in FY 95 and FY 96 and continuing in FY 98. 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 teachers to reflect the needs of the National Council of Mathematics Teachers (NCTM) Standards. Similarly, the consortium project led by the University of Nebraska and Oklahoma State University involves a multidisciplinary approach to mathematics with attention to the needs of preservice teachers. An FY 96 project funded under the *Systemic Changes in the Undergraduate Chemistry Curriculum Initiative* continuing at the University of California, Los Angeles addresses the preparation of primary and secondary teachers by involving them as active participants in the lower division course of the molecular science curriculum.

The South Carolina Advanced Technological Education Center of Excellence, an ATE project, 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) focuses on technician education for advanced semi-conductor engineering and is helping prepare future grades 7-12 teachers through a partnership with Arizona State University.

## **Workshops and Conferences**

In FY 98, DUE awarded support to, or hosted, a number of dissemination activities including a workshop on the role of two-year colleges in the science and mathematics preparation of prospective teachers, the fourth annual meeting of CETP Principal Investigators, a workshop for evaluators of CETP projects, and workshops on undergraduate education that specifically focused on teacher preparation.

## **Teacher Preparation Efforts in Other EHR Divisions**

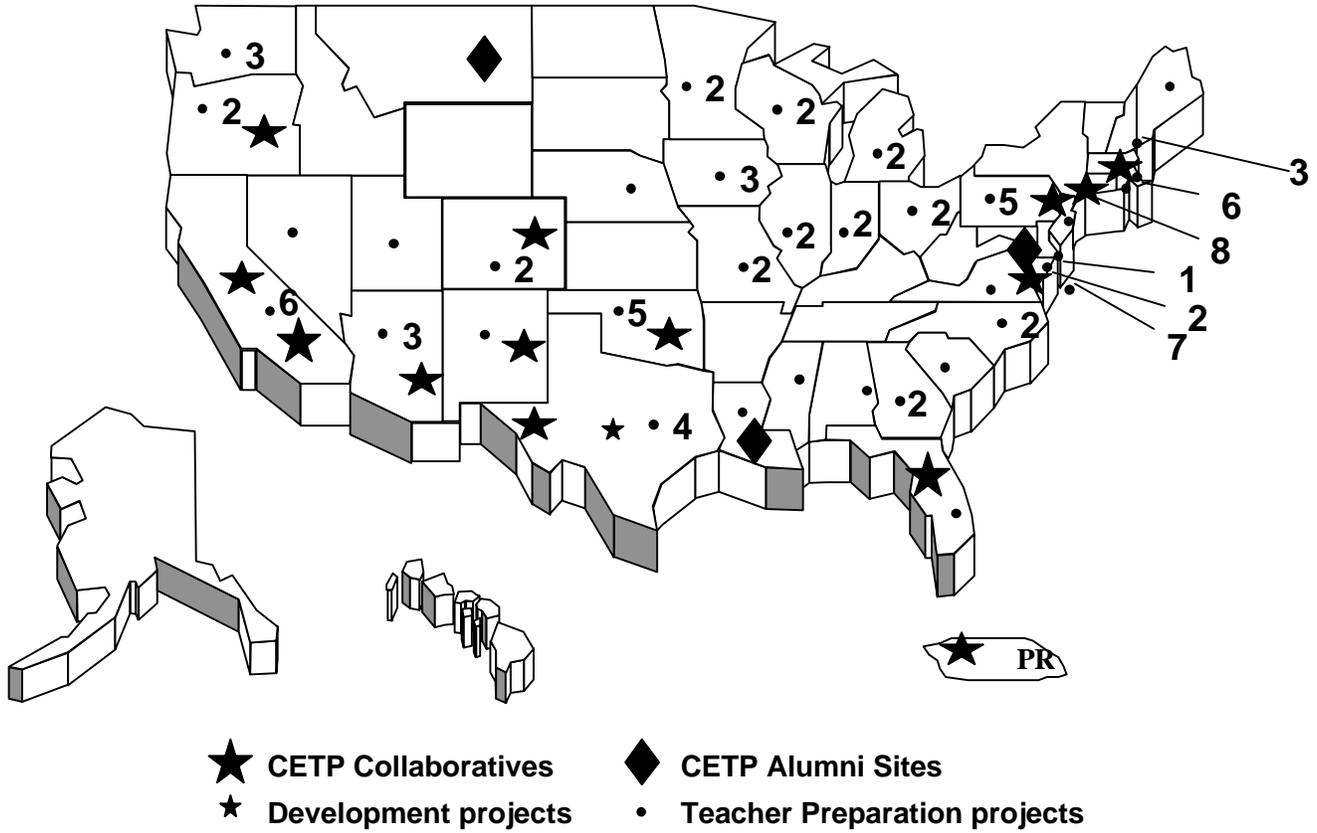
Teacher preparation is supported throughout the Directorate of Education and Human Resources. The Divisions of Elementary, Secondary, and Informal Education (ESIE), Educational Systemic Reform (ESR), Human Resource Development (HRD), and Research, Evaluation, and Communication (REC) all contribute to 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 Informal Science Education Program provide opportunities outside a formal school setting for individuals to increase their understanding and appreciation of science, mathematics, engineering, and technology. With support from 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. The HRD Program for Persons with Disabilities supports the development of intervention strategies to increase the interest, retention and advancement of students with disabilities in SMET education and careers. 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. The primary research program under REC, Research on Education, Policy, and Practice, supports the cultivation of a research base for implementing K-16 educational reform and advancing the understanding of learning and pedagogical processes.

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

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

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

### MAP OF NATIONAL IMPACT: FY 98 CETP/TP COLLABORATIVES AND PROJECTS



**This document has been archived.**

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

**PROJECT DESCRIPTIONS: FISCAL YEAR 1998**

**NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER  
PREPARATION (CETP)**

**Full Collaboratives for FY 98**

**Puerto Rico Collaborative for Excellence in Teacher Preparation (PR-CETP)**

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DUE-9753543  
\$5,000,000

The Puerto Rico Collaborative for Excellence in Teacher Preparation (PR-CETP) includes science, mathematics, and education faculty from the six main institutions that prepare over 80% of K-12 science and mathematics teachers in Puerto Rico -- the University of Puerto Rico-Rio Piedras, Mayaguez, and Cayey campuses, the Inter-American University System, Ana G. Mendez University College of the East, and Pontifical Catholic University of Puerto Rico -- in partnership with the Resource Center for Science and Engineering, the Puerto Rico Department of Education and exemplary K-12 schools, the Arecibo Observatory and local industry. The goal of the PR-CETP is to enhance the conceptual understanding of the disciplines to be taught by future teachers as well as their mastery of content specific teaching methodology, in alignment with local and national standards. The PR-CETP articulates with the K-12 systemic reform of the Puerto Rico Statewide Systemic Initiative (PRSSI) and the undergraduate reform of science and mathematics education through the Alliance for Minority Participation project. Key courses in content and teaching methods are being redesigned following a constructivist approach and incorporating authentic assessment methods and the use of educational technology. Practicum and field experiences in PRSSI and other exemplary schools will be established. A capstone course for students to engage in school-based curricular materials development is being created as well as a course in the principles and methods of scientific research to promote preservice students' participation in research experiences in EPSCoR laboratories. A degree in natural sciences for elementary and intermediate teachers is being pioneered at one of the institutions. A Collaborative Action-Research Program promotes joint efforts between faculty of science, mathematics and education, teachers and students. Student Academic Support activities recruit students to pursue studies in areas of shortage of certified teachers, support students with academic difficulties, and provide induction activities to graduates with exemplary teachers as mentors. Academic administrators are developing institutional policies to recognize and value faculty efforts in the continuous reform of teacher preparation programs and to institutionalize the collaborative reform. The PR-CETP is expected to impact over 5,000 future teachers.

## **Florida Collaborative for Excellence in Teacher Preparation (FCETP)**

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DUE-9753546  
\$2,499,848

The Florida Collaborative for Excellence in Teacher Preparation (FCETP) project is building a state-wide model of interdisciplinary and institutional cooperation for improving the preparation of future middle and high school science and mathematics teachers. The collaborative, centered at Florida A&M University, includes Florida State University, the University of Florida, University of North Florida, the University of West Florida, the University of Central Florida, Florida International University, Bethune-Cookman College, Tallahassee Community College, Miami-Dade Community College, and Florida Community College at Jacksonville in addition to area school districts and educational organizations that support the preparation of mathematics and science teachers.

Program goals are to: 1) increase significantly the number of high-achieving high school graduates who enroll in and receive baccalaureate degrees from science, or mathematics teacher education programs; 2) establish an effective community of SMET faculty from participating institutions, and work towards increasing the frequency and effectiveness of communication among these faculty and participating teachers and students; 3) develop a core of mathematics and science courses for pre-service teachers that are inquiry-based and taught in cooperative learning environments; and 4) create a model of teacher training that also incorporates summer mentoring of FCETP students and early sustained classroom experiences.

## **CETP FY 98 Development Grants**

### **Texas Collaborative for Excellence in Teacher Preparation**

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DUE-9753542  
\$470,000

The Texas Collaborative for Excellence in Teacher Preparation (TCETP) is a ten university partnership committed to joint development and common implementation of comprehensive improvements in the preparation of K-12 teachers in mathematics, science, and technology. Fifteen Collaborative Faculty from the departments of mathematics, science, and education at eight universities in The Texas A&M University System and from Texas Woman's University and Angelo State University are leading this effort. This partnership prepares over 25% of Texas K-12 teachers and 25% of the mathematics and science teachers certified annually in Texas, typically over 3,700 Texas teachers certified each year. Through its partnership with the NSF Texas Statewide Systemic Initiative (TSSI), 47 of Texas' Presidential Awardees for Excellence in Science and Mathematics Teaching, and major industries committed to preservice and novice teacher internships, the project is positioned to implement common systemic improvements and disseminate them in Texas and nationally. The five project goals of the Collaborative Faculty are Core Course and Curriculum Redesign, Recruitment to Teaching, University Faculty Professional Development and Instructional Modeling, Industry Internships for Preservice and Novice Teachers, and Partnership with the Texas SSI and Texas Presidential Awardees.

## ADVANCED TECHNOLOGICAL EDUCATION (ATE) PROGRAM

### Network Training for Educators

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DUE-9752060  
\$350,742  
Interdisciplinary

This project creates a statewide infrastructure that provides education and training in network technology for 2-year college and secondary computer technology faculty that, in turn, enables the implementation of a computer network management curriculum for two-year technical students, a related curriculum for secondary students, and enables the utilization of computer networks as an instructional tool. Prospective teachers are being prepared to introduce, teach, and maintain information technology systems in the K-12 schools.

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

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DUE-9752081  
\$700,000  
Interdisciplinary

Hawkeye Community College along with Kirkwood Community College and Lansing Community College is currently validating and implementing a coordinated precision agriculture curriculum which incorporates modules and courses in precision farming, environmental science, and geographic information systems with a core of applied mathematics and science courses. Preservice teachers and current teachers are offered workshops in precision agriculture technology and conferences to coordinate discussion on articulation between educational levels.

## COURSE AND CURRICULUM DEVELOPMENT (CCD) PROGRAM

### Integrating Pedagogical and Curriculum Theory with Teaching Practice Throughout all Mathematics and Science Courses in the College of Arts & Sciences and Evaluating and Disseminating the Results

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DUE-9752185  
\$100,000  
Mathematics

Georgia State University (GSU) is beginning to design, implement, and report on the results of systemic change in pedagogy in collegiate-level mathematics, statistics, computer science, and physical sciences courses, especially those for preservice teachers, in keeping with the recommendations of the Mathematical Association of America and the American Mathematics Association of Two-Year Colleges. One goal of the project is to change the basic *modus operandi* of how courses are taught. The initial focus is on the first two years of college mathematics, statistics, and computer science with plans to extend the efforts into the physical sciences. In the first phase of the project, faculty in Mathematics and Computer Science are collaborating with faculty from the GSU College of Education to coordinate

pedagogy taught in education courses with that experienced in content courses. The second phase of the project includes the participation of faculty from Chemistry and Geology departments. The project includes support for representative faculty from other schools to plan programs for their institutions. Products include: an ethnographic study of the entire program; a model for colleges interested in such systemic change; and guidelines/practical suggestions on ways in which mathematics and science departments can spur joint effort among faculty to ensure that innovative curriculum development and pedagogical change has a sustained impact.

### **Engineering and Technology Literacy for High School Science and Math Teachers**

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DUE-9752186  
\$150,000  
Interdisciplinary

This project is providing preparation for science and mathematics teachers to address the need to encourage more students to pursue engineering careers. The project is developing a capstone course that introduces fourth year preservice teachers in mathematics and science education to engineering problem solving through specific practical applications. The course focuses on the practice of engineering rather than theory. In addition, the business aspects of engineering, a prerequisite for a successful engineering career, are introduced. The course includes projects to be completed by teams of students and features guest lecturers. A business plan or cost analysis will be completed for each project undertaken by the students. The course includes activities performed by practicing engineers and the related ethical, social and environmental issues within the rubric of Science, Technology and Society (STS) and emphasizes science literacy and inquiry learning as suggested by the National Science Education Standards.

### **The Rio Grande River Project: An Interdisciplinary Math/Science Curriculum for College Freshmen and Sophomores**

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DUE-9752192  
\$110,000  
Interdisciplinary

Laredo Community College is developing a two-course undergraduate interdisciplinary program of studies focusing on a major natural resource at risk, the Rio Grande River. The program integrates biology, algebra, trigonometry and the physical sciences using problem-posing, discovery learning, river monitoring and exploration, teleconferencing, microcomputers, and culminates with a student-led mini-science symposium. This interdisciplinary approach provides a model for those students intending to pursue K-12 science teaching as a career. The project is developing approaches effective with students for whom English is a second language. The major objectives of the project are to: 1) help faculty design interdisciplinary math/science courses; 2) design a two-course sequence which will provide the required foundations in four areas of college mathematics and science; 3) maintain a high level of academic achievement for participating students; 4) increase career knowledge in mathematics, science and math/science education, especially for female and Hispanic students; and 5) expedite institutionalization of the courses.

### **Guided Inquiry Physical Chemistry Laboratory**

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DUE-9752195  
\$220,000  
Interdisciplinary

In recent years, extensive efforts have been expended to develop open-ended, inquiry-based, laboratory exercises for introductory, college-level chemistry courses to develop the student's conceptual, molecular-level picture of chemical interactions. This project is restructuring physical chemistry laboratory courses by creating a set of real-world, inquiry-based experiments that reflect current practice. Cutting-edge materials are examined with spectroscopic techniques such as adsorption, luminescence, FTIR, photocorrosion, and chemical derivatization. The courses are completed with groups of experiments highlighting biochemical experiments to appeal to those with medical interests, environmental experiments for the environmental studies constituent, and electrochemistry to appeal to engineers. Dissemination of the project includes workshops and follow-up visits to participants' institutions by project faculty.

### **Interactive Fractals and Chaos Unit for Undergraduate Science Education**

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DUE-9752226  
\$99,925  
Interdisciplinary

An integrated mathematics and science course and accompanying pilot technological enhancements use fractals and chaos to build a conceptual understanding of scientific principles in mathematics, physics, chemistry, and biology for undergraduate students training to be pre-college teachers. This project builds on the previous NSF-funded K-12 project, Mathematics and Science Teacher Enhancement through Chaos and Fractals. Technological enhancements consist of: 1) interactive exercises based on spreadsheets; 2) Java applets; and 3) hypertext curricula and evaluation material. Content areas include: 1) SYMMETRY: the mathematical properties of translational, rotational, and self-similarity symmetries are used to provide a basis for understanding the concept of invariants; 2) PATTERN FORMATION PROCESSES: the mechanisms of processes that generate tree structures are used to understand the vascular and pulmonary branching patterns in biological systems; and the spatial patterns generated by diffusion in chemical systems and their resultant time dependencies; and 3) PREDICTABILITY: the mathematical properties of nonlinear, chaotic systems, such as sensitivity to initial conditions, bifurcations, and attractors in phase space are used to develop the concepts of stability and instability in physical systems such as fluid flow, in chemical systems such as biochemical reactions, and in biological systems such as predatory-prey relationships.

### **Integration of Collaborative Case-Based Learning into Undergraduate Biology Curricula via Molecular Computer Simulations and Nationwide Internet Conferencing**

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DUE-9752268  
\$299,912  
Life Sciences

This project addresses the need to engage introductory biology students in critical thinking and problem-solving by making topics in molecular biology more interesting and relevant to all students. Open-ended software simulations integrated with Internet conferencing are facilitating collaborative case-based learning among teams of students at a variety of educational institutions across the nation and the world.

Simulation modules share a user-friendly interface and generate realistic output in a format understandable to introductory biology students. The modules work with any DNA, RNA, or protein sequence and also give students the option of using simulated laboratory equipment to generate data. Students analyze pre-designed cases or else develop their own cases using molecular sequences obtained via the Internet. Preservice K-12 science teachers involved in case development and evaluation are gaining experience with research methodology applicable to their own classrooms. Educators can download modules, cases, and resource manuals at no cost from an Internet site at the University of Wisconsin-River Falls. Project results are being widely disseminated at local, regional, and national professional meetings, and also are published annually on the BioQUEST Library CD-ROM.

### **Integrating Mathematics and the Sciences in Teacher Education Programs**

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DUE-9752285  
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Interdisciplinary

A team of mathematicians, science educators, and scientists from three institutions (a research university, a technical/community college, and a historically black university) is reforming teacher preparation courses, making them student-centered, inquiry based, and aligned with the national K-12 science standards. Courses include projects, in which students design and conduct their own investigations over a period of weeks. One pair of physical science and biology courses is being thoroughly integrated in content and pedagogy, with instructors in one course teaching in the other, and with joint staff meetings. A summer retreat and some cross-disciplinary teaching facilitate the integration of mathematics and science at all three campuses. Research on the successful treatment of the nature of science in one course supports curriculum development in other courses.

### **Rich Problem Solving Contexts: Integrating Mathematics and Reading Curricula for Preservice Elementary Teachers**

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DUE-9752288  
\$150,224  
Mathematics

This project focuses on the following primary objectives: 1) coordinating curriculum offerings in three interrelated courses for preservice elementary teachers (mathematical content, mathematics methods, and reading methods); 2) creating and field testing new curricular materials for use in the targeted courses; 3) evaluating the completeness and appropriateness of the courses and materials developed; and 4) disseminating the curriculum materials to teacher education faculty locally, regionally, and nationally. The project is collaborating with the Oklahoma Collaborative for Excellence in Teacher Preparation (O-TEC) to ensure that the development work in this project is fully aligned with the goals and needs of O-TEC. A series of "rich problem solving contexts" comprised of an inter-related set of mathematical ideas and educational activities designed to build a full context for meaningful learning are being developed and field tested under the guidance of an outside evaluator. The project is providing valuable data with important implications for the design of reading and mathematics curricula for preservice teachers. The resulting curricular materials are being disseminated through a variety of media including paper presentations, journal articles, and a professional development conference which serves as a vehicle for establishing a network for the exchange of information among teacher education faculty locally, regionally, and nationally.

### **Energizing Physics Teachers for the Twenty-First Century**

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Physics

The College of Education and the College of Engineering at Auburn University (AU) are developing a comprehensive four part program to enhance physical science education at the K-12 level. The effort is based on a new course entitled Engineering Physics for Teachers which prepares teachers to meet national science standards via problem solving using dimensional analysis, appropriate graphing, logical reasoning and teamwork. The course theme of energy is taken from the 1995 *Alabama Course of Study: Science* developed by the State of Alabama Department of Education. Problems, demonstrations, and projects use energy-related technologies to which the general public can relate. The four efforts of this project are to: 1) refine and improve the existing course; 2) expand the target audience to future and practicing teachers in Birmingham using real time video link with the University of Alabama at Birmingham; 3) develop accompanying resource materials in the form of printed matter and CD-ROM; and 4) incorporate and integrate resources developed in the course into the Science in Motion van program, a successful state-wide K-12 outreach effort. The project aims to provide teachers with information on state-of-the-art technologies so they can: 1) describe 21st century science in their classrooms, with special emphasis on energy usages in homes and automobiles; 2) integrate physics, mathematics and engineering with methods of teaching; enhance interest in science through projects that involve energy and engineering concepts; and 3) provide teachers with a systematic approach to quantitative problem solving.

### **Using Technology to Transform Instruction and Improve Learning in Introductory Psychology**

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Social Sciences

An Introduction to Psychology course, the focus of this project, emphasizes active learning using computer-based laboratories and collaborative groups. The world-wide web is used to deploy course materials, laboratory experiences, information retrieval and evaluation exercises, and practice quizzes "any time, anywhere." Evaluations of student satisfaction and learning showed that students appreciated the flexibility of the on-line format, and that they learned as much as students taught in the traditional lecture-test format.

This project is improving the quality of the collaborative group interactions in the course, increasing the amount of student learning through increased opportunities for active learning enabled by technology, identifying those students for whom an on-line course is most appropriate, conducting a thorough evaluation of the on-line course format to determine how it can be used to improve both immediate and long-term learning of content, and disseminating the findings so that the course may serve as a national model for the social and behavioral sciences. Four more Web based courses are now being developed in the College of Education to allow elementary education majors to take initial courses in mathematics and science teaching in this format. It is hypothesized that this will further sensitize future teachers to the importance of using a variety of teaching approaches and determining what is working and not working with their students. The project is assessing learning styles and personality traits in order to determine the characteristics of those students who benefit most from the on-line course format.

### **Virtual Science Environment for an Oceanography Course**

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DUE-9752367  
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Geosciences

This project addresses science literacy and knowledge transfer from research to the classroom. Students are participating in the work of science by collecting real Earth data, making authentic observations on the sea-floor, and analyzing and interpreting obtained results. Interactive, multimedia modules for a general education class and also for preservice teacher to use in their classrooms are being developed. The emphasis is on teaching students both content and the process of doing science. Many of the investigations are automatically graded and posted to the students' records, thereby allowing instructors to help students achieve higher cognitive levels of understanding. The project develops a "Virtual Science Workshop", and "Virtual Reality Field Trip to the Mid-Ocean Ridges", both of which build on, and integrate with, the recently developed "Our Dynamic Planet" CD-ROM, created by the PI, with support from NSF. The interactive "Virtual Science Workshop", modeled after a real science workshop, addresses the issues of providing students with background information in an engaging way, modeling how scientists argue from evidence, and helping students to pose their own experimental problem. The "Virtual Reality Field Trip" to the mid-ocean ridges uses the latest research data from ongoing ridge and vent studies to create a dynamic field laboratory where students can explore, gather data, and analyze their findings.

### **A New General-Education Biology Course: An Integrated Approach**

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DUE-9752402  
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Life Sciences

This introductory biology course is designed to serve both majors and non-majors, with particular attention to those students preparing to be teachers. Students are introduced to concepts in context through seven to fifteen scenarios based on popular issues or current research conducted at Oklahoma State University. In lecture, students work collaboratively, making observations, formulating hypotheses, answering questions, and solving problems stemming from the scenarios. An extensive set of multimedia materials and demonstrations present and define the scenarios for the students. Newly developed laboratories help students solve or explain the scenarios presented in lecture. Students conduct pre-laboratory activities in a Learning Resources Center and on the WWW allowing the full use of laboratory time for designing and conducting experiments. Computers are used to collect and analyze data and produce team reports in each laboratory. Approximately 900 students will be affected each year, including 150-200 lower division K-12 education majors and a dozen upper-division science-education majors acting as group facilitators. The impact of the course is being examined via the use of test scores, attitude surveys, direct observation of students, and interviews with students and faculty.

### **Peer Learning Resource Materials for Introductory Geoscience Courses**

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Geosciences

The goal of this proposal is to publish a guidebook and video for teachers who wish to implement innovative teaching methods to make science learning an active process in introductory geoscience, Earth

systems, and geology courses. The teacher's guide and video is based on the method of peer learning developed for introductory physics by Dr. Eric Mazur at Harvard University. In essence, the teacher presents a small amount of information, then poses a challenging conceptual question for the students to answer. Students try to convince their peers that their own answers are correct, hence the phrase "peer learning". In the process, students construct explanations and communicate their ideas to others, making the classroom science experience an active one, yet providing a sense of routine and structure that is meaningful and fun for students. Teachers draw upon the extensive collection of class-tested, ready-to-use peer learning materials compiled in the teacher's guide. The video, produced with AudioVisual Instructional Services at Franklin and Marshall College, consists of visual examples of how this peer learning approach can be implemented.

### **On-Line Weather Studies: Introduction to the Atmosphere Through the Use of Internet-Delivered Meteorological Information**

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Geosciences

The American Meteorological Society (AMS) is developing for national implementation a one-semester, introductory college-level, on-line distance-learning course on the fundamentals of atmospheric science in which students study weather as it happens. The project is preparing learning materials for teacher preparation students that demonstrate good pedagogy and innovative ways of presenting content. This course addresses the need for innovative and cost-effective science education opportunities for an increasingly diverse and non-traditional student population. It is providing pre-service teachers with both an understanding of meteorological principles as well as numerous useful classroom investigations. The course contains learning activities with components written to current meteorological data and delivered via the Internet. Use of simulation modules and a weather forecasting module, developed at Iowa State University is an integral component of this initiative. The experience of real-time study enables students to negotiate scientific understanding of the atmosphere and its processes while actually tracking the ways the atmospheric system behaves.

### **An Innovative Mathematics, Science, and Technology Program for Pre-Service Elementary Teachers**

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Interdisciplinary

A model, innovative program to restructure the elementary preservice teacher preparation program at the University of Virginia involves over twenty Education, Arts & Sciences, and Engineering faculty. Six new mathematics and science content courses stressing hands-on activities are being developed, and three other courses are being restructured to be more aligned with National Mathematics and Science Education standards. Following completion of the six new mathematics and science courses, preservice students take a capstone research/design course: a two semester course of integrated mathematics, science, and technology (including engineering). The first semester course integrates mathematics and science with an emphasis on data analysis and presentation. Students complete several mini-projects to acclimate them to research problem solving, and prospective faculty mentors present possible student projects for the second semester. During the second semester each group of students completes a research project under the direction of a faculty mentor. Instructional technology is emphasized in all phases of the project.

### **Linking Undergraduate Geoscience Research Programs and Teacher Education Programs**

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\$149,998  
Geosciences

The American Geophysical Union, is bringing together geoscience and education faculty, and appropriate administrators, from four higher education institutions (University of Arizona, University of Oklahoma, University of Washington, and Montana State University) for the purposes of finding and developing a viable undergraduate curriculum that will lead to teacher certification for geoscience students. These four institutions, and the programs they develop and implement, will serve as models for other institutions. This initiative will present ways in which a four-year, science-based major can effectively integrate a professional education component. This initiative, an accompanying report, and special teacher preparation session(s), held at the annual meeting of the American Geophysical Union, provide an important implementation model for other institutions working to develop similar programs.

### **The Effective Use of Web-Based Scientific Resources in Teaching & Teacher Training: A Collaborative Pilot Program Using Real Data Sets to Explore Oceanography & Global Environmental Change**

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Life Sciences

The availability of real scientific data via the World Wide Web (WWW) affords a unique opportunity for educators to teach science in authentic and engaging ways. This project is exploring ways in which educators can most effectively use the scientific resources available via the World Wide Web in their curriculum development and teaching. The project is linking scientists and data at the Bermuda Biological Station for Research (BBSR) with prospective science teachers in the College of Education at Florida International University. This link is mediated via an existing virtual campus operated by the College of Exploration. The content emphasizes global environmental change as it relates to the oceanographic data in BBSR's Bermuda Atlantic Time-series Study. The objective is to help prospective teachers gain the skills needed to design additional web-based curricula for use in grades 6 to 12 classrooms. Curricula developed during this course are shared with teachers everywhere through a web database. The project is also documenting the most effective design process for creating a web-enabled learning environment by identifying the components, pedagogies, personnel, and technologies needed to make the distance-learning environment effective.

### **A Modular, Integrated, College Science Course for Pre-Service Elementary Teachers and Other Non-Technical Majors**

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DUE-9752498  
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Interdisciplinary

This project develops a broad-based, interdisciplinary approach for future elementary school teachers leading to a positive attitude toward science. Twenty teaching modules are being developed that cover major science concepts and inquiry skills outlined in national and states standards. Each module is designed for two weeks of class time. While the approach is specifically designed for preservice teachers,

it also meets well the needs of all non-SMET majors. The modules also provide an excellent format for inservice development.

### **Mathematical Modules in Biology and Chemistry**

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DUE-9752555  
\$49,952  
Mathematics

The central role that mathematics plays in the advancement of all branches of science has created the demand for biologists and chemists who are quantitatively literate, mathematicians who can work with scientists in collaborative problem solving efforts, and educators who have a broad perspective on the interplay between mathematics and the sciences. This project is developing a library of modules through which students majoring in biology, chemistry, mathematics, and mathematics education gain substantial practical experience in the application of mathematical methods to biology and chemistry. Each module is being developed through a collaborative effort by mathematics and science faculty and addresses individual applications at four levels: precalculus, differential calculus, integral calculus, and differential equations. Through use of the modules in mathematics courses and science laboratory courses, science and mathematics students learn to work together as a problem solving team and to accurately express the results of their mathematical and scientific investigations in writing.

### **Environmental Literacy for All Students: Development of Environmental Science Courses in a New Core Curriculum**

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DUE-9752602  
\$150,000  
Interdisciplinary

This project is developing environmental courses in four science disciplines: biology, chemistry, geology, and physics. These courses constitute a particular area of Georgia Southern University's new core curriculum that will be required of all students, including science majors, non-science majors, and future K-12 teachers. The new courses utilize environmental issues to introduce and discuss relevant scientific concepts, providing in-context instruction on a "need-to-know" basis. The project has three distinctive features: 1) an approach that will expand students' awareness of local, regional, and global environmental problems; 2) a focus on hands-on laboratory activities based on these issues; and 3) involvement of advanced science and science education majors in the laboratories as faculty-mentored interns in the Undergraduate Teaching Internship Program (UTIP). Expected project outcomes are: 1) graduates who possess the knowledge to engage in environmentally-aware behavior and informed citizenship; 2) improved scientific and environmental knowledge of future K-12 teachers; and 3) appreciation by students of the connections between science and real-world problems; and teaching experiences for UTIP participants.

### **Project C-CUESST: A College Curriculum for Elementary School Science Teachers**

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\$244,374  
Physics

The goal of this project is to design and implement an inquiry based undergraduate physics course for preservice K-8 teachers which integrates scientific content knowledge with research based knowledge

about teaching and learning science. Research evidence has been building to support inquiry-based lessons, student centered pedagogy such as cooperative learning and peer teaching, and computer based laboratory instruction as effective strategies to improve student learning. This project is implementing and evaluating these strategies in Concepts in Physics, an introductory course for future K-8 teachers designed by a team consisting of physics and education faculty and a teacher from the local school district. The course is integrated with the science methods course. Of special concern are strategies to address ethnically diverse student populations.

### **An Interdisciplinary Approach to Teaching Mathematics and Composition Through a Course Cluster**

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Interdisciplinary

This project is designed to strengthen mathematical and writing skills among first-year college students who do not plan to major in a field with specific mathematical requirements. In this integrated teaching approach, students are enrolled simultaneously in an introductory level mathematics and a writing class. The mathematics class provides students with the skills necessary (basic number theory, vectors, functions, permutations, and some basic group theory) to understand and create check digit schemes. In addition to exploring the topic of check digit schemes in depth, students also investigate the uses of mathematics in other academic disciplines. Applications to cryptography, finance, art, and science are explicitly explored. In the writing course, the students are guided in the writing process and compose six formal essays, based on content from the mathematics class. Students learn the value of writing to research and to express an understanding of a mathematical topic. Electronic resources are also being developed to support this approach. The course enrolls a number of teacher education freshmen in the cluster each year, and uses education students who have completed the cluster as mentors or undergraduate teaching assistants.

### **Learning to Teach While Learning to Learn**

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Interdisciplinary

The purpose of this project is to develop and test a model for revitalizing introductory geoscience courses. The approach is two-pronged: 1) to use appropriate computer-based technology to engage students in constructivist, inquiry-based activities in large introductory science courses, and 2) to help enrolled pre-service teachers critically analyze the teaching and learning strategies used in these courses. The goals for this project are to restructure and revitalize two introductory science courses and to develop companion science methods courses to be taken concurrently by preservice teachers. Java simulations provide natural learning environments for students and allow instructors and students to analyze student efforts and thought processes. These methods are being tested in similar science courses at the University of Northern Iowa. This project is: 1) producing a collaborative model to improve learning in large introductory science classes by restructuring the classes to integrate constructivist, inquiry-based activities; 2) enhancing preservice teacher science education by encouraging student teachers to focus on their own metacognition while learning science; 3) providing learner-centered, inquiry-driven simulations and management software which will be widely available on the Internet for use in K-12 and college science courses; 4) modeling exemplary uses of instructional technology for preservice teachers; 5) demonstrating the transferability of the model by revising an introductory course in a second geoscience

area; and 6) providing an instructional software design framework for use in the development of future inquiry-based simulations.

### **C<sup>3</sup> Connection, Collection, and Correlation**

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Life Sciences

The American Society for Microbiology (ASM) is developing and disseminating an electronic collection of peer-reviewed teaching and learning resources for biology education specifically centered on the microbial world. The primary purpose of the electronic collection is to establish a national center of microbiological resources for teaching and learning. Entries range from the basic sciences to engineering, environmental sciences, medicine and public health, public policy, and business. The collection has two unique features: 1) all items included in the collection are correlated to key microbial concepts and basic laboratory skills for undergraduate education; and 2) all items are peer-reviewed and selected for scientific accuracy, educational quality and visual presentation. Curriculum development teams connect the national collection of microbial resources to the World Wide Web (WWW) and correlate these resources to key microbial concepts and basic laboratory skills. The development teams identify the resources and link the collection of educational resources to key microbial concepts and basic laboratory skills. The collection contains specific information which would appeal to preservice teachers and can be used by them to introduce microbial concepts into their classes.

### **MIDDLE MATH: A Project to Improve the Undergraduate Mathematics Preparation of Middle Grades Teachers**

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Mathematics

MIDDLE MATH is a project to improve the undergraduate mathematics preparation of middle grades teachers. The project focuses on the development of an algebra/number class, and a precalculus course that forms a bridge from the algebra class to the later calculus sequence. The curriculum development is based on experience and seminal recommendations by the NCTM, MAA, and mathematics education researchers. The model for course development is grounded in a dynamic cycle of research on the materials and their effect on student learning. The project team includes mathematicians and mathematics educators. The project benefits from a strong institutional commitment to improve the quality of teacher preparation, and a research video laboratory that facilitates the study of teaching and learning with new course materials and methods of instruction.

### **Transforming the Teaching and Learning of General Biology for Non-Majors: A Model for the 21st Century**

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Life Sciences

Portland Community College is undertaking a radical transformation of its introductory biology curriculum to better reach and prepare students for advanced science courses, teaching careers, technical training and most importantly to improve science literacy and application of this knowledge in the home,

workplace, and the world. This revitalization shifts the college's industrial age model of science education into an information age model which addresses the needs of 21st century learners and workers. The faculty are creating a new learner driven curriculum, modifying existing instructional materials and developing new materials as they transform the current audio-tutorial method of general biology instruction to include small group sessions and an enhanced multimedia platform with multimedia based instructional materials. The project is working closely with the Oregon Collaborative for Excellence in the Preparation of Teachers to ensure that students in the course preparing to be teachers will be able to use new technologies in their future teaching careers.

### **Mathematical Modeling as Teacher Preparation**

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Mathematics

This project is developing, field-testing, and publishing a text for a modeling course intended both for majors and for future secondary school teachers of mathematics which mirrors and models courses that future teachers will experience in the high school classroom. The course emphasizes how to mathematize a problem and how to select the mathematics to use. It also makes frequent use of technology, group and inquiry based learning, and alternative assessments.

### **Hands-on Laboratory Projects for Non-Engineers: Learning Scientific Principles in the Context of Everyday Technology**

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Engineering

This project develops, evaluates, and disseminates, hands-on laboratory exercises specifically designed for undergraduates who are not majoring in SMET disciplines. A portion of the project focuses on teacher preparation with a significant number of the target audience being future K-12 teachers. Familiar technological devices such as the automobile, the radio, and the telephone are used to engage the interest of students in learning about technology and science. Exercises explore both the technological and the scientific aspects of these devices and demonstrate how technology incorporates a scientific understanding of nature. All exercises are designed to result in tangible evidence of accomplishment on the part of the student such as construction of a simple working radio. Approximately half of the projects use inexpensive and simple materials so that each student can take home the working device. Other exercises stress a high degree of contact with the workings of technology such as construction of a diode laser light source or construction of a 4-bit binary adder from basic logic circuits. Exercises are optimized for non-engineering and non-science students with little prior technical background. All laboratories are inexpensive, do not require any specialized equipment or facilities, and are capable of being modified to suit different institutional circumstances.

## Chemistry ConcepTests Linked to Course Learning Objectives

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Chemistry

Presentation of sophisticated course material to chemistry students has become easier, richer, and broadly available, significantly enhancing or sometimes replacing the traditional lecture mode of information delivery, but comes with the risk of overwhelming students with information. Students need the ability to determine whether they are on track towards meeting the learning objectives that are expected of them. Similarly, faculty need to recognize whether their teaching methods are effectively bringing students to success in the course learning objectives.

Working with the ConcepTests database, which is part of the University of Wisconsin New Traditions Project, this project is producing a collection of web-based questions intended to be useful to students for self-assessment and to faculty for immediate feedback in class. This project is adding to the size and diversity of the ConcepTests database, and extending its usefulness by correlating the questions to specific learning objectives for general chemistry and organic chemistry classes. The ConcepTests are being evaluated in terms of their usefulness in assessing student readiness for different levels of chemistry in general education coursework. The project is collaborating with the Oregon Collaborative for Excellence in Preparation of Teachers in developing support systems for the two mainstream chemistry courses and a seminar on teaching/learning that help students recognize the values and rewards of teaching as a profession.

## INSTRUMENTATION AND LABORATORY IMPROVEMENT (ILI) PROGRAM

### Teaching Laboratories in Mathematics and Astronomy

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Interdisciplinary

Hofstra University is enhancing the science education of non-majors, and especially prospective K-12 teachers, by constructing a dedicated Teaching Laboratory for the Departments of Mathematics and Physics. The laboratory serves 820 students enrolled annually in the courses "Mathematical Excursions" and "Explorations in Mathematics", 625 students enrolled annually in the courses "The Solar System" and "Stars and Galaxies", and an anticipated 120 students enrolled annually in a new course "Models and Algorithms" developed with support from this project. The project involves students actively learning major concepts and methodologies of both mathematics and astronomy: the processes of observation, discovery, description (as rules or algorithms) and verification. The Teaching Laboratory includes 18 networked high-end personal computers (PCs) together with an instructor station, projector and printers serving instructional needs in all of the affected courses and PC-based charge-coupled device (CCD) cameras attached to existing telescopes to facilitate gathering data for later analysis in Astronomy courses. The Teaching Laboratory complements several existing open-access laboratories located throughout Hofstra's campus.

### **Design and Rapid Prototyping Instrumentation for Technology Teacher Education**

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Engineering

The Design and Rapid Prototyping Instrumentation Project for Technology Teacher Education puts high-tech design equipment in the hands of tomorrow's technology teachers. The objective of this project is to give undergraduates in technology education experiences with advanced tools for technological design, an increasing emphasis for secondary school teachers. Students engage in both two- and three-dimensional design experiences using page scanners, design or drafting software, and a laser cutting machine. Students use a three-dimensional laser scanner to input the surface coordinates of existing objects and then manipulate this design data to suit the needs of their project. The output is either an illustration, or files that can be used with an existing numerically controlled milling machine or an existing fused deposition modeling machine to create a prototype.

### **An Undergraduate Instructional Laboratory for Computer Mapping and Geographic Information Systems**

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DUE-9850595  
\$36,345  
Social Sciences

An undergraduate Geographic Information Systems (GIS) instructional computer lab is enabling the Department of Geography and Planning, in cooperation with two research/education centers at Buffalo State College (BSC), to expand its course offerings and undergraduate research opportunities and to develop new and innovative K-12 curricula and teacher training tools. The instrumentation: 1) supports the development of new courses in computer mapping for elementary and secondary education majors and a summer workshop to provide similar training to teachers; 2) increases the effectiveness and number of computer mapping and GIS courses offered by the department for its majors and other non-education majors; 3) increases opportunities for undergraduate students to undertake supervised research projects on social and environmental problems; and 4) supports the development of a new course in the application of GIS methodology in the analysis of environmental and conservation issues. The project is coordinated with the National Center for Geographic Information and Analysis (NCGIA) at SUNY Buffalo and reaches inservice teachers through the New York Geographic Alliance. Project results are being disseminated through a national conference on GIS in K-12 education organized by the NCGIA at SUNY Buffalo, the NCGIA at the University of California, Santa Barbara, and the Department of Geography and Planning at BSC.

### **Enhancing Undergraduate Curriculum Reform with an Interdisciplinary Science Computer Laboratory**

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DUE-9850643  
\$35,000  
Interdisciplinary

Lake Erie College is establishing an Interdisciplinary Science Computer Laboratory to significantly facilitate NSF-funded campus-wide undergraduate science reform currently underway. The computer laboratory fills a serious need to provide future K - 12 teachers the opportunity to become more engaged in problem-based learning using current technology. This project incorporates the simulation and

modeling ability of new science software into pre-teacher laboratory experiences. Students in biology, chemistry, physical science, mathematics, environmental management, psychology, and equine studies courses benefit from the 18 computers, software, and related "smart classroom" equipment by becoming more actively engaged in the scientific process. The computer facility is to be the focus for teacher preparation in science. Workshops utilizing new programs such as Geographic Information System software are being developed for pre-college students and teachers in the region as well as for students at nearby two-year colleges. The laboratories allow students to provide data to and interact with professionals in local environmental organizations.

### **Modern Laboratory Courses in Biochemistry and Immunology**

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DUE-9850654  
\$58,704  
Life Sciences

This project is providing biology majors, including those preparing to be teachers, with sophisticated training in protein purification, enzymology, monoclonal antibody development, cellular activation strategies, and mammalian cell culture techniques. The equipment facilitates major improvements in both Biochemistry and Immunology. The affected courses utilize a research approach. Students design experiments, generate, record, analyze, and disseminate scientific data from their own research. Other undergraduate courses benefiting from these improvements include: microbiology, cell biology, molecular biology, nutritional biochemistry, analytical chemistry, environmental chemistry, and instrumental analysis. The equipment also helps to enhance undergraduate research projects and a science camp for talented high school students.

### **Developing a Modern Genetics Laboratory for Biology Majors**

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DUE-9850691  
\$28,522  
Life Sciences

This project is enabling the department to build a strong program in genetics, one that incorporates modern theory and methods. Hands on investigative laboratories are being designed and offered to first and second year biology majors; many of whom are planning to be teachers. Laboratory exercises include computer simulations of Mendelian crosses of peas and *Drosophila*, sex-linkage and mapping through 3-factor linkage analysis and chi-square tests, cytological preparation and microscopic examination of giant salivary chromosomes. Identification of chromosomal mutations and haploid linkage analysis complete the transmission genetics labs. Students also isolate DNA, transform bacteria with plasmids, use restriction enzymes to construct standard curves, map restriction sites, probe Southern blots, amplify human DNA using the polymerase chain reaction, sequence DNA, align DNA sequences on a computer, and apply allozyme electrophoresis to a problem in population genetics.

**Development of an Interdisciplinary Environmental Studies Geographic Information Analysis (GIA) Program at Montclair State University**

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DUE-9850835  
\$35,469  
Interdisciplinary

Geographic information analysis (GIA) methods and techniques are being integrated into the undergraduate environmental studies curriculum in the Department of Earth and Environmental Studies at Montclair State University to provide a more active-learning, hands-on approach to interdisciplinary environmental study. The interdisciplinary framework examines phenomena and systems from a holistic perspective including integration of the scientific and societal dimensions of contemporary environmental issues and problems. GIA enables one to display spatial environmental data, such as land use, and geology, and to ask questions about how and why these phenomena interact. The integration of GIA will foster interdisciplinary study in three ways: 1) changing environmental issue and problem identification as a consequence of enhancing overall understanding and conceptualization of environmental issues; 2) strengthening analytical thought by encouraging alternative problem-solving approaches which recognize key interactions between natural systems and societal systems; and 3) focusing on differing perspectives in addressing and evaluating environmental issues that emerge from student/group dynamics. Students enrolled in earth science and biology secondary teaching certificate programs are required to take some of the courses undergoing revision.

**Enhancing Environmental Geology Courses through Development of Laboratory Exercises and Field Experiences**

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DUE-9850891  
\$13,948  
Geosciences

This project is revising a core curriculum environmental geology course that is required of all students, including science majors, non-science majors, and future K-12 teachers. The course utilizes environmental issues to introduce and discuss relevant scientific concepts, providing in-context instruction with a substantial amount of field experience. Distinctive features include: 1) an approach that makes students aware of local, regional, and global environmental problems which relate to the earth sciences; 2) a focus on hands-on laboratory activities; and 3) involvement of advanced science and science education majors in the laboratories as faculty-mentored interns in the Undergraduate Teaching Internship Program. The laboratory is equipped with three piezometer nests, with each nest consisting of two to three monitoring wells equipped with continuous water-level recorders which will record the hydraulic head in separate shallow aquifers as a function of time. With this system of monitoring wells, students learn how subsurface water levels can vary with time, how multiple "water tables" may exist in the subsurface, and how groundwater moves both vertically and laterally. In addition, students learn fundamental aspects of water quality and chemistry through the sampling and analysis of water from the monitoring wells.

### **Development of the Laboratory Component of a Materials Chemistry Course for Nonscience Majors**

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DUE-9850903  
\$38,305  
Chemistry

This project focuses on the development of new experiments for the World of Materials course for nonscience majors that is also mandatory for elementary education majors. The course explores the chemistry of familiar materials from everyday life (paper, fabrics, metals, plastics, glass, leather, etc.) and discusses the life-cycle of each material from its source in the animal, vegetable, or mineral world, through the stages of its processing to finished products, to its demise when it becomes used up or worn out and its ultimate fate in disposal or recycling. The new experiments allow students to observe microscopic and atomic-scale images, to carry out some pertinent chemical transformations, and to measure some important physical properties of these materials. For example, in one experiment the atomic structures of the surfaces of gold and graphite, observed using a scanning tunneling microscope, are correlated with their vastly different densities. These experiments allow students to observe atomic structure, experience real world chemistry, and draw their own conclusions about structure-property relationships in materials helping them to understand and appreciate why different materials behave the way they do.

### **Integrating Computer-Based Physiology Exercises across the Curriculum**

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DUE-9850907  
\$51,550  
Life Sciences

The School of Biological Sciences at the University of Kentucky is renovating its biology curriculum and designing new laboratory exercises for both majors and non-majors that center on the scientific method and science as a process. This project focuses on the development of a series of computer-based physiology laboratory modules using Macintosh-based data acquisition stations, each with probes, transducers and data analysis software. MacLab-based physiology exercises provide important components of the introductory laboratory for life science majors, the required midlevel Animal Physiology course and physiology-based summer research experiences. In addition, students preparing for careers in elementary and middle school education who are enrolled in the non-majors General Biology Laboratory utilize the MacLab system in a basic human physiology exercise. These laboratory exercises familiarize students with the use of computers in biological investigations, and provide opportunities for real time data collection and analysis, hypothesis testing, report writing and participation in active group discussions.

### **Scanning Probe Microscopy and the Science Curriculum: Course Development and Support**

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DUE-9850912  
\$21,350  
Physics

This project is introducing scanning probe microscopy (SPM) into the science curriculum at Lebanon Valley College (LVC), integrating SPM into both introductory and advanced physics courses and laboratories at LVC. A one-credit course on SPM for upper division students (e.g., biology and chemistry

students) who have completed one year of introductory college physics uses senior physics students who have been trained on SPM as laboratory teaching assistants. The project is developing demonstrations/short laboratory exercises to support courses offered by the chemistry and biology departments as well as the Master of Science Education program at LVC (a program designed for elementary and secondary school teachers). In addition, the SPM assists the department in its outreach programs to local high schools and industries and has the potential for not only introducing SPM concepts into the high schools but SPM instrumentation as well.

### **An Inquiry-Based, Problem-Solving Approach to Introductory Geology Laboratories**

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DUE-9850923  
\$40,800  
Geosciences

This project is establishing an inquiry-based, problem-solving, constructivist introductory geology laboratory experience with a particular emphasis on pre-college teachers. The laboratory curriculum is designed to engage students in three multi-week, continuing investigations that require them to collect observations and data, graphically and statistically analyze their data, formulate reasonable interpretations to specific scenarios, and present this range of information to classmates. These investigations address: 1) Earth Materials through a "tabloid" who-dun-it mystery where students will study Earth materials within the context of forensic geology; 2) Surficial Processes through the study of the "real value" of real estate (where students learn the potential hazards associated with purchasing a home); and 3) Earth Systems Science through development and testing of computer models for the past history of the Earth in order to understand the "precision" associated with global change predictions generated by computer Global Change Models. Assessment of the relative effectiveness of the individualized instruction designs is performed by the School of Education. Preservice students study the evaluation procedure as an integral part of their educational training. The Introductory Geology course fulfills the natural science general education requirement for preservice students and is required of preservice students in the science program.

### **Weather Analysis Laboratory**

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DUE-9850924  
\$44,522  
Geosciences

Mankato State University is equipping a Weather Analysis Laboratory with a series of Radac Workstations, an integrated Graphics Workstation capable of on-air quality TV graphics. With this facility students integrate local weather data and use a video recording, slide making and graphics production facility. Local weather data, along with national and international data streams received over satellite links, are collected and displayed in an integrated series of workstations. These are connected to graphics display consoles to enable students to analyze, create, and present data in a variety of formats. Real-time data is captured digitally, and students are encouraged to evaluate their real-time weather observations together with national data. Mesoscale models are also used and students are taught to run and interpret these and other models. At Mankato State University, preservice teachers take weather courses as part of their preparation for the teaching of the life sciences, geography and earth sciences. This project impacts directly upon enhanced classroom teaching and visual materials preparation and is creating a nucleus facility for teacher service workshops. It will also provide opportunities for local schools to obtain this data through dial-in and Internet means.

### **A Visual Introduction to Laboratory Studies**

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DUE-9850954  
\$41,245  
Chemistry

Faculty at Millikin University are developing a set of introductory, special-topics courses that allow students to experience the excitement of an in-depth study while simultaneously placing the study in the broader context of overarching principles of scientific inquiry. Each course focuses on a particular area of inquiry, such as molecular structure, stars, or prairie ecology. Elementary and secondary teacher certification requirements are fulfilled by taking three of the courses. This project provides equipment that will support a three-week laboratory module that involves the use of instrumentation to make observations that both extend and improve the accuracy and precision of one or more of the human senses and the use of graphs and mathematical expressions to organize and simplify data, ideas, and concepts. Students consider what they can say about objects on the basis of their color and then reconsider after evaluating with visible transmission and reflectance spectra, visible fluorescence spectra and infrared spectra.

### **Establishing a Mathematics Education Center**

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\$34,580  
Mathematics

This project is establishing a Mathematics Education Center consisting of a computer enhanced classroom, an activity area, a material storage area, and a curriculum development area. The objective is to improve the preparation of both preservice and inservice teachers and serve as a model for Centers at other universities. Preservice teachers are learning mathematics in ways consistent with the California Mathematics Framework and with recommendations of groups such as the National Council of Teachers of Mathematics and the National Research Council. Inservice teachers have access to the Center through activities organized by the Central Coast Mathematics Project and are able to upgrade their mathematical knowledge and acquire and construct appropriate learning experiences for their students.

### **Astronomical Observing for All Undergraduates**

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\$10,171  
Astronomy

Astronomical observing facilities at Luther College are being upgraded with telescopes, charge-coupled device (CCD) cameras, portable computers and associated accessories and software to provide observing sessions for introductory classes consisting primarily of non-science majors and including a large fraction of elementary education majors. Astrophysics students are able to process data from CCD observations to make precise measurements of objects such as variable star periods and the orbital periods of Jupiter's moons. An outreach program with local K-12 schools involves Luther College faculty and students running observing sessions as part of a hands-on astronomy program offered to the schools. One telescope is available on a loan basis.

### **Request for Two Environmental Growth Chambers**

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DUE-9851050  
\$18,640  
Life Sciences

Explorations of changes in global environments and determining how species may function and adapt under such changes are two fundamental areas of physiological ecology with theoretical and practical applications. The Biology Department at San Jose State University has a conservation and ecological emphasis in its undergraduate and graduate curricula which includes studies exploring the effects of changing global environments on plant growth. Students have the opportunity to explore, in a meaningful way, concepts of global changes with the use of environmental growth chambers. A major program in this department is the preparation of undergraduate science students for science teaching at the pre-college level. Growing plants in different climatic environments stresses the integrated approach to learning science, and allows students to explore natural phenomena in controlled environments. In addition, this project supports the department goal to ensure that students develop positive attitudes about doing science and are comfortable with the use of scientific equipment.

### **Introduction of Advanced Instrumentation in Science Classes Primarily Serving Allied Health and Education Majors**

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\$80,480  
Life Sciences

The goal of this project is to introduce the modern techniques of biology and chemistry to a non-science major student population which includes future health care workers and science teachers. An interdisciplinary approach melding biology and chemistry is enhancing student understanding of fundamental levels of the organization of life, the cell and the molecule. Fluorescent microscopy equipment with imaging capabilities, a medium pressure chromatography/gel filtration apparatus, and high performance liquid chromatography with mass analysis capabilities are improving the science experience for allied health and education majors as well as science majors. Laboratory activities are reinforcing lecture topics with direct experience, promoting critical thinking, and encouraging students to teach each other in a collaborative manner.

### **Northern Arizona University Archaeology Program Undergraduate Materials Analysis and Imaging Laboratory**

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DUE-9851101  
\$33,231  
Social Sciences

The Department of Anthropology at Northern Arizona University is establishing an Undergraduate Materials Analysis and Imaging Laboratory (UMAIL) for undergraduate anthropology student instruction and research in archaeology. The UMAIL serves undergraduate anthropology majors as an interactive classroom and provides resources for undergraduate student research and independent study. The laboratory also helps prepare preservice K-12 teachers to incorporate anthropology exercises and examples in natural and social science lesson plans. The laboratory is equipped with up-to-date microscopes and graphics imaging equipment for student use in studying the university's extensive comparative collections of prehistoric artifacts and ecofacts. UMAIL is also providing hands-on science

laboratory experience to many students through a new curriculum and special seminars and workshops for students associated with the Navajo Nation Archaeology Department and Hopi Cultural Preservation Office.

**Integration of Quantitative Materials Characterizations Throughout Chemistry and Physics Curricula: Purchase of Thermal Analysis, Viscometry, & Gel Permeation Chromatography Equipment**

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\$44,600  
Chemistry

At Youngstown State University, Materials Science lecture topics and qualitative laboratory experiments are integrated into many Chemistry and Physics courses. The acquisition of new equipment allows the introduction of many new quantitative synthetic and biologically derived polymer and solid state materials experiments into the sophomore through senior level Chemistry laboratory classes, the condensed matter Physics laboratory classes, and a proposed Materials Science laboratory course. Non-science majors, including education majors and preservice science teachers, use this instrumentation in new laboratory-based general education courses with a discovery research format. Thermal analysis equipment allows students to quantitatively evaluate phase changes in solid state, polymeric and biologically relevant materials and to quantify the chemical reactions of solid state materials at elevated temperatures. Viscometry and gel permeation chromatography/size exclusion chromatography (GPC/SEC) equipment allows students to quantify the molecular weights and related physical properties of synthetic and biologically derived polymers. In addition, materials characterization is integrated into professional development offerings for working teachers through specialized summer laboratory courses optimized to meet the needs of science teachers and through "in service" days.

**Experiencing Geometry: Enhancing Prospective Elementary and Middle School Teacher's Learning of Geometry Through the Use of Technology**

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\$42,756  
Mathematics

This project is providing prospective elementary and middle school teachers the opportunity to develop and utilize their own imagery and spatial sense. Towson University Mathematics Department is revising the way it teaches geometry to prospective elementary and middle school teachers by infusing computing technologies into mathematics content courses. Sixteen desktop computers with appropriate geometry software are connected to the Internet so that the existing electronic materials may be fully utilized, including web-based materials under development. Additional laptop computers allow instructor demonstration and students' sharing of their ideas in regular classrooms. Data is being collected to identify in what ways and how often computing technologies are utilized in the geometry course.

### **Extended Classroom for Enhanced Learning (EXCEL)**

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\$57,500  
Engineering

Faculty members in the Department of Curriculum and Instruction and the Department of Materials Science and Engineering at Iowa State University are establishing an instructional program and a classroom dedicated to bringing the capabilities of the scanning electron microscope (SEM) into elementary and secondary classrooms. With the development of the Internet and remote-controlled SEMs, a unique opportunity now exists to facilitate children's access to extremely expensive, technologically advanced equipment via inexpensive Internet connections. The classroom consists of an environmental SEM fully connected to the World Wide Web and the Internet. A summer training program involving inservice and preservice teachers at the elementary and secondary levels provides instruction on how to use the SEM in the classroom. During the school year, preservice elementary and secondary teachers who are specializing in science and mathematics facilitate the K-12 classroom investigations.

### **Enhanced Environmental Biology Literacy for all Undergraduate Students**

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DUE-9851312  
\$50,000  
Life Sciences

An environmental biology course that is part of Georgia Southern University's (GSU) new core curriculum course utilizes environmental issues to introduce and discuss relevant scientific concepts. All students who wish to obtain a degree from GSU will complete this core curriculum including science majors, non-science majors, and future K-12 teachers. The project provides equipment to allow development of innovative hands-on laboratory activities related to local, regional, and global environmental problems. Expected project outcomes include graduates who: 1) are able to engage in environmentally-aware behavior; 2) have improved scientific and environmental knowledge; 3) and appreciate the connections between science and "real-world" problems.

### **Enhanced Science Education Through the Use of Modern FTNMR Spectroscopy**

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\$90,004  
Chemistry

This project, which is a collaborative effort between science and education faculty, enables education students and lower division science students to more concretely grasp chemical principles through hands-on experience with a Fourier Transformed Nuclear Magnetic Resonance (FTNMR) Spectrometer. Prospective K-12 teachers and other students with relatively limited chemistry background conduct NMR laboratory exercises geared to their level of expertise. Experiments involve identifying common chemical structures and following the course of a metabolic pathway through the use of FTNMR. K-12 teachers carry out similar experiments in summer workshops hosted jointly by Whitworth faculty in the science and education departments. Participants in the workshops are encouraged to bring their students back to the campus for "laboratory field trips" focused on the NMR spectrometer. Upper division chemistry students identify stereoisomers of a coordination complex, analyze the intricacies of an enzyme-catalyzed

reaction, and utilize multi-pulse 1D and 2D NMR techniques to determine the structures of monoterpenes. The spectrometer is also stimulating faculty-directed undergraduate research projects.

### Technology Center for Teacher Preparation

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This project is enabling the department to establish a PC multi-media laboratory. With the new facility, the curriculum is enhanced by the introduction of additional technology that is relevant to the educational experience in K-12. For example, Geometer's SketchPad, or Cabri Geometry are being incorporated into the teacher preparation curriculum. In addition, the multi-media laboratory is enhancing the department's ability to develop cooperative programs with local public schools. Teachers from area schools are invited to demonstrate technology that they use in their classrooms and a series of workshops for inservice teachers are offered. In these workshops teachers and students are prepared to teach, view, evaluate, and compare various software appropriate to their instructional needs.

### Science Laboratories for Prospective Elementary Teachers (K-8)

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This project is establishing four laboratories for the elementary teacher preparation program at Western Michigan University for use in the physical sciences, the earth sciences, and the life sciences. The fourth laboratory enables students to work on lessons and projects outside of class time and also serves as a commons room. Six science content courses for prospective elementary teachers, two in each of the three broad areas above, together with a "capstone" course are offered in the new laboratories. The program currently graduates over 250 elementary teachers each year and is preparing teachers who will be able to teach in line with both the content and pedagogical standards outlined in the Michigan Essential Goals and Objectives of Science Education and advocated by several recent national studies.

### Inquiry-Based Science Experiences for Pre-Service Teachers

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The overall objective of this project is to provide a series of learning experiences that fully engage the curiosity and enthusiasm of future K-8 teachers while they develop the ability to understand and use scientific knowledge and concepts to answer questions and to help students discover that mathematics is essential to accurately describe what they see, hear, or measure. Computers and interactive software are being used to help students answer "what if" questions about things they cannot see easily, such as atomic structure, chemical bonding, genetics' and some aspects of cell biology. Computer software is also providing alternate modes of self-assessment to foster student understanding. The project includes a series of lab/field research modules that: 1) are rich in disciplinary and interdisciplinary subject matter content; 2) can be adapted "on the spot" to address whatever questions students formulate; 3) use instrumentation of varying sophistication; 4) require mathematics to describe data; and 5) help students appreciate the scientific process and the relation between technology, science, and society.

### **Using Computers to Expand Reform Beyond Calculus**

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\$34,291  
Mathematics

This project is extending the pedagogical changes and appropriate use of technology that characterize calculus "reform" to courses in linear and abstract algebra, geometry, and computer science. The major focus is on proof-oriented courses in introductory linear algebra, abstract algebra, and advanced linear algebra, where the objective is to use technology to develop students' intuition and conceptual understanding while supporting, rather than supplanting, an axiomatic treatment of the subject. Such a treatment is important for all mathematics majors, including future secondary school teachers, whose requirements for certification include a familiarity with abstract algebra and axiomatic systems. Instructional materials use a variety of software to foster visualization and illustrate the broad applicability of relevant theorems. In-class activities and student projects utilize specialty programs like Group Analyzer that are easy to use but of limited range, as well as more comprehensive software packages like Groups, Algorithms, Programs (GAP) and Maple, which are designed for professional use but can be adapted for use by students who are still learning the mathematical concepts they involve. The project is also developing materials for teaching informal geometry to future elementary and middle school teachers. These materials use existing software packages to develop preservice teachers' understanding of the abstract concepts underlying the concrete activities that their students will be performing in precollege classrooms. The computer science course addressed by the project primarily serves students majoring in the sciences, engineering, and education.

### **A Technology Transitions Laboratory for Preservice Teachers**

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DUE-9851412  
\$54,394  
Mathematics

This project is addressing the need for teachers of K-12 mathematics to make appropriate choices in the use of technology. The typical mathematics course most often solves each problem with a single type of technology, thus depriving preservice teachers of an opportunity to analyze the pros and cons of different technologies. Prospective teachers in the Transitions Laboratory are using different technologies within the context of the same problem, then comparing and discussing what each technology brings to it. The laboratory is equipped with a wide array of manipulatives, four different types of calculators, laptop computers, and Internet access. It serves eight mathematics methods and content courses ranging from the early childhood to the secondary mathematics level. A set of five to ten transitions modules are being developed for each of these courses. Focusing on a single concept or problem, each transitions module prompts the students to perform a series of mathematical investigations while using a range of different technologies. Students write a report comparing and contrasting the advantages and disadvantages of each technology and indicate which technology they would choose if they were the teacher. By exposing the prospective teachers to a wide range of technologies and then asking them to critically analyze their experiences, the Transitions Laboratory is producing teachers with the competence and confidence to make appropriate use of technology in mathematics instruction.

### **Undergraduate Physical Anthropology Laboratory**

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DUE-9851420  
\$36,916  
Social Sciences

A network of computer workstations in an undergraduate physical anthropology laboratory complements and enriches the "hands-on" experiences of students in two introductory level laboratory science courses, Introduction to Human Evolution and Introduction to Human Variation, and one advanced level course, Human Osteology. These courses target both science majors and non-science majors, including many prospective elementary and secondary school teachers participating the CUNY Lehman College Collaborative for Excellence in Teacher Preparation (NYCETP), as well as preprofessional students with interests in medicine, dentistry or veterinary science. As part of the development of this anthropology laboratory, an introductory course in human evolution is being designed to serve the needs of preservice teachers. Workstations are used in conjunction with actual physical specimens and a graphics database is being created using a high resolution digital imaging camera. These images are stored on an NT Server that links the workstations and peripherals and provides internet connectivity. Specimens in the department's collections of fossil human and primate materials are available for on-screen display, allowing students to make comparative observational and measurement assessments between them and the specimens at their workbenches. A high performance, high capacity server allows the many "one-of-a-kind" specimens which the department has in its collections to be accessed simultaneously by up to 15 student study groups.

### **An Investigative Laboratory to Accompany a New Introductory Mixed-Majors Course**

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DUE-9851458  
\$62,700  
Life Sciences

Oklahoma State University's (OSU) life-sciences departments are restructuring the present introductory curriculum and creating a combined majors and non-majors course emphasizing collaboration and inquiry in both lecture and laboratory. This project provides the equipment to make possible new and revised laboratories involving computer-assisted data collection and group report writing in each laboratory. Students are presented with "scenarios" in lecture that introduce concepts in the context of popular issues or current research conducted at OSU and guide students toward questions to be addressed in the laboratory. They learn to apply overarching concepts (e.g. surface-to-volume ratio, cost-benefit analysis) in multiple contexts involving different levels of organization and are expected to provide quantitative data to answer problems or test hypotheses. This process allows students to discover rather than verify concepts. Students use digital spectrophotometers and a variety of physical and chemical sensors to investigate problems at the cellular, organismal, population and ecosystem levels. Students create digital-video-logs of investigations and engage in molecular genetics experiments for the first time. Of the approximately 900 students affected by this project each semester, approximately 150 are K-12 education majors.

**Adaptation and Assessment of Workshop Physics and other Activity-Based Curricula in a Physics Course for Preservice Teachers**

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DUE-9851480  
\$17,554  
Physics

This project is developing an improved algebra-based introductory physics course sequence based on Workshop Physics and other activity-based curricula. The new course sequence is aimed at preservice science teachers, especially physics teachers, for whom this course sequence may serve as their sole exposure to physics. Coverage is reduced slightly from the standard introductory course to mechanics, waves and sound, light, and electricity and magnetism, with treatment of modern physics limited to electrons and radioactivity. Lectures are replaced by direct observation and guided, collaborative inquiry. When possible, computer-based laboratories and video capture and analysis is used to model real world phenomena. Each student group completes an independent investigation each semester, and gives an oral presentation to the class using presentation software and hardware. The new course is intended to improve scientific inquiry skills, conceptual understanding, skill and confidence with modern technology, and student retention and attitudes towards science. Multiple choice conceptual evaluations are combined with free-response items to probe conceptual understanding and ability to apply conceptual knowledge in novel contexts. The Maryland Physics Expectation survey is administered to evaluate changes in student attitudes and beliefs about physics. Baseline assessment data collected in the present course permits meaningful comparisons. Assessment results, new free-response assessment items, and improved instructional methods based on assessment results are presented at the American Association of Physics Teachers national meetings and the Project Kaleidoscope network.

**GPS/GIS/Image Analysis Technology for Field Research in Biology and Environmental Science**

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DUE-9851507  
\$28,376  
Life Sciences

Global positioning system (GPS), geographical information system (GIS), and image analysis technology are being used in field oriented courses in biology and environmental science. This technology is incorporated into a number of courses that all require a variety of spatial analysis applications (e.g., lake bathymetry, habitat analysis, endangered species distribution mapping, lichen community dynamics, landscape analysis of old growth forest, and avian bioenergetics). The overall objective of this project is to foster problem solving skills, critical thinking, and a richer appreciation for the scientific process by involving all science and science-education majors in real-world, field research problems, rather than contrived classroom "studies." The natural attraction that students exhibit toward field research is encouraged through the combination of state-of-the-art, computer interfaced technology and hands-on examination of ecological problems that were previously logistically difficult or technically impossible using available alternative methods. Students engage in both course-related and independent field research projects, which are basic and/or applied, and may last for a semester, several semesters, or a number of years. GPS/GIS/image analysis technology is providing effective and highly visible tools for the science faculty to increase student motivation and interest in careers in science and science teaching.

### **Preservice Training for Teachers in Molecular Biology**

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DUE-9851511  
\$33,614  
Life Sciences

A novel course, Molecular Biology for Teachers, team taught by science educators and a molecular biologist, provides preservice teachers training in the following: 1) theory of molecular biology; 2) hands-on laboratory techniques appropriate for the curricular needs of 6-12 schools and their limited resources; 3) adapting existing biotechnology lessons and critical evaluation of popular "prepackaged" programs; 4) performance assessment of student skills; and 5) evaluation of student content knowledge. Students are eligible to continue research in this area, and, once they graduate, are eligible to borrow equipment kits for use in their 6-12 classrooms. An advisory board of individuals experienced in delivering molecular biology education for inservice 6-12 teachers provides added expertise.

### **Upgrade Materials Testing Laboratory to Materials Science Laboratory for an Industrial Technology-Based Curriculum**

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DUE-9851515  
\$59,083  
Engineering

This project is integrating materials science into a market-driven curriculum that is introductory in nature for undergraduate manufacturing technology and electromechanical students, preservice technology education teachers, and inservice technology education teachers in the state of Iowa. The specific objectives of the project are to: 1) upgrade the existing materials testing laboratory to reflect the current state of materials science in industry; 2) integrate the fundamentals of materials science in lower-level courses for Technology Education (preservice teachers), General Industry & Technology, Electromechanical Systems and Manufacturing Technology program majors; 3) provide activity-based learning experiences in quantitative microstructural evaluation utilizing image analysis methodology, mass spectrometer and microhardness readings for chemical composition and mechanical properties testing of industrial materials in mid-level undergraduate courses; and 4) facilitate upper-level student research activities in materials testing and development. These objectives are being accomplished through the purchase of an Image Analysis System, a table-top optical emission spectrometer, retrofitting an existing universal testing machine, and purchasing a new microhardness tester. As a result of this project, the faculty are: 1) introducing materials science concepts earlier in the curriculum; 2) offering improved laboratory experiences for preservice technology teachers; 3) developing industry-appropriate student research projects; and 4) opening new avenues for independent study projects requiring utilization of contemporary research techniques for mechanical and microstructural testing of industrial materials.

### **Equipment to Interface Modern Technology with Critical Thinking in the Genetics Laboratory**

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DUE-9851581  
\$39,874  
Life Sciences

The Department of Biology of Indiana University of Pennsylvania is implementing reforms to create a cohesive, student-centered natural sciences learning community; a new curriculum for Biology majors, stressing hands-on, experiential learning and providing progressively greater opportunities for semi-

independent student research. Three components are being introduced into the Genetics course, a course required for students preparing to be biology teachers and the capstone course of the new curriculum: 1) a distributive computing environment for the course to enable utilization of genetic analysis programs available on the Internet; 2) a set of new experiments emphasizing modern molecular genetics and providing opportunities for discovery and for synthesis; and 3) addition of a required student research project to the laboratory segment of the course. The equipment is also being used in Saturday workshops for inservice teachers and in a set of traveling workstations. Preservice biology teachers are assisting with the workshops and are being given the opportunity to utilize the workstations during their student teaching.

### **DNA Amplification throughout the Biology Curriculum**

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DUE-9851631  
\$29,590  
Life Sciences

This project includes a set of laboratory investigations which emphasize the impact of molecular biology and computer technology on diverse biological fields. The experiments introduced into General Biology, Ecology, Cell Biology, Genetics, Microbiology, and Molecular Biology courses are investigative and discipline-specific. Several of the investigations are based on prior independent student research projects. Students are actively engaged in the process of science as they design and conduct DNA amplification experiments to test hypotheses, use electronic media for data collection, and analyze their results in the context of internet resources arising from the emerging field of bioinformatics. Student laboratory reports are created using a novel electronic conferencing system. A project home page includes the laboratory procedures used and examples of student laboratory reports, serving as a vehicle for communicating project results to the educational community. A commitment has been made by Modern Biology, Inc. to market the discipline specific DNA amplification investigations resulting from the project as experimental kits. The kits will provide high school and college classrooms nation-wide with the materials and procedures needed to give students first-hand experience with technology that is reshaping biology. Students preparing to be teachers are also involved in the courses and in special workshops to investigate incorporation of these techniques into their future classrooms.

### **Inquiry-Based Physics Laboratory Using Pre-Service Teachers as Peer Instructors**

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DUE-9851668  
\$15,177  
Physics

A microcomputer-based laboratory is being used to introduce an inquiry-based curriculum into the general physics sequence. The course is approximately half science majors and half secondary education students within the majors. While one of the motivations for the project is to improve the students' understanding of basic physics by using and adapting the well tested Workshop Physics curriculum, there is a particular focus on the preservice secondary teachers in the course. This focus consists of having "alumni" of the general physics sequence return as peer instructors in both the workshop physics course and the conceptual physics course designed for non-majors. Physics and secondary education faculty are collaborating to effect program changes requiring secondary education students to have this teaching experience as an internship that counts towards their degree in education. The goals are to further improve the understanding of physics of these science teachers-to-be and to give them some practical experience with an inquiry-based physics curriculum.

## UNDERGRADUATE FACULTY ENHANCEMENT (UFE) PROGRAM

### **Molecular Genetic Analysis Applied to Evolution, Ecology, and Systemic Biology: An Extended Laboratory Course**

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DUE-9752712  
\$155,982  
Life Sciences

This project provides an intense fourteen-day laboratory short course, Molecular Genetics & Evolutionary Biology, in the summer; a four-day follow-up session the following summer; and on-going technical and material support. Twenty-two faculty are selected each year from a national applicant pool comprised of faculty from community colleges, four-year liberal arts colleges and universities, comprehensive universities, and research universities. Four preservice teachers are selected from San Francisco State University (SFSU). Participants learn the fundamentals of molecular biology through lectures and demonstrations, and conduct a series of experiments to develop skill in polymerase chain reaction (PCR) amplification, restriction enzyme analysis, and various gel separation techniques. Participants investigate "thematic" research projects in research groups of six composed of a mix of a preservice teacher, a mentor teacher and faculty from community colleges and four-year institutions. Seminar topics include the use of molecular techniques to investigate procaryote, vertebrate, invertebrate, and plant systems, the incorporation of these techniques into the undergraduate laboratory, and examples of effective teaching practices. As a final exercise, each of the preservice teachers and faculty create teaching modules incorporating the new laboratory and teaching techniques developed during the workshop. The instructional materials developed in prior courses as well as materials developed by new UFE participants are being placed on an SFSU/UFE web site.

### **Faculty Institutes for Reforming Science Teaching Through Field Stations**

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DUE-9752713  
\$299,999  
Life Sciences

Field stations and marine laboratories (FSMLs) offer an exceptional opportunity to teach biology in ways that truly enhance student learning. FSMLs are particularly well suited to inquiry-based learning as their unique natural settings foster learning communities and cooperative activities that are not always evident on main campus locations. Faculty Institutes For Reforming Science Teaching Through Field Stations (Project FIRST) is designed to prepare communities of faculty associated with field stations throughout the United States to utilize inquiry-based, active learning approaches for reforming undergraduate biology courses and curriculum. During FIRST, new faculty, senior faculty and post-doctoral students who are either based at, or associated with, a field station or marine laboratory form a Field Station team (the FSML team) to work together to expand their knowledge of inquiry-based learning at FSMLs, active learning settings. Six FSML teams recruit 180 biology and education faculty from universities, and four-year and community colleges in their region to form a regional network centered at the field station or marine laboratory. FSML teams work with the regional faculty to translate and make connections between active learning models designed at field stations, and similar innovative teaching methods or strategies that would work for courses and curriculum within departments to enhance student learning. These techniques also serve as models for the prospective K-12 teachers enrolled in the science and education courses of participating faculty.

### **PRE-STAT Project**

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DUE-9752749  
\$59,992  
Mathematics

PRE-STAT is enabling college faculty to enhance the statistical education of preservice teachers on their home campuses and to encourage active learning through problem-solving in order to improve statistical education in the middle and secondary schools. The PRE-STAT project is developing a model faculty development workshop which prepares participating mathematics educators to implement an effective statistical education curriculum. A network of teacher educators is being established to share statistical education ideas. PRE-STAT is also supporting the participants during the development and incorporation, at their home institutions, of statistical education components into the curriculum for preservice and inservice teachers. Curriculum ideas are being organized into "Guidelines" for differing curriculum settings. A World Wide Web site is being implemented and maintained to share ideas.

### **Institute in the History of Mathematics and its Use in Teaching**

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DUE-9752755  
\$149,992  
Mathematics

The goal of the Institute in the History of Mathematics and its Use in Teaching (IHMT) is to increase the presence of history in the undergraduate mathematics curriculum. At the same time the IHMT is targeting teacher preparation programs by developing materials for use in K-12 classrooms and materials for use in teacher preparation programs. Participants will be prepared to teach courses in the history of mathematics and to use history to improve their teaching of standard undergraduate mathematics courses, especially teacher preparation courses, through an ongoing year-round program of activities which include: 1) an intensive two-week program in one summer with a follow-up week in the successive summer for mathematics faculty new to the use of history; 2) a two-week program each summer for faculty with experience in the use of history; 3) a vigorous email discussion group together with the 80 participants in the original institute; and 4) supervised research by IHMT alumni. Specific techniques for incorporating history into undergraduate mathematics courses is a central theme. Through presentations at national and regional mathematics meetings, publications, and electronic communications, the information and techniques of IHMT are being disseminated nationally.

### **Coalition for the Mathematical Preparation of Elementary Teachers**

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DUE-9752756  
\$60,000  
Mathematics

This project is extending an existing coalition among Sam Houston State University, North Harris College, and Tomball College originally formed to implement changes in the mathematics content courses for prospective elementary school teachers. These changes were given impetus by the Guidelines for Mathematics Courses for Prospective Elementary School Teachers, a document developed and disseminated in 1996 by the Texas Statewide Systemic Initiative (SSI) and consistent with nationally-known standards. The original coalition (SSI Coalition) is expanding to a network of two-year colleges and universities seeking to revitalize their mathematics courses for elementary teachers. The instructional materials integrate substantial mathematical tasks with cooperative learning, manipulatives, technology,

and writing that challenge students while improving their confidence and appreciation of mathematics. The project is employing an instructional consultant and an outside evaluator as well as an advisory board to guide the project's progress. Evaluation is being used to refine the instructional approach, to customize it to local site conditions, and to measure the success of the project.

### **Partnerships: Interdisciplinary Workshops and Materials**

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DUE-9752757  
\$282,902  
Mathematics

The Mathematical Association of America (MAA) is providing seven intensive six day workshops over three summers (1998, 1999, and 2000) serving over 100 faculty teams (some 210 faculty) from mathematics and partner disciplines. Each of the seven workshops focuses on interdisciplinary curriculum materials combining mathematics and a partner discipline. Each participating institution sends a team of faculty from each of the disciplines being studied to develop interdisciplinary materials to use at their home institution. Participants are introduced to interdisciplinary materials in those disciplines developed at one or more of the Mathematics Sciences and Their Applications Throughout the Curriculum (MSATC) projects, and develop new materials under the guidance of experienced interdisciplinary teams from the MSATC projects.

### **Undergraduate Faculty Workshop for the Integration of Chemistry and Art into Liberal Arts, Chemistry and Teacher Curricula**

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DUE-9752769  
\$169,983  
Chemistry

Three week-long workshops based on a 1996 Chautauqua Short Course, Chemistry and Art: A Science Course for Non-science Majors, designed for undergraduate science, science education, art, art education, archaeology and anthropology faculty are being held in the summers of 1998-99. These workshops provide a sound foundation for disseminating courses in chemistry and art by giving participants an intensive, participatory experience in not only the content of integrated science and art but of effective pedagogical strategies for teaching the content to diverse student populations. The workshops allow intensive work with undergraduate faculty to: 1) develop courses for non-science majors in chemistry and art; 2) develop example applications in art for the teaching of chemistry to scientists; and 3) develop and disseminate curricula in chemistry and art for use in high schools. The first workshop, held in the summer of 1998 at Millersville, brought together faculty from the physical sciences, technology, art, anthropology, and archaeology to develop courses in chemistry and art for non-scientists based upon the model courses. The second and third workshops, held at Millersville in the summer of 1999, involving science education faculty, art education faculty, and preservice or inservice high school teachers, focus on developing the use of chemistry and art in the high school curriculum. Teaching and learning activities, lessons, and laboratory experiments generated by faculty as a result of participation in these workshops are disseminated by a variety of means including an electronic listserve, a Chemistry and Art website, publications in professional journals, and symposia on chemistry and art held at national, regional, and local professional meetings.

**Undergraduate Faculty Enhancement in Mathematics**

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DUE-9752807  
\$100,000  
Mathematics

The teaching of undergraduate geometry courses for future school teachers is being enriched by three week-long summer workshops for college and university faculty to enable them to: 1) experience new teaching strategies and techniques; 2) experience and/or see examples of non-test based assessment schemes; 3) learn about and observe these and other examples of pedagogical techniques that have been successful in encouraging women and underrepresented minorities in mathematics; 4) learn new subject matter and experience new instructional materials being produced by the Cornell Undergraduate Geometry Project; 5) interact and share with colleagues and experts who have common interests in the teaching of mathematics to future school teachers; and 6) learn about recent recommendations, guidelines and standards regarding the teaching of mathematics. Regional coordinators are being identified and trained.

**RENEWALS**

**Systemic Teacher Excellence Preparation (STEP)**

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DUE-9815276  
\$600,000

This project is studying long term changes in teacher preparation in Montana initiated by the five-year Systemic Teacher Excellence Preparation (STEP) Collaborative for Excellence in Teacher Preparation project. The long term evaluation is focusing on the following: 1) tracking progress of underrepresented students as they attain teacher certification and employment; 2) assessing preservice teacher perceptions of reform teaching strategies; 3) monitoring the progress of the first cohorts of graduates; and 4) monitoring continuing efforts to institutionalize various aspects of the project and to sustain collaboration within and between campuses. The NSF Teaching Scholars program is continuing as NSF support is replaced by state-wide fundraising. Continuing activities also include the telecommunications feature of the STEP early career program and curriculum work involving tribal college and university faculty.

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

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DUE-9816194  
\$600,000

Additional support is enabling the Louisiana Collaborative to evaluate the Louisiana Collaborative for Excellence in the Preparation of Teachers (LaCEPT) program by: 1) surveying preservice students in reformed classes for comparison with their counterparts in non-reformed classes; 2) comparing classroom behaviors of LaCEPT graduates with non-LaCEPT comparison groups; and 3) comparing student learning outcomes of students taught by LaCEPT novice teachers with learning outcomes of students of comparable non-LaCEPT novice teachers. In addition, with increasing institutional support, the collaborative is continuing to provide scholarship support for preservice students, supporting novice

teachers through mentoring programs, supporting selected educational projects on LaCEPT campuses, and continuing to promote policies that support reform at both the state and campus levels.

**Maryland Collaborative for Teacher Preparation: Institutionalization and Assessment of Innovative Teacher Preparation Programs**

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DUE-9814650  
\$606,359

This project of the Maryland Collaborative for Teacher Preparation (MCTP) supports evaluation and research focusing on the success of MCTP graduates as teachers. The initial evaluation is being conducted by university faculty through interviews, questionnaires, content examinations, and surveys. MCTP-trained teachers participate in the evaluation by documenting their performance of reform-based teaching and the performance of their own students. Scholarship funds are provided to continue support of MCTP teacher candidates for three years with the goal of institutionalizing the scholarships at all MCTP-affiliated including ten University of Maryland system institutions and five community colleges.

**SPECIAL PROJECTS**

**The NSF Project Showcase 1998-2000**

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DUE-9800628  
\$97,439  
Engineering

The American Society for Engineering Education (ASEE) administered an NSF Project Showcase, an exhibition of research, products and findings from projects that have been supported by the Foundation's Division of Undergraduate Education and the Engineering Education and Centers Division at the ASEE Annual Conference in Seattle, Washington in June 1998. In addition to the showcase sessions, this effort includes a mini-plenary, "Crossing the Great Divide: Can the Engineering Community Truly Collaborate with the Education Community?" featuring a discussion concerning efforts to get the engineering education community more actively involved in effective teacher enhancement and teacher preparation projects for K-12 education.

**Strategies that Support the Development of High Quality Teachers - A Meeting with State Higher Education Leaders**

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DUE-9809338  
\$35,000  
Interdisciplinary

The State Higher Education Executive Officers (SHEEO) and the National Association of System Heads (NASH) co-sponsored a one-day meeting of state and system leaders to examine current reform efforts to prepare high quality teachers in April, 1998. The discussions focused on changes in undergraduate education programs at public colleges and universities, and included profiles of programs supported through grants from the National Science Foundation's Collaboratives for Excellence in Teacher Preparation (CETP). The goals of this meeting included: 1) examination of state- and system-level initiatives to improve the preparation of preservice teachers for K-12 classrooms (with a particular focus

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*Supplements and Continuations*

on mathematics and science program); 2) identification of continuing challenges to these efforts; 3) creating a profile of innovative and effective practices; and 4) advancing recommended follow-up action.

Two white papers are being published jointly by SHEEO and NASH: 1) a background paper outlining current state initiatives on teacher education and professional development and including information on the roles and responsibilities of diverse state agencies, outcomes of recent state-level studies on teacher education, and supply and demand studies; and 2) a report that analyzes new and emerging state teacher certification and licensure requirements aimed at strengthening the knowledge and abilities of new and veteran teachers.

**SUPPLEMENTS AND CONTINUATIONS**

Project descriptions can be found in *Teacher Preparation and NSF Collaboratives for Excellence in Teacher Preparation: FY 97* (NSF 98-99).

**Middle Atlantic Consortium for Mathematics and Its Applications Throughout the Curriculum**

Dennis DeTurck University of Pennsylvania Philadelphia, PA 19104 <i>deturck@math.upenn.edu</i>	DUE-9552464 \$499,653 Interdisciplinary
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**Maricopa Advanced Technology Education Center in Semiconductor Manufacturing and Related Fields**

Alfredo G. De los Santos Maricopa County Community College District Tempe, AZ 85281-6941 <i>delossantos@maricopa.edu</i>	DUE-9602373 \$918,228 Engineering
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**South Carolina Advanced Technological Education (SC ATE) Center of Excellence**

Elaine Craft South Carolina State Board for Technical and Comprehensive Education Columbia, SC 29201 <i>craft@sbte.sc.us</i>	DUE-9602440 \$1,000,000 Engineering
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**Teaching Improvements through Mathematics Education 2000: An Integrated Undergraduate Program to Improve the Preparation of Mathematics Teachers (Time 2000)**

Alice F. Artzt CUNY Queens College Flushing, NY 11367-1575 <i>alaqc@qcvaaxa</i>	DUE-9652972 \$100,000 Interdisciplinary
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**A New Model for Physics Education in Physics Departments: Improving the Teaching of Physics from Elementary through Graduate School**

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Seattle, WA 98195  
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DUE-9354501  
\$750,870  
Physics

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

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Carbondale, IL 62901  
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DUE-9554807  
\$63,760  
Life Sciences

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

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DUE-9555152  
\$239,928  
Interdisciplinary

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

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DUE-9555401  
\$692,080  
Mathematics

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

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DUE-9555404  
\$214,735  
Mathematics

**Mathematics and Undergraduate Education: A New Framework for Mutual Invigoration**

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DUE-9555408  
\$700,129  
Mathematics

**Project Inter-Math**

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DUE-9555414  
\$426,556  
Mathematics

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*Supplements and Continuations*

**Molecular Science**

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DUE-9555605  
\$575,000  
Chemistry

**Elementary Physics Course Based on Guided Inquiry**

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DUE-9653079  
\$34,578  
Physics

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

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DUE-9706060  
\$425,000  
Interdisciplinary

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

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DUE-9653381  
\$25,000  
Mathematics

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

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DUE-9653383  
\$339,610  
Mathematics

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

**The Math Forum**

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Swarthmore, PA 19081  
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REC-9618223  
\$965,319  
Interdisciplinary

(Funded through the Division of Research, Evaluation, and Communication.)

**Learning to Teach Secondary Mathematics in Two Reform-Based Teacher Education Programs**

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Boulder, CO 80309-0019  
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REC-9605030  
\$251,361  
Mathematics

(Funded through the Division of Research, Evaluation, and Communication.)

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

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DMR-9619834  
\$66,000  
Interdisciplinary

(Funded through the Division of Materials Research within the Mathematical and Physical Sciences Directorate.)

## **NSF COLLABORATIVES FOR EXCELLENCE IN TEACHER PREPARATION (CETP)**

Project descriptions can be found in *Teacher Preparation and NSF Collaboratives for Excellence in Teacher Preparation: FY 97* (NSF 98-99) and at <http://www.ehr.nsf.gov/EHR/DUE/start.htm>.

### **PROJECTS INITIALLY FUNDED IN FY 97**

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

Morton Sternheim DUE-9653966  
Richard Yuretich, Allan Feldman, Sue Thrasher, Charlene D'Avanzo \$4,999,414  
University of Massachusetts at Amherst  
Amherst, MA 01003-6010  
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#### **Oregon Collaborative for Excellence in the Preparation of Teachers (OCEPT)**

Marjorie Enneking DUE-9653970  
Carroll Dekock, Michael Jaeger, Julia Keener, John Koroloff, \$4,999,988  
Marlene Moore, Phyllis Rock, David Sokoloff, Camille Wainwright, Holly Zanville  
The Math Learning Center  
Salem, OR 97302  
*marj@mth.pdx.edu*

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

Ricardo B. Jacquez DUE-9653973  
Peggy Blackwell, Kenneth Brooks, Edmund Casillas, Michael Fischer \$4,999,998  
New Mexico State University  
Las Cruces, NM 88003  
*rjaquez@nmsu.edu*

### **PROJECTS INITIALLY FUNDED IN FY 96**

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

Daniel B. Walker DUE-9553786  
Frank Bayliss, Nancy Carnal, Ron Drucker, Jose Gutierrez, Eloise Hamann \$5,000,000  
San Jose State University Foundation  
San Jose, CA 95192  
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#### **Virginia Collaborative for Excellence in the Preparation of Teachers**

Reuben W. Farley DUE-9553789  
William Haver, Joseph Chinnici, Alan McLeod, Julia Cothron \$5,000,000  
Virginia Commonwealth University  
Richmond, VA 23284-9004  
*rfarley@atlas.vcu.edu*

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

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Smith Holt  
University of Tulsa  
Tulsa, OK 74104-3216  
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DUE-9553790  
\$5,000,000

**PROJECTS INITIALLY FUNDED IN FY 95**

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

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James Neujahr, Leonard Ciaccio, James Bruni, Frank Gardella,  
Rodney Varley, Neville Kallenbach, Ann Marcus  
City University of New York (CUNY)  
Brooklyn, NY 11210  
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DUE-9453606  
\$4,999,996

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

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Kenneth L. Anderson, Gretachew Kidane  
California State University - Dominguez Hills  
Carson, CA 90747-0001  
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DUE-9453608  
\$4,977,277

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

Susan Wyckoff  
Dale Baker, James Birk, Marilyn Carlson, Herb Cohen,  
David Hestenes, Anton Lawson, James Mayer, Daniel McLaughlin,  
John D. Mildrew, Michael Piburn, Stephen J. Reynolds, Fredrick A. Staley  
Arizona State University  
Tempe, AZ 85287  
*wyckoff@asu.edu*

DUE-9453610  
\$4,989,864

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

Arturo Pacheco  
John R. Bristol  
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El Paso, TX 19968  
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DUE-9453612  
\$4,641,407

## **PROJECTS INITIALLY FUNDED IN FY 94**

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

Fredrick M. Stein  
Kathy Cochran, Nancy Hartley, Loretta Jones, Jim Loats,  
Barbara Nelson, Marilyn Taylor,  
University of Northern Colorado  
Greeley, CO 80639  
*fstein@csmate.colostate.edu*

DUE-9354033  
\$5,000,000

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

Nina Hillman  
Ranganathan Srinivasan, Jane Drucker, Matthew Bruce, Lorne Ruby  
Temple University  
Philadelphia, PA 19122  
*nhillman@thunder.ocis.temple.edu*

DUE-9354034  
\$3,900,000

## **PROJECTS INITIALLY FUNDED IN FY 93**

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

James Fey  
Genevieve Knight, John Layman, Thomas O'Haver, Jack Taylor  
University of Maryland  
College Park, MD 20742  
*sb161@umail.umd.edu*

DUE-9255745  
\$6,000,000

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

Kerry Davidson  
Louisiana Board of Regents  
Baton Rouge, LA 70801-1389  
*davidson@regents.state.la.us*

DUE-9255761  
\$4,000,000

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

Elisabeth Swanson  
Lyle Anderson  
Montana State University  
Bozeman, MT 59717  
*eswanson@mathfs.math.montana.edu*

DUE-9255792  
\$6,000,000

## 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; Research, Evaluation, and Communication; and Human Resource Development. Abstracts are available through the NSF Web site at <<http://www.nsf.gov>>.

## 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 preservice teacher education programs to inservice 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. Informal Science Education projects provide opportunities outside a formal school setting for individuals of all backgrounds to increase their understanding and appreciation of science, mathematics, engineering, and technology.

### Teacher Enhancement

Susan Snyder, Section Head K-8

(703) 306-1613

*ssnyder@nsf.gov*

### Renewing Mathematics Teaching Through Curriculum (RMTC)

Laura Van Zoest  
Western Michigan University  
Kalamazoo, MI 49008  
*laura.vanzoest@wmich.edu*

ESIE-9618896  
\$707,957

### Valle Imperial Project in Science (VIPS)

Michael Klentschy  
El Centro School District  
El Centro, CA 92243  
*mklent@mail.ecsd.k12.ca.us*

ESIE-9731274  
\$3,309,989

### Guiding Education in Mathematics and Science Network (GEMS-NET)

Betty J. Young  
University of Rhode Island  
Kingston, RI 02881  
*rry101@uriacc.uri.edu*

ESIE-9731316  
\$1,308,239

**An Inquiry-Based Summer Course for In-Service Teachers**

Graham E. Oberem  
California State University - San Marcos  
San Marcos, CA 92069  
*oberem@mailhost1.csusm.edu*

ESIE-9731367  
\$309,472

**Strategies for Teacher Excellence Promoting Student Success (STEPSS)**

Darryl Medders  
Visalia Unified School District  
315 E Acequia  
Visalia, CA 93277  
*darrylm@visalia.k12.ca.us*

ESIE-9814102  
\$3,849,999

**Learning That Works: A School-to-Career Video Collection**

Michele Korf  
WGBH Educational Foundation  
125 Western Avenue  
Boston, MA 02134  
*michele\_korf@wgbh.org*

ESIE-9816634  
\$329,565

**Informal Science Education**

Hyman Field, Acting Division Director

(703) 306-1616

*hfield@nsf.gov*

**ADVENTURES IN SCIENCE: An Interactive Exhibit Gallery Exploring Biological Diversity and the Changing Nature of Life on Earth**

Allen M. Young  
Milwaukee Public Museum  
Milwaukee, WI 53201  
*young@mpm.edu*

ESIE-9725177  
\$1,376,931

**DIVISION OF EDUCATIONAL SYSTEM REFORM**

**Statewide Systemic Initiatives Program**

Celeste Pea, Program Director

(703) 306-1682

*cpea@nsf.gov*

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**

Suzanne Mitchell  
Arkansas Department of Higher Education  
Little Rock, AR 72201  
*susannem@adhe.arknet.edu*

ESR-9350027  
\$10,150,000

**Connecticut Statewide Systemic Initiative**

Richard Cole  
Connecticut Academy for Education in Mathematics, Science and Technology  
Middletown, CT 06457  
*rcole@ctacad.org*

ESR-9634086  
\$5,999,993

**Massachusetts Statewide Systemic Initiative**

David Driscoll  
Massachusetts Department of Education  
Malden, MA 02148-5023  
*ddriscoll@doe.mas.edu*

ESR-9250033  
\$10,000,000

**Louisiana Statewide Systemic Initiative (LaSIP)**

Kerry Davidson  
Louisiana Systemic Initiative  
Baton Rouge, LA 70806  
*davidson@regents.state.la.us*

ESR-9150043  
\$9,940,000

**Puerto Rico Statewide Systemic Initiative**

Manuel Gomez  
Resource Center for Science and Engineering  
University of Puerto Rico  
San Juan, PR 00931  
*m\_gomez@upr1.clu.edu*

ESR-9250052  
\$10,000,000

**The Texas Statewide Systemic Initiative**

Philip Uri Treisman  
University of Texas at Austin  
Austin, TX 78713-7726  
*uri@mail.utexas.edu*

ESR-9250036  
\$8,000,000

**Urban Systemic Initiatives Program**

Celeste Pea, Program Director

(703) 306-1682

*cpea@nsf.gov*

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

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*FY 98 Awards*

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**

M. Suzanne Navarro	ESR-9453664
El Paso Collaborative	\$14,348,789
University of Texas, El Paso	
El Paso, TX 79968	
<i>navarro@utep.edu</i>	

**Fresno Unified School District Urban Systemic Initiative**

Carlos Garcia	ESR-9452988
Fresno Unified School District	\$11,749,365
Fresno, CA 93721	
<i>cagarci@fresno.k12.ca.su</i>	

**Milwaukee Urban Systemic Initiative**

Mary Henry	ESR-9554487
University of Wisconsin - Milwaukee	\$5,000,000
Milwaukee, WI 53201-8210	
<i>henryme@mail.milwaukee.k12.wi.us</i>	

**Rural Systemic Initiatives Program**

Celeste Pea, Program Director	(703) 306-1682	<i>cpea@nsf.gov</i>
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The goal of the Rural Systemic Initiatives (RSI) Program is to promote systemic improvements in science, mathematics, and technology education for students in rural and economically disadvantaged regions of the nation, particularly those that have been underserved by NSF programs, and to ensure sustainability of these improvements by encouraging community development activities in conjunction with instructional and policy reform. RSI projects address curriculum reform, teacher preservice and inservice education, policy restructuring, assessment, and implementation of national standards as well as the economic and social well-being of targeted regions.

**Rural Systemics Initiatives in Physics**

Thanumala Y. Pillai	ESR-9713025
Mississippi Valley State University	\$84,759
Itta Bena, MS 38941	
<i>tpillai@fielding.mvsu.edu</i>	

## DIVISION OF HUMAN RESOURCE DEVELOPMENT

### Louis Stokes Alliances for Minority Participation - Pre-Service Teacher Preparation Initiative

A. James Hicks, Program Director

(703) 306-1632

*ahicks@nsf.gov*

The goal of the Louis Stokes Alliances for Minority Participation - Pre-Service Teacher Preparation initiative (LSAMP-TP) is to increase substantially the number of minority students with strong academic credentials, who are certified to teach science and mathematics in elementary and secondary schools. The majority of activities intended for NSF support under the LSAMP-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. LSAMP projects with an LSAMP-TP component include:

#### **Southern Rocky Mountain Alliance**

Antonio Garcia  
Arizona State University  
Tempe, AZ 85287  
*tony.garcia@asu.edu*

HRD-9623615

#### **California State University AMP**

Alfonso F. Ratcliffe  
San Francisco State University  
Northridge, CA 91330  
*rick.ratcliffe@csun.edu*

HRD-9353276

#### **California Alliance for Minority Participation**

Nicolaos G. Alexopoulos  
University of California at Irvine  
Irvine, CA 92717  
*alfios@uci.edu*

HRD-9153663

#### **Chicago AMP-TP**

Marian Wilson-Comer  
Chicago State University  
Chicago, IL 60628  
*bacomer@csu.edu*

HRD-9350587

#### **Louisiana Alliance for Minority Participation (LAMP)**

Robert L. Ford  
Southern University and A&M College  
Baton Rouge, LA 70813  
*robert.ford@em.doe.gov*

HRD-9550765

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*FY 98 Awards*

**New Mexico State University AMP**

Ricardo B. Jacquez

New Mexico State University

Las Cruces, NM 88003

*rjaquez@nmsu.edu*

HRD-9353215

**Washington-Baltimore-Hampton Roads AMP**

Clarence M. Lee

Howard University

Washington, DC 20059

*cmleone@access.howard.edu*

HRD-9353137

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

Craig A. Rogers

University of South Carolina

Columbia, SC 29208

*Rogers@sc.edu*

HRD-9255165

**NCAMP Teacher Preparation Program Supplement**

Harold L. Martin

North Carolina A&T State University

Greensboro, NC 27411

*hlm@ncat.edu*

HRD-9255239

**All-Nations Alliance for American Indians**

Joseph F. McDonald

Salish Kootenai College

Pablo, MT 59855

*joe\_mcdonald@skc.edu*

HRD-9450369

**Oklahoma State Alliance for Minority Participation in Science,  
Engineering, and Mathematics**

Earl D. Mitchell

Oklahoma State University

Stillwater, OK 74078

*ldsilva@biochem.okstate.edu*

HRD-9450355

**Florida-Georgia Alliance for Minority Participation Teacher Preparation**

Lynette P. Padmore

Florida A&M University

Tallahassee, FL 32307

*lpadmore@famu.edu*

HRD-9255219

**New York City Alliance for Minority Participation**

Neville Parker

City College

New York, NY 10031

*ampcc@.cunyvm.cuny.edu*

HRD-9252789

**Heartland's Alliance for Minority Participation**

Charles Sampson  
University of Missouri-Columbia  
Columbia, MO 65211  
*sampson@grad.missouri.edu*

HRD-9550704

**Mississippi Alliance for Minority Participation**

Richard Sullivan  
Jackson State University  
Jackson, MS 39217  
*sullivan@tiger.jsums.edu*

HRD-9153747

**Program for Women and Girls (Program for Gender Equity)**

Ruta Sevo, Program Director  
Gretchen Klein, Program Director

703-306-1637

*hrdwomen@nsf.gov*

The Program for Women and Girls in Science, Engineering, and Mathematics, is designed to improve the achievement in mathematics and science skills needed by all Americans and to effect a diverse workforce of scientists and engineers by increasing the participation of women and girls in science education and careers. The program funds education research and projects targeted at levels of K-16 and complements other EHR efforts to improve education from elementary school through graduate school. Large Collaborative Projects, Small Experimental Projects, and Information Dissemination Activities seek positive change in the academic, social, and scientific infrastructure to increase the participation of women.

**Girls on Track: Increasing Middle-Grade Girls' Interest in Math-Related Careers by Engaging Them in Computer-Based Mathematical Explorations of Urban Problems**

Sarah B. Berenson  
North Carolina State University  
P.O.BOX 700  
Raleigh, NC 27695  
*berenson@unity.ncsu.edu*

HRD-9813902  
\$772,120

**Computer Hardware Diagnosis and Repair for Women and Girls**

Judi W. Wakhungu  
Pennsylvania State University/University Park  
201 Old Main  
University Park, PA 16802-1503  
*jww105@psu.edu*

HRD-9714759  
\$234,160

**Gender-Equity in Science, Engineering and Mathematics Education: Making Connections for 3rd to 5th Grade Girls**

Sara Cohen  
Metropolitan State College Denver  
1006 11th Street  
Denver, CO 80204-2025  
*sacohen111@aol.com*

HRD-9714751  
\$838,139

## **Program for Persons with Disabilities**

Lawrence A. Scadden, Program Director

(703) 306-1636

*lscadden@nsf.gov*

The Program for Persons with Disabilities (PPD) seeks to eliminate barriers in science, engineering, and mathematics that prevent the participation of students with disabilities; change the attitudes of the education community and the public in general, about the potential of persons with disabilities; and offer support for adaptive technologies to allow students, scientists, engineers and mathematicians to participate in NSF-funded projects. PPD supports projects that develop new methods of teaching science and mathematics, increase the awareness and recognition of the needs and capabilities of students with disabilities, promote the accessibility and appropriateness of instructional materials and educational technologies, and increase the availability of mentoring resources.

### **PPD/IEP: Information Access - Education, Opportunities, and Technology**

Kenneth Barner

University of Delaware

Newark, DE 19716 302/451-2000

*barner@eecis.udel.edu*

HRD-9800175

\$893,967

## **DIVISION OF RESEARCH, EVALUATION, AND COMMUNICATION**

The Division of Research, Evaluation, and Communication (REC) supports projects that merge research with classroom practices. The Research on Education, Policy, and Practice (REPP) Program supports the cultivation of a research base for implementing innovative K-16 reform strategies as well as ways of improving graduate, professional, informal, and lifelong learning. REPP research foci address the following themes: data, methodology, and theory; policy; practice; and technology. Research topics include technology utilization, content, pedagogy, assessment, and policy-oriented studies and indicators. In addition to the REPP Program, division activities include the evaluation of EHR programs and outreach to the teaching and learning communities.

### **Research on Education, Policy, and Practice**

Anthony Kelly, Program Manager

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*akelly@nsf.gov*

Elizabeth VanderPutten, Program Manager

(703) 306-1651

*evanderp@nsf.gov*

### **NSF Institute for Science Education (NISE)**

Andrew Porter

University of Wisconsin - Madison

Madison, WI 53706

*acporter@macc.wisc.edu*

REC-9452971

\$8,708,901

### **Middle Grades Mathematics and Science Teacher Induction in Selected Countries**

Senta A. Raizen

WestEd

San Francisco, CA 94107

*sraizen@wested.org*

REC-9814803

\$993,405

**Investigating Multimedia Case Studies as a Tool for Pre-Service Teacher Development**

Helen M. Doerr  
Syracuse University  
Syracuse, NY 13244-1200  
*hmdoerr@sued.syr.edu*

REC-9725512  
\$605,891

**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 Defense Troops to Teachers: <http://voled.doded.mil/dantes/ttt/>

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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