



A Celebration of Innovation



Awardees for the FY 96 Institution-Wide Reform initiative were recognized as part of *Shaping the Future: Strategies for Revitalizing Undergraduate Education*, a working conference sponsored by NSF, in cooperation with the National Research Council, held July 11-13, 1996.

The conference highlighted the progress of ongoing efforts in undergraduate systemic reform and involved teams of participants in a constructive dialogue about the challenges facing undergraduate education. Findings of a recent review of undergraduate education were presented in conjunction with the National Research Council's "Year of National Dialogue."

The conference provided an opportunity for awardees to showcase their projects to a wide variety of stakeholders in undergraduate education, including participants from professional societies, industry, federal agencies, other institutions, and the public.



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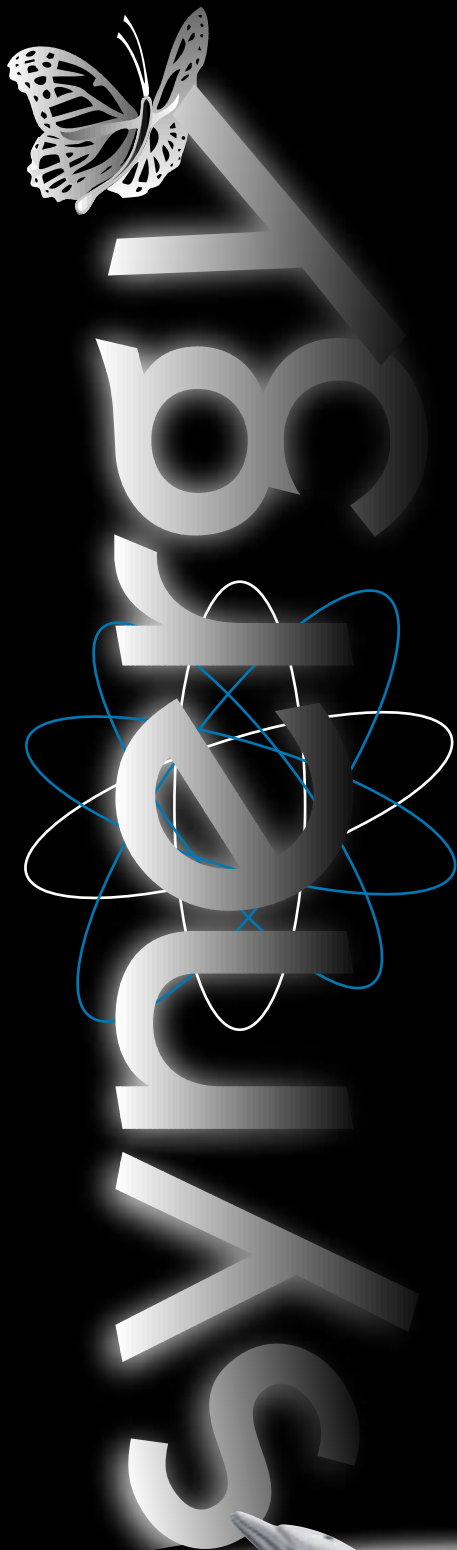
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Reforming Undergraduate Education

Introduction

The National Science Foundation's Directorate for Education and Human Resources (EHR) recently launched a new initiative: *Institution-Wide Reform of Undergraduate Education in Science, Mathematics, Engineering, and Technology (SME&T)*. Twenty-three awards were made to colleges and universities to stimulate comprehensive, innovative reforms that promote student learning, prepare students for rewarding careers, and enhance awareness of and appreciation for SME&T issues.

Dr. Luther S. Williams, NSF's Assistant Director for Education and Human Resources, introduced the new initiative to college and university presidents in August 1995 and called for proposals

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► Momentum is building in America's undergraduate institutions for the reformation that must occur to meet the changing needs of society.

working together to revitalize science & mathematics education



Reforming Undergraduate Education



Comprehensive Universities



The **University of Hartford (CT)** is building on its significant achievements in the use of student-centered pedagogies and technologies to reform numerous gateway courses, strengthen faculty collaboration and development, and increase curricula coordination and pedagogical innovation.

Urban students will be the particular beneficiaries of the proposed reform project

at the **University of Michigan at Dearborn**, which is supporting faculty throughout the sciences as they adapt and adopt new pedagogical methods, including cooperative learning strategies, the development of laboratory experiences for non-science majors, and development of a three-course sequence for potential K-12 teachers.



Baccalaureate Institutions

St. Andrew's Presbyterian College (NC), in collaboration with Pembroke State University, is reforming its general education requirements in science and mathematics. Mastery of quantitative skills is integrated with experience-based learning in the natural and social sciences. The project

also includes extensive faculty retraining in interdisciplinary teaching, and engages undergraduate science and mathematics majors as mentors and teaching assistants.

The Richard Stockton College of New Jersey is instituting a quantitative literacy requirement through courses that stress quantitative reasoning and the use of mathematics in an interdisciplinary context. A seminar series will assist faculty with the development of new courses and the integration of more "real-world" material into existing courses. Faculty will conduct research on the teaching and learning of mathematical ideas and the new contexts to which they are being applied.



Community Colleges

Middlesex County College (NJ) is addressing the science literacy of non-science majors by extending an earlier curriculum reform geared toward science, mathematics, and technology majors to the entire institution. Teams of faculty will develop thematic interdisciplinary courses that provide students with the cognitive skills and knowledge base required to support independent learning in the

workplace and in areas of interest to informed citizens.

Wake Technical Community College (NC) is expanding its capstone project requirement—an unusual requirement for community colleges—to almost 90 percent of its technical units. The project is working in cooperation with local businesses to develop courses that provide students with project-oriented teamwork experiences in mathematics, business, computers, and communications, as well as with high schools to nurture the interest of potential incoming students.



INSTITUTION-WIDE REFORM AWARDEES

Institutions receiving awards in FY 96 are listed alphabetically.

California Institute of Technology (CA)
California State University - Fullerton (CA)
Clark Atlanta University (GA)
Community College of Philadelphia (PA)
Grinnell College (IA)
Miami University (OH)
Middlesex County College (NJ)
New York University (NY)
Northeastern University (MA)
Oakton Community College (IL)
Panola College (TX)
Rensselaer Polytechnic Institute (NY)
The Richard Stockton College of New Jersey (NJ)
Salish Kootenai College (MT)
St. Andrew's Presbyterian College (NC)
Stanford University (CA)
State University of New York - Binghamton (NY)
University of California - Berkeley (CA)
University of Hartford (CT)
University of Michigan - Ann Arbor (MI)
University of Michigan - Dearborn (MI)
University of Rochester (NY)
Wake Technical Community College (NC)

Reforming Undergraduate Education *continued...*

that “present visionary plans for the revitalization of undergraduate education based on significant past institutional achievements.” According to Dr. Williams, the IR awards are intended to stimulate changes in institutional culture and infrastructure and to provide national models of excellence in SME&T education.

This broad-based activity is a special thrust of the Division of Undergraduate Education’s (DUE) Course and Curriculum Development program, in partnership with other EHR Divisions. Successful IR institutions include public and private comprehensive and research universities, and two-year and four-year colleges. Outcomes such as higher quality SME&T education for all students and the removal of barriers between discipline-based departments are expected.

Today, students with diverse backgrounds are seeking an education that will prepare them for careers in a global society with science and technology as a common currency. Because undergraduate education is central to the preparation of tomorrow’s knowledge workers—and affects such a large, diverse, and growing segment of the population—its reform has potentially widespread application and benefits.

The initiative is an extension of EHR’s mandate to improve the quality of instruction at institutions of various types, to educate and retain students and teachers of diverse backgrounds, to develop inter-disciplinary SME&T curricula, to prepare students for rewarding technical and instructional careers, and to promote the scientific literacy of all citizens. It is particularly appropriate for EHR to encourage such

reform efforts because of the Directorate’s mission to ensure that science and mathematics education provided at all levels, for all students, is of high quality.

A Growing Trend

Several factors—the rise of the “Information Age,” corporate restructuring, and increased global competition—have contributed to an impending

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THE INSTITUTION-WIDE REFORM INITIATIVE

SNAPSHOT

Announced: August 1995

Aim: To promote the development of comprehensive and self-sustaining reform efforts in undergraduate education.

Eligibility: All institutions that teach undergraduates

Amount: Up to \$200,000 each

Number of awards: 23

Duration: Specific to project

Process: Successful proposals offer visionary plans for institution-wide reform of undergraduate education based on an institution’s significant achievements toward this goal, with the intent of providing national models of excellence in science, mathematics, engineering, and technology education. Proposals are submitted to NSF by the institution president.





Reforming Undergraduate

EMERGING THEMES IN COMPREHENSIVE CHANGE...

Proposals addressed reform from a number of perspectives, including the four that follow.

1 Promoting Changes in Institutional Culture and Curriculum Structure by:

- Involving faculty, students, and administrators in the implementation of institution-wide reform
- Transitioning from discipline-based studies towards more “seamless” curricula
- Supporting interdisciplinary team teaching of science and mathematics in the context of real-world problems
- Promoting a reward structure supportive of innovative teaching and mentoring

2 Introducing New Teaching/Learning Models such as:

- Active student learning, discussion sessions, and module-based science and mathematics courses for non-science majors
- Student collaboration to enhance communication, teamwork, and critical thinking skills

crisis in higher education that can be averted only through a major change in the context and delivery of college-level instruction. A number of institutions have begun bold initiatives to improve the learning of science and mathematics, but few have really begun to design programs that combine or transcend traditional academic disciplines.

Working as partners to promote excellence in SME&T education, faculty, students, and administrators at these institutions have started to revitalize the undergraduate learning experience. The approach is “interdisciplinary” in order to foster communication between institutional units and to better address the complex and multifaceted issues faced by society.

“The institution-wide reforms envisioned uphold high academic standards while promoting development of a diversity of individual students to their maximum potential,” said DUE Division Director Robert F. Watson. “A major objective is to help two- and four-year colleges and universities align their curricula and experiences with the kinds of employment opportunities that await their students.”

Inaugural Awards Hold Promise

“Impressive and broadly representative” is how NSF reviewers described the proposals submitted to the initiative in its first year. For FY 96, NSF made awards of up to \$200,000 each to colleges and universities that have demonstrated success in revitalizing undergraduate education on a relatively modest scale and now wish to infuse their entire institution with similar gains. More than 130 institutions submitted applications; 23 were funded. For FY 97, NSF anticipates providing an equivalent level of support to a second cohort of 20-25 institutions (first-year awardees will not be eligible to re-apply).

Representative projects among the first-year awards include (by institution type):

▶ Doctoral/Research Universities

Rensselaer Polytechnic Institute (NY) is completing its campus-wide transition from large, lecture-based introductory courses to a format in which lecture, recitation, and laboratory are conducted



Education *continued...*

in a single facility. The “studio” format provides an approach that places a greater responsibility on students for their own learning. A planned new facility will house a center for faculty development and evaluation/ dissemination efforts.



Miami University (OH) is enhancing and evaluating its ongoing research-rich model curriculum. The number of undergraduates involved in interdisciplinary research projects is being increased, and an ambitious longitudinal study will examine the success of the student researchers.

At the **University of Michigan at Ann Arbor**, a team of faculty from six schools and eight departments is establishing an “undergraduate curriculum development testbed” that will focus, initially, on developing a sequence of interdisciplinary courses in global change. Through this testbed, the university will identify barriers to implementing interdisciplinary instruction and curricula, develop and test a means of eliminating those barriers, and create templates that can be used in developing courses involving several subject areas.

Faculty from the schools of Arts and Sciences, Education, and Business at **Clark Atlanta University (GA)** are collaborating on the expansion of its Earth Systems Science curriculum. By promoting faculty development in this interdisciplinary area, expanding opportunities for student research, and making widespread use of case studies in instruction, the institution intends to improve the ability of all undergraduates to think critically across disciplines.

Forums at **New York University** are catalyzing institution-wide reform by engaging science and non-science faculty in an examination of the role of science education and continuing development of a math/science curriculum for non-science majors.

Using its highly successful Summer Undergraduate Research Fellowship as a model, the **California Institute of Technology** is engaging its students in the instructional process in significant ways. Working closely with faculty mentors, students are developing instructional aids for a broad range of science and engineering courses. The goal is to improve the students’ ability to visualize complex concepts, analyze available information, and communicate with each other.

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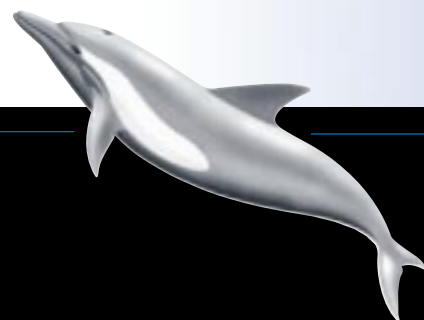
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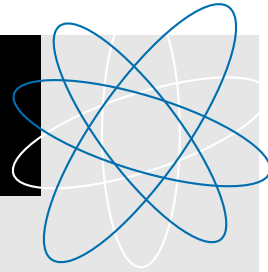
3 Supporting Faculty Development by:

- Expanding mentoring programs
- Offering forums to allow faculty to share ideas and materials that have been demonstrated as successful
- Preparing faculty to work collaboratively in an interdisciplinary environment
- Fostering efforts to improve communication with non-science majors

4 Encouraging Student-Centered Activities that:

- Involve undergraduates in peer instruction with faculty mentors
- Enhance tutorial and mentoring programs
- Broaden opportunities for research experience
- Improve training of graduate student instructors



The word "synergy" is written in a blue, lowercase, sans-serif font. It is slightly blurred and set against a dark, rectangular background.

ABOUT SYNERGY

Synergy is a publication of NSF's Directorate for Education and Human Resources (EHR). In newsletter format, it presents to the various science, mathematics, engineering, and technology education communities information on EHR programs and events, as well as summaries of project results. Each **Synergy** issue highlights an EHR program that is demonstrating progress in reforming the teaching and learning of science, mathematics, engineering, or technology, pre-kindergarten through career entry. "Synergy" derives from NSF working in partnership with organizations throughout the United States and in all sectors of the economy to help foster the positive changes in education to which NSF is dedicated. The ingredients of these outcomes-based, data-laden success stories are unchanging: access to quality science and mathematics education, high expectations for the success of these efforts, proven excellence of materials and their delivery, and measurable gains in learning by all students.

IN THIS ISSUE...

Synergy looks at the new Institution-Wide Reform (IR) initiative. In its inaugural year, the awards from this initiative promise to catalyze changes in institutional culture and infrastructure that are prerequisite to systemic reform. The aim of these awards is to motivate changes in priorities and the allocation of resources that will enable institutions to support the ongoing activities of the visionary reforms they proposed. **Synergy** is created when these efforts transcend the traditional divisions of departments or disciplines to create a more seamless curriculum, incorporate skills and knowledge applicable far beyond the campus, and are adopted by graduates who aspire to be lifelong learners.

Innovation Through Imagination

In promoting reform, NSF maintains a flexible approach about the types of plans for comprehensive change that can be submitted by institutions involved in undergraduate education.

All awarded proposals are expected to demonstrate:

- **excellence** in science and technology education;
- **national leadership**, by providing an exemplar for sweeping change at institutions of a similar type and education mission;
- **visionary thinking** about broad-based change in curriculum and infrastructure that will significantly improve learning and teaching campus-wide;
- **balance** in the resources devoted to excellence in both teaching and research that is appropriate for the type of institution; and
- **active involvement** of administrators, faculty, and students from many backgrounds, disciplines, and areas of interest.



the conversion of traditional facilities into interactive learning centers, and the introduction of educational technologies that accommodate different learning styles and promote conceptual thinking.

Through these projects, the higher education community is demonstrating its awareness of the need for changes in the traditional infrastructure to meet the responsibilities of the institution and those of its students.

In addition to meeting these requirements, successful FY 96 proposals included new teaching/learning models and expanded opportunities for student and faculty professional development.

Several proposals called for the enhanced use of technology in the institutional infrastructure, including the provision of a resource center that makes available the latest instructional technology and technology-based, cross-curricular materials for students,

The initial response to NSF's Institution-Wide Reform initiative suggests a strong inclination within academe to initiate needed changes. These IR institutions have the potential to lead the way in meeting the needs of their own students and the higher education system as a whole, now and for decades to come.

