



Enhancing the Diversity of the Science and Engineering Workforce to Sustain America's Leadership in the 21st Century

Executive Summary of the CEOSE Report to Congress

In this new century, U.S. jobs are growing fastest in areas that require knowledge and skills stemming from a strong grasp of science, mathematics, engineering, and technology (SMET). The number of workers capable of adequately filling these jobs is not keeping pace. A critical shortage of workers in these fields threatens U.S. competitiveness in the global marketplace.

The good news is that an enormous, underutilized human resource exists to fill the gap. Women, minorities, and persons with disabilities are significantly underrepresented in SMET occupations, even though they are among the fastest growing segments of the American workforce. Institutional change and partnerships are required to address this underrepresentation. If business, academia, and government come together to mine this resource and develop its inherent talents, the shortage could be eliminated before it undermines America's leadership role in building the 21st Century workforce.

The National Science Foundation (NSF) is working hard to address these challenges. The Committee on Equal Opportunities in Science and Engineering (CEOSE) was established by Congress in 1980 to encourage the participation of underrepresented groups in SMET fields. Committee membership consists of eminent scientists and engineers from academia and private industry.

This executive summary of the biennial CEOSE report recommends a variety of approaches. Many are based upon increasing opportunities for women, minorities, and persons with disabilities to help eliminate the shortage of scientific and technical workers.

Among the recommendations:

- Develop tactics and systems to lower barriers to entry for underrepresented groups into SMET fields.
- Showcase examples of underrepresented individuals who are succeeding in scientific and technical careers.
- Make the need for action more apparent to key audiences.
- Create business, government, and academic partnerships to develop action plans.
- Track progress through systems that measure accountability and results.

For a full copy of the CEOSE report, contact:

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Or it will be available online at www.NSF.gov.

Committee on Equal Opportunities in Science and Engineering

The Committee on Equal Opportunities in Science and Engineering (CEOSE) was established by Congress in 1980. It is charged with advising the National Science Foundation (NSF) on policies and activities to encourage full participation by women, minorities, and persons with disabilities in science, mathematics, engineering, and technology. The membership of this committee consists of eminent scientists and engineers from academia and private industry.

CEOSE envisions a nation in which every segment of the population is empowered and enabled to participate fully in the science, mathematics, engineering, and technology (SMET) enterprise. CEOSE will advise and guide NSF to ensure the fulfillment of this vision by promoting an SMET advancement and dissemination paradigm that is inclusive of all citizens, regardless of gender, ethnicity, or disability status.

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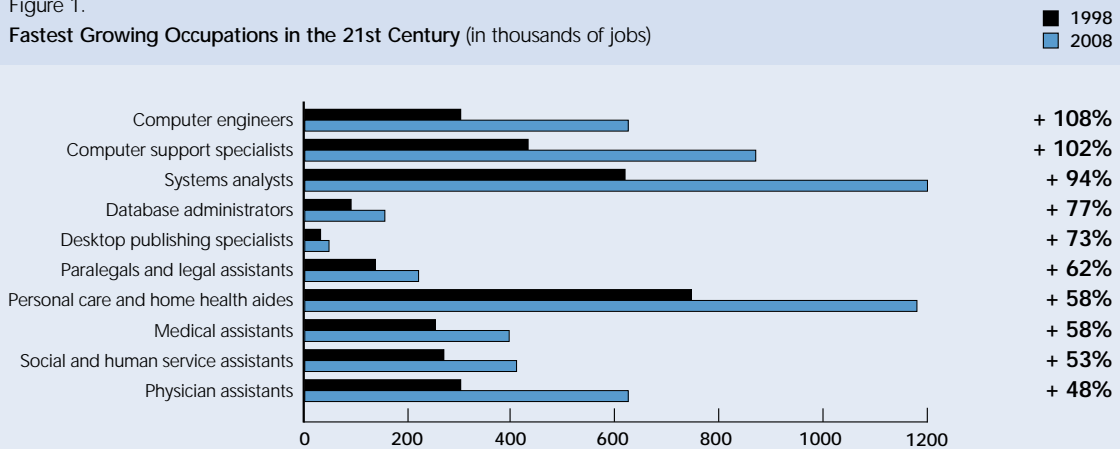
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A Growing Demand; An Inadequate Supply

Virtually every process and product used today incorporates information technology developed over the last two decades. New advances and discoveries in science have resulted in a wide range of innovations including Magnetic Resonance Imaging (MRI) machines, efficient and reliable sources of fuel, and weather forecasting systems. There is a personal computer on almost every office desk in America. The Internet is the library of choice for many students. Business – including the business of education – is conducted by computer and in real time. And the fast pace of technological change shows no signs of slowing.

The transformation to a wired world is fueling an unparalleled explosion in SMET jobs and will continue to do so for the foreseeable future. The U.S. Bureau of Labor Statistics predicts that 1.9 million new jobs will be created in SMET fields by 2008. While the economy as a whole is expected to provide about 14% more jobs during the coming decade, SMET employment will grow by 51%, almost four times faster than all other occupational areas. Positions in some of the scientific disciplines, such as computer engineering, computer support specialties, and systems analysis, will double.

Figure 1.
Fastest Growing Occupations in the 21st Century (in thousands of jobs)



Source: Bureau of Labor Statistics, 1999.



Figure 2.
Projected Employment and Labor Force Growth,
by Gender and Race/Ethnicity: 1998-2008

SMET employment	+ 51%
Total employment	+ 14%
Total civilian labor force	+ 12%
Men	+ 10%
Women	+ 15%
White, non-Hispanic	+ 7%
African-American	+ 19%
Hispanic	+ 37%
Asian & Other	+ 40%

Sources: Fullerton, H.N., "Labor force projections to 2008: steady growth and changing composition," *Monthly Labor Review*, November 1999; Braddock, D., "Occupational employment projections to 2008," *Monthly Labor Review*, November 1999.

Barriers To A Competitive SMET Workforce

Business leaders predict a major shortage of American technology workers in the coming decade. However, there is an underutilized domestic talent pool that could virtually eliminate the SMET worker shortage – consisting of women, minorities, and persons with disabilities. All three groups are underrepresented in the SMET workforce compared to their percentages within the general population. The disparity continues to grow as underrepresented groups become an ever larger part of the workforce. For example, the number of whites in the labor force is expected to grow by only 7% by 2008, while the number of Hispanics will soar by 37% and the number of African-Americans will climb by 19%. (See figure 2 on previous page.)

Why are underrepresented groups not entering the SMET fields fast enough to address the labor shortage? The reasons can be traced all the way back to elementary school. Research shows that boys and girls show similar prowess in science and mathematics in elementary school, but a gap appears as they grow older. The National Assessment of Educational Progress (NAEP) tracked science and mathematics progress throughout the 1990s for male and female students beginning at age nine and ending at 17. The study found that nine-year-old male and female performance on mathematics and science assessments was nearly identical. By age 17, the gap had widened dramatically, particularly in science: males outscored females by nearly 10 points.

There are several reasons why underrepresented minority groups choose not to pursue SMET careers. Primarily, it seems, their schools suffer from a lack of educational resources, limiting access to high quality

science and math education. Educators may encourage students from underrepresented groups towards certain fields and away from others. For example, when males and females select a major as they enter college, a distinctive difference occurs in the fields they choose to pursue. Young women show a high level of interest in the biological sciences, yet they tend to avoid computer or information science and engineering. By the time they reach graduate school, women represent 22% of the enrollment in computer or information science programs and 18% of the enrollment in engineering programs. (See figure 3 below.)

Highly motivated minority students often function at a disadvantage. Minorities tend to be enrolled in urban schools that are staffed by fewer teachers who majored in mathematics or science. The 1998 Conditions of Education Report from the U.S. Department of Education pointed out that in schools where most students were minorities, almost 40% of mathematics teachers did not major in that discipline, and close to 25% of science teachers did not major in science. By contrast, in schools where less than 5% of students are minorities, 25% of teachers did not major in mathematics and 19% did not major in science.

Social and family issues play a large role in the academic performance of minorities. On average, they face far more risk factors as they progress through school than do whites, and they often do not have the family support structure or financial support to help them succeed. Without a formal support structure, minorities may not successfully overcome barriers to educational performance.



Figure 3.
College Students Expressing Interest in an SMET Major: Gender Breakdown

Intended College Major	Male	Female
Biological Sciences	35%	65%
Computer or Information Science	78%	22%
Engineering	82%	18%
Mathematics	57%	43%
Physical Sciences	59%	41%
Technical and Vocational	68%	32%

Source: The College Board, "SAT Math Scores for 2000 Hit 30-Year High," *The College Board News*, 2000, (see <http://www.collegeboard.org/press>).

Signs Of Progress

Despite the barriers, underrepresented minority groups are making progress in a number of areas. For example, students with disabilities are pursuing careers as scientists, engineers, and technicians. With special accommodations many of them can excel.

Minority students are pursuing college educations in greater numbers than ever before. Between 1988 and 1998, the number of Hispanic students taking Advanced Placement (AP) exams and qualifying for college credit leapt 303%. African-American students also posted strong progress, with a 159% increase, according to The College Board, "1998 College-Bound Seniors, National Report." (See figure 4 below.)

Early indications are that many of these students may become teachers; ideally, they will serve as mentors to other minority students. Of the 110,000 undergraduate and post-baccalaureate students currently in NSF's Collaboratives for Excellence in Teacher Preparation (CETP) programs, close to 50% are minorities. By comparison, only 13% of today's teacher workforce is made up of minorities.

Throughout the 1990s, women continued an established trend of increased enrollment in graduate SMET programs. In 1976, women represented only one-quarter of SMET graduate enrollment. By 1998, they accounted for 40%. However, there are still some fields in which the enrollment of women remains quite low.

Organizations charged with improving diversity and the quality of SMET education are also making strides in the right direction. NSF supports a number of programs

designed to help underrepresented groups further their science and mathematics education, such as:

- Program for Persons with Disabilities (PPD) supports projects to remove barriers to full participation in SMET coursework and careers by individuals with impaired hearing, vision, physical agility or dexterity, or learning disabilities.
- The Louis Stokes Alliance for Minority Participation (LSAMP) encourages minority students to complete SMET baccalaureate degrees. About 20,000 participants receive degrees each year under this program.



Figure 4.
Students Participating in Advanced Placement Exams

	Number Taking AP Exams			Number Graduating AP Seniors		
	1988	1998	Increase	1988	1998	Increase
White	215,110	403,553	88%	113,632	216,406	62%
African-American	10,448	27,054	159%	6,691	15,085	125%
Hispanic	13,322	53,627	303%	7,665	25,240	229%
Total	288,372	618,257	114%	175,572	321,443	98%

Source: The College Board, "1998 College-Bound Seniors," *National Report*. September 1, 1998, (see <http://www.collegeboard.org/press/senior98/html/980901.html>).

Recommendations

CEOSE is providing a series of recommendations for addressing the challenges laid out in its biennial report. Five of these are presented below.

1. NSF should create programs that encourage minorities, women, and persons with disabilities to enter SMET fields and address the barriers to their entry.

Action Steps:

- Fund research on barriers to minority graduate degree attainment and design programs to address the identified barriers.
- Assess the impact of discontinuing the Minority Graduate Fellowship Program and pursue new strategies to provide support to minorities at the graduate level.
- Increase funding of intervention programs for women, minorities, and students with disabilities at the graduate and undergraduate levels.
- Fund incentives to provide supplemental support that allows individuals with severe disabilities to participate in the workforce. These could include training programs in workplace-based equipment such as voice recognition systems, automated Braille printouts, robotic devices, and the new information technologies that allow research to be carried out virtually or through remote access.

2. NSF should raise the visibility of the need for the minority, female and disabilities audiences to participate in SMET fields.

Action Steps:

- Actively promote and sell SMET by defining and highlighting occupations, developing economic data on availability of positions and professional tracks, and developing salary structure information and comparisons.
- Collaborate extensively with the U.S. Department of Education and other Federal agencies to further develop math and science enrichment programs.
- Institute an award to recognize exemplary achievement of SMET workplace diversity by employers in business, government and academia.

3. NSF should establish partnerships with elementary and secondary schools and colleges and universities to improve the quality of science and math education at all levels.

Action Steps:

- Increase funding and support to programs that improve the skills and teaching capabilities of K-12 science and mathematics teachers across the nation, particularly in urban schools.
- Adopt and implement at the state level comprehensive school standards concerning mathematics and science curricula, mathematics and science teacher qualifications, physical infrastructure, technological assets, built environments, and assistive technologies.
- Fund aggressive, focused intervention efforts targeting women, underrepresented minorities and students with disabilities at the high school level, at the transition into post-secondary education, and at the transition from community college into four-year degree programs.

4. NSF should become the model for a diversity-based workforce in order to demonstrate what can be accomplished when barriers are lifted.

5. NSF should create accountability and measurement systems to measure progress in the various programs it supports.



Action Steps:

- Seek equitable distribution of underrepresented minorities, women and persons with disabilities at all staff levels throughout NSF.
- Collect demographic data on review panelists and Committees of Visitors in an effort to maintain diversity of review panels and ad hoc reviewers.
- Target research funding to provide eligibility to non-tenured-track principal investigators to achieve a higher level of female and minority participation.
- Continue the policy of embedding diversity at all levels and in all programs throughout NSF, and delineate strategies for implementing this policy and establishing measures of accountability.

Action Steps:

- Require written comments on electronic proposal submissions that address the intellectual merit and broader impacts of the proposed activity.
- Implement an annual NSF-wide quantitative assessment of the effectiveness of proposal criteria implementation.
- Establish clear lines of responsibility and define effective accountability mechanisms for each program in the diversity continuum.

America's exceptional SMET workforce is at the core of the economic prosperity of the last decade and of U.S. technological leadership. Sustaining the quality, productivity and creativity of this critical human resource in the years ahead will require new ways of thinking about meeting the need for SMET professionals. NSF recognizes – as outlined in the CEOSE Report – that women, minorities and persons with disabilities represent a huge source of underutilized talent that can help meet this critical need.

Effective use of this resource base creates enormous challenges for NSF and other leaders in business, government and education. A partnership among all of the involved parties is of vital importance to moving this process forward. NSF intends to take a leadership role in more effectively bringing women, minorities, and persons with disabilities into the SMET workforce and ensuring that America will retain its competitive edge in the global economy of the 21st century.

CEOSE recommendations for addressing the challenges laid out in its biennial report.

- 1. NSF should create programs that encourage minorities, women, and persons with disabilities to enter SMET fields and address the barriers to their entry.*
- 2. NSF should raise the visibility of the need for the minority, female and disabilities audiences to participate in SMET fields.*
- 3. NSF should establish partnerships with elementary and secondary schools and colleges and universities to improve the quality of science and math education at all levels.*
- 4. NSF should become the model for a diversity-based workforce in order to demonstrate what can be accomplished when barriers are lifted.*
- 5. NSF should create accountability and measurement systems to measure progress in the various programs it supports.*